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COGNITIVE APPROACHES TO THE EXPLANATION OF GAMBLING BEHAVIOUR: AN EVALUATION.

by

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<u>Cognitive Approaches to the Explanation of Gambling Behaviour: An Evaluation</u>

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Abstract

This thesis investigates three hypotheses in relation to the cognitive explanation of normal and problematic gambling behaviour. The "strong cognitive hypothesis" takes the view that if cognitive processes alone account for different levels of play, then the order of the events experienced during a task may be a good predictor of the levels of play. Four large scale experiments are presented focusing on the Illusion of Control, particularly the order effects originally observed by Langer and Roth (1975). Drawing on Hogarth and Einhorn's (1992) belief adjustment model an adjusted methodology is employed making the paradigm resemble the real gambling decision making task more closely. The results of the Illusion of Control experiments suggest that the strong cognitive hypothesis can account for gambling in general, but there is no consistent support in favour of its role in explaining differential levels of play. Three questionnaire studies are then presented investigating the two alternative hypotheses assessed in this thesis. The "weak cognitive hypothesis" stipulates that an additional individual differences element is necessary to supplement the strong cognitive hypothesis in order to explain differential levels of gambling behaviour. Individual differences in the level of everyday general dissociation, the enjoyment and engagement in two forms of processing (Rational or Experiential, Epstein 1990), and in the extent to which heuristics and biases are used when making decisions are investigated. Factor analysis for the heuristics and biases investigation, particularly in relation to the understanding of the principle of randomness, reveals some evidence for the weak cognitive hypothesis. Strongest evidence emerges in relation to the "integrative hypothesis" which stipulates that cognitive factors and processes are only important in relation to and interaction with other variables. The questionnaire studies investigate the role of erroneous beliefs and their relationship with the dissociation experienced within the gambling task. Using Structural Equation Modelling techniques, the results lead towards the generation of a new model of differential levels of gambling and the causal links between these variables and the loss of control are discussed.

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Laurie A. D. and Coventry K., (1998). The Illusion of the Illusion of Control: The Society for the Study of Gambling Annual Newsletter.

CONFERENCES PAPERS:

Laurie, A. D., and Coventry, K., (2000). Dissociation, erroneous perceptions during gambling and loss of control: the results of two questionnaire studies and the development of a new model. 11th International Conference on Gambling and Risk Taking, Las Vegas, 12.06.00

Laurie, A. D., Coventry, K., Norman, A., and Dennis, I., (1998). Illusion of Control and Belief Revision. Third Conference on Gambling Studies and Policy Issues. European Association for the Study of Gambling, Munich, Germany, 01.07.98.

Laurie, A. D., and Coventry, K., (1998). The Illusion of the Illusion of Control. Annual General Meeting, The Society for the Study of Gambling, University of London. 14.05.98

Laurie, A. D., and Coventry, K., (1997). A Cognitive Perspective to Gambling Explanation. Psychology Post-Graduate Affairs Group Annual Conference, University of Plymouth. 15.07.97

Laurie, A. D., and Coventry, K., (1997). The Illusion of Control, Long and Short-term Forecasting and Gambling Explanation. 10th International Conference on Gambling and Risk Taking, Montreal, 30.05.97

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1. Chapter 1: Introduction

1.1. Introduction

Gambling involves staking money on an uncertain event in the hope of winning more money at the risk of losing the money staked. The core feature of all gambling forms is that the expected outcome of each gamble is less than the money staked. If this were not so businesses in the gambling industry would not be making such colossal profits. Typically about 60% of the revenue from the sale of lottery tickets, for example, is returned in prizes (Walker 1992). Thus the expected value of a lottery ticket costing one pound sterling is typically only about 60 pence and the probability of winning anything at all is often extremely low, e.g. the chance of success for the jackpot in the UK National Lottery is 1 in 14 million. People however still gamble on such games, as well as the many other forms of gambling. The economic utility of gambling is therefore clearly negative. In objective terms, gambling should never take place if winning money is the primary (or only) motivation. This suggests that the motivation for gambling may not be purely economic and has led to a range of explanations for the behaviour.

An alternative explanation for why people continue to take part in activities in which negative return is the norm, is that they may believe that they are likely to win. There is ample evidence in the literature to suggest that subjectively speaking, people can develop the unrealistic expectation of monetary gain. This expectation needs to be explained. The cognitive perspective on gambling assumes that the utility of gambles is sometimes misperceived, and sets out to clarify the processes involved. The main aim of the thesis is to investigate the cognitive approach, particularly to evaluate whether the cognitive approach alone can offer a complete explanation for both gambling and problem

gambling (the distinction will be discussed below), or whether other perspectives need to be considered alongside this approach to explain these phenomena.

Before reviewing and evaluating the cognitive perspective, this introductory chapter first sets out to present the context in which the present research programme is set and to present and discuss some other plausible theories. Rather than exhaustively reviewing all possible theories on the nature of gambling behaviour, four of the main recent and popular perspectives will be examined. The theoretical perspectives considered are those of arousal theory, personality theory, the behavioural perspective, and the cognitive approach. After these alternative theoretical perspectives have been examined, this chapter will then set up the rationale and framework for the experimental work that was conducted for this thesis.

1.2. Context

Gambling is a common activity in most countries of the world. Walker (1992) estimates that 80% of the population in industrialised Western societies take part in some form of gambling activity.

Ladouceur (1991) reported that 88% of the adults in Quebec played the lotteries. In Germany, Hand (1992) claimed that 60% of the population played one form of lotto, and 10% actively played slot machines (Buhringer and Konstanty, 1992). These rates of gambling are reflected in the increase in overall amount spent in the gambling industry by punters. Christiansen (1993) reported that in the USA over a period of only 18 years from 1974 to 1992 expenditure rose from \$17.4 billion to \$329.9 billion, an increase considerably greater than inflation.

This suggests that gambling activities are not restricted solely to any particular group in society or financial status, be it the rich who may have plenty of money to spare or the poor in an attempt to strike it lucky.

If the activity is just so very normal and so many people take part then why should there be such interest in researching the factors that lead to the initiation and maintenance of the behaviour? The answer to this is two-fold. Firstly, the processes resulting in behaviours with a mean negative expected return are worthy of investigation in their own right. The second reason lies in the fact that the consequences of continued gambling behaviour can be very broad and very devastating for those who earn the label "Pathological Gambler". Caldwell, Young, Dickerson and McMillen (1988) provide an encompassing definition of the pathological gambler. According to these authors, a pathological gambler is a gambler who: gambles once a week or more often, has lost more than can be afforded six or more times, has lost more than was planned on four of the last five sessions, usually chases losses, gets into debt, and who has tried, without success, to stop gambling. In 1980 the American Psychiatric Association formally recognised pathological gambling as a disorder of impulse control (A.P.A., 1980) and it has remained within the diagnostic manuals since then, e.g. DSMIV (A.P.A., 1994).

Hraba and Lee (1996) surveyed the gambling behaviour of 459 men and 552 women. They defined problem gambling as having lost control over ones' gambling behaviour in relation to the consequences from it. They observed that men and women did not differ with respect to the incidence of problem gambling. Although men took part in a wider number of forms, the two sexes did not differ in terms of the amount and time spent or the frequency at which they gambled on their respective forms.

Lesieur and Blume (1991) interviewed 50 female pathological gamblers recruited from various Gamblers Anonymous centres across the US and reported that the principal features of their pathology were loss of control, emotional dependence and interference with normal functioning. Another related characteristic included a chronic and progressive failure to resist impulses to gamble which had personal, familial and vocational consequences.

Rosenthal (1992) viewed pathological gambling as a progressive disorder characterised by a continuous or periodic loss of control and related it in this respect to alcoholism or substance dependence. He specified four phases in the career of a pathological gambler. The first stage is that of winning followed by a period of losing, which in turn leads to desperation followed by helplessness. Other research also report an early win experience as important in the development of a gambling pathology (e.g. Custer and Milt, 1985).

Estimates for the prevalence of pathological gambling range from 0.25% (Dickerson and Hinchy 1988) to 2.8% (Volberg and Steadman 1988) of the adult population. Comparisons across countries suggest that the highest levels of involvement in gambling (Haig, 1985) and the highest levels of problems generated by gambling (Dickerson, 1993) are to be found in Australia, and possibly in the Far East as well; although gambling is widespread in many other countries throughout the world.

There are two important points to note regarding this. Firstly, it is clear that gambling is a very common activity. Secondly, it is also clear that a large number of individuals go on to lose control of their gambling behaviour. Both of these situations, normal and problem gambling, require explanation.

1.3. Theory and gambling paradox

There are two problems that need to be addressed by theories of gambling. Firstly, as Wagenaar (1988) explains, the biggest paradox of gambling is that the activity exists at all, and that so many people engage in it without taking on board the negative expected outcome. A theory therefore needs to offer an account of why people gamble and continue to gamble. Secondly, what is also in need of an explanation is why some people continue

to excessive and problematic levels, losing control over their gambling behaviour, despite regular feedback about the infrequent wins and the regular losses.

The reasons why people begin to gamble in the first place have been widely researched (see Walker 1985, Brenner and Brenner 1987, Arrow 1970 and Sullivan 1972, for examples). It is important to recognise that gambling is itself not a unitary activity; gambling occurs in many forms and contexts. The social and structural differences between the various forms are large. The intensity at which the activities are played also varies dramatically from the occasional lottery ticket purchase to as much as the commitment of all available time and resources. These two extremes for example would undoubtedly have little in common with each other and are obviously at opposite ends of the "normal" to "compulsive" gambling continuum. Dickerson (1993) argues that, although not making them explicit, there may be different psychological processes that cause impaired control in different forms of gambling. He concludes that to assume that the same psychological models will explain impaired control in all forms of gambling is "not only naïve, but also runs the risk of not fully exploiting the significant differences between different forms to develop a far richer and informative vein of research" (page 243).

Several differences across gambling forms are very apparent. The time delay between the choice of a particular gamble to the point at which the outcome is known (hence when feedback is received concerning the win or loss of that gamble) varies widely from a few seconds in the case of scratch card and fruit machine gambling, to a week or more with the purchase of a lottery ticket for example, and even longer still with some sorts of event. There is also a luck versus skill dimension on which the gambling activities can vary. The extent to which someone can use their knowledge and ability playing roulette, for example, is minimal. However there is a certain degree of skill associated with other forms such as poker and horse racing.

Furthermore the characteristics of a compulsive gambler who is compulsive on one particular gambling form, may be very different to another compulsive gambler who takes

part in another activity. Cornish (1978) additionally argued that the aspects of gambling which determine the choice of gambling form can be distinguished from those in which the chosen form is actually used.

With these cautionary points in mind, we can consider why a gambler continues with a behaviour which is clearly not in his or her best interests. The persistence of playing throughout long series of systematic losses has been explained in many ways.

Early psychoanalytic approaches to gambling made the assumption that problem gamblers were developmentally predisposed to gambling. The mechanisms underlying these predispositions have varied from, for example, masturbation (Freud, 1928) and the self-destructive Death Instinct (Freud, 1917), to oral fixation, (Maze, 1987).

Hess and Diller (1969) and Vickrey (1945) have argued that gamblers value the money that they expect to win more highly than the money they have already lost, and that gambling is in this respect is therefore rational. Devereaux (1968) argued that gambling is a form of entertainment for which gamblers are prepared to pay. There have also been suggestions that psychological motives play a role such as a need for conflict resolution (Devereaux 1968), a need for competition and aggression (Thomas 1901, Zola 1963), and a need for self-punishment in neurotic people (Bergler, 1957).

More recently, these kinds of approach have persisted focusing on individual differences in sensation seeking and achievement motivation, and in some cases underlying neurobiological mechanisms have been proposed, (Carlton and Manowitz, 1987). Four of the most popular current explanations for gambling behaviour and continued gambling behaviour are the arousal perspective, individual differences perspective, the behavioural perspective and the cognitive perspective. Here each of these perspectives are considered in turn.

1.3.1. Arousal Theory, Heart Rate

Gamblers often report that excitement is the main reason for why they gamble, e.g. Anderson and Brown (1984) and Coventry and Brown (1993). Arousal theories of gambling assume that the primary motivation for gambling is the excitement that the activity engenders. Excitement in the literature has been measured using both objective physiological (e.g. heart rate, Leary and Dickerson 1985, Coventry and Norman 1997, Anderson and Brown 1984) and subjective non-physiological measures, (e.g. Coventry and Constable 1999, Griffiths 1995). A number of studies have shown that gambling is associated with arousal increases across a range of forms.

Anderson and Brown (1984) found gamblers betting on blackjack in both a real and laboratory setting, and observed significant heart rate increases for those in the real casino environment. The within-participant comparisons revealed that all gamblers showed a higher heart rate increase in the real situation (up to 58 beats per minute) in comparison to the artificial laboratory setting that was used.

Coventry and Norman (1997) measured heart rate increases in a sample of off-course horse racing gamblers before, during and after the gambling process, and observed significant correlations between the frequency of gambling, the number of forms taken part in, and heart rate increases at the end of the task.

Griffiths (1995) found, on the basis of self-report measures, that regular and pathological gamblers experienced significantly higher rates of excitement during gambling than did non-regular players. However, subjective measures of arousal have been found not to be correlated with objective heart rate measures, e.g. Coventry and Constable (1999), and their usefulness should therefore be questioned. In the Griffiths study for example, participants could have simply been trying to find a reason that would rationalise their gambling activities, i.e. that at least the activity was exciting.

There are problems associated with the use of heart rate as the objective measure of arousal. As Coventry and Norman point out (1997) heart rate has been observed to fluctuate greatly as a function of motor activity, relaxation and acclimatisation to the experimental conditions, (Obrist, 1981; Smith, Guyton, Manning and White, 1976). Even gentle movements can increase heart rate from baselines. Lynch, Schuri & D'Anna (1976) observed significant changes in heart rate with both isometric hand and foot exercises, whilst Fahrenberg, Foerster and Wilmers (1993) observed increases following handgrip movements and even free speech. Generally in the literature baseline heart rates from which later comparisons were made were taken during a period of relaxation prior to the participants' involvement with the gambling task or when the participants were stationary. The fact that most gambling activities, and those involved in the literature, involve some form of motor activity, suggests that the observed results may have been confounded simply due to the increased physical movement following the start of the activity, and not necessarily due to the "exciting" nature of the task.

Coventry and Norman (1997) rectified this potential problem by measuring baseline heart rates whilst walking and still observed elevated heart rates during the gambling episodes as compared to baselines. Therefore, even with the methodological concerns raised, there is much evidence that gambling forms are arousing.

Levels of arousal have in addition been argued to be differentiated between high and low frequency gamblers, and therefore offered as an explanation for varying levels of continued play. Dickerson and Adcock (1987) and Brown (1986) argued that the more regular gamblers become more aroused whilst gambling as compared to low frequency players.

Although there is ample evidence to affirm that arousal is associated with gambling and across a variety of forms, the evidence to suggest that high frequency gamblers get more aroused than low-frequency gamblers is somewhat equivocal. Leary and Dickerson (1985) did observe significantly increased heart rates for their high frequency gambling

group, whilst gambling on poker machines. However, although Coventry and Norman (1997) observed significant heart rate differences during the different phases of the gambling process, no differences were found between high and low frequency gamblers or between gamblers who chased or did not chase their losses, even with their methodology in which they controlled for the reported effects of motor activity. Although the gamblers were objectively excited during the off course betting, differences in arousal changes could not account for the different levels of gambling behaviour reported by the participants. Griffiths (1993) monitored heart rates of fruit machine gamblers in regular and non-regular players. Although again both groups heart rates did increase (an average 22 beats per minute) during the gambling episodes, there were no differences in this arousal measure between regular and non-regular gamblers. Dickerson, Hinchy, England, Fabre and Cunningham (1992) also found no differences between high and low frequency gamblers in their measurements of heart rate during play.

While arousal seems important for some gambling forms, it seems unlikely that arousal theories can explain levels of gambling on their own. One possibility that has been considered is that arousal theories, in combination with an individual differences dimension may offer a means of predicting differences between gamblers gambling at different levels. One such plausible approach is that of Zuckerman's Sensation Seeking theory (1979), which is considered in the following section.

1.3.2. Personality Theory, Sensation Seeking

Individual difference type approaches have assumed that the reason why some people continue to gamble has something to do with certain personality characteristics that the individual gambler holds. It should be noted however that as the majority of people

gamble, these individual difference type approaches seem unlikely to offer a suitable explanation for normal gambling.

Of all the personality dimensions available, Zuckerman's biologically based theory of Sensation Seeking offers one of the most direct applications to gambling behaviour. Zuckerman (1979) defined sensation seekers as people with the need for high states of arousal. He originally predicted that gamblers should be high sensation seekers, and that the reason that they gamble would be to satisfy their need for arousal, and that higher frequency gamblers would score higher on the Sensation Seeking scale than lower frequency players.

The behavioural expressions of sensation seeking have been found in various kinds of risk-taking behaviours such as driving habits, health, financial activities, alcohol and drug use, sexual behaviour, and sports, (Zuckerman 1994), and Sensation Seeking scores have been found to correlate highly and significantly with, for example, Eysencks extroversion and psychoticism super factors.

The Sensation Seeking Scale (SSS, Zuckerman, 1979) has received wide interest in investigating the role of arousal in continued involvement in gambling activities and its relationship to the level of risk adopted by gambling individuals.

Waters and Kirk (1968) investigated the relationship between gambling and sensation seeking in a gambling situation (outcome prediction from drawing a card from a deck of cards) in which there were varying degrees of risk taking possible, by offering different probabilities of success. High sensation seekers tended to opt for the riskier outcome; to opt for the lower probability of winning in which the potential payoff was higher.

Wong and Carducci (1991) observed that in their undergraduate population, high sensation seekers displayed greater risk-taking tendencies in everyday financial matters than low sensation seekers, and that this difference existed within both gender groups.

Kuley and Jacobs (1988) observed that their high frequency gamblers (in their problem gambling group) scored significantly higher than the low frequency social gamblers on their total sensation seeking scores and specifically on the Boredom Susceptibility, Experience Seeking and Disinhibition subscales of the SSS.

Wolfgang (1988) examined the relation of gender and sensation seeking in respect of undergraduates ratings of past, present and expected future participation in leisure activities that usually involve money. Expected future gambling ratings were associated with two of the subscales on the sensation seeking scale, those of disinhibition and boredom susceptibility. The authors even went so far as to suggest that these personality factors were more influential than early experience or sex-role socialisation in determining an interest in gambling. Men also reported significantly more past and present leisure gambling than women, although this difference did not exist with respect to future expected gambling.

Allcock and Grace (1988) investigated pathological gamblers with respect to their sensation seeking and impulsivity. Compared to their non-patient control group, pathological gamblers did not differ on either measure. In comparison to other addictions, their drug addict group scored significantly higher and their alcoholic group significantly lower than both the pathological gamblers and the non-patient groups on the sensation seeking scores, whilst the only difference in impulsivity scores were those of the drug addicts which were significantly higher than all other groups. The authors suggested that the classification of pathological gambling as a disorder of impulse control should be reconsidered.

Steinberg, Kosten and Rounsaville (1992) investigated the relationship between gambling activities and sensation seeking among a group of cocaine abusers. They observed significant positive relationships between sensation seeking scores and gambling frequency. High frequency gamblers scored significantly higher on the SSS than their low frequency counterparts. However, the generalisability of these results to the gambling

population as a whole should be made with caution, considering that gambling for these participants was not their only addiction.

There has however been substantial empirical support against the relationship between the SSS scores and gambling frequency, e.g. Dickerson, Walker, England, and Hinchy (1990).

Dickerson, Hinchy and Fabre (1987) observed that male bettors scored significantly lower on the SSS than existing population norms; Coventry and Brown (1993) reported identical results. In both studies, their off-course betting gamblers scored lower than both non-gamblers and general population norms. These two studies clearly did not support Zuckerman's hypothesis that high frequency gamblers are high sensation seekers.

However it should be noted that within the Dickerson et al (1987) results, they did report a weak but significant relationship between the SSS subscales (particularly the Boredom Susceptibility subscale) and the level of betting involvement. The authors argued that the relationship between boredom susceptibility and arousal may be a predisposing route to eventual problematic gambling.

Blaszczynski, Wilson, and McConaghy (1986) investigated the hypothesis that arousal associated with gambling was related to a general sensation seeking personality trait. Pathological gamblers were found to have elevated psychoticism, neuroticism and state and trait anxiety scores, but the hypothesis was not confirmed. Again, pathological gamblers scored significantly lower than the general population norms. They argued that these gamblers were not necessarily sensation seekers but that avoidance of noxious physiological states or dysphoric mood, in conjunction with a behaviour completion mechanism was a major factor in explaining persistence in gambling. One variable that will be considered in some depth later in the thesis is the extent to which someone has a tendency to seek out a dissociative experience, in which they could be using the gambling situation as an escape from their otherwise stressful or unsatisfying life.

What appears a problem with these theories is that they seem to be unable to distinguish alone between an individual who stops gambling (or continues at non-problem levels), and an individual who goes on to develop a problem. So although arousal may be important for continued play, it does not appear a sufficient explanation, particularly as not all gambling forms are arousing. Sensation Seeking as an additional measure also seems unlikely as a predictor of levels of play.

1.3.3. Behavioural Perspective

A different view of persistent gambling, and one that has been around for some time, is that of the behavioural perspective. For example, Dickerson (1993) and Dickerson, Hinchy, Cunningham and Legg-England, (1991, 1992) have suggested that poker-machine gambling may be a schedule-based behaviour. According to this behavioural view, persistent gambling can be explained in terms of the powerful reinforcing effects of intermittent schedules, (Ferster and Skinner, 1957; Skinner 1953) and the sensitivity of behaviour to stimuli in the gambling environment, (Delfabbro and Winefield, 1998). Behavioural perspectives also acknowledge the reinforcing effects that arousal can have on the individual, Dickerson (1977, 1979, 1984) and Saunders (1981). For instance, Anderson and Brown (1984) and Leary and Dickerson's (1985) view that increased risk taking is a necessary step once the task becomes familiar as greater risk is required to obtain the same degree of physiological arousal, can also be explained by the behavioural perspective in terms of the process of habituation.

One common finding within this research paradigm is that small wins appear to increase betting behaviour, whilst large wins appear to decrease them, (Dickerson et al 1992, Delfrabbro et al 1998). Griffiths (1999) and Reid (1986) stress also the importance of non-monetary reinforcement, such as the "near-miss". Near-misses can be described as

failures that are close to being successful. Right up to when the final outcome of the gamble is known, the individual could be increasingly close to winning. One obvious example of this is when the chosen horse in a particular race, is beaten past the post by a matter of inches. All the learned associations, normally associated with a win are apparent, (increased arousal, expectation of monetary gain, etc) right up to the last second before the race is over. The behavioural perspective argues therefore that near misses can also act as reinforcements for the behaviour.

The concept that behaviour can become sensitive to gambling events relinquishes to some extent the role of the gambler, in that as the reinforcement for gambling becomes associated with certain events, it becomes a learned behaviour and therefore increasingly dictated by factors external to the gambler. This view allows for explanations without reference to internal biological processes, personality differences, genetic predispositions or traditional addiction theories, all of which have often proved unsatisfactory in distinguishing problem gamblers from those who would be defined as "normal" gamblers, those who manage their gambling behaviour (Dickerson, 1984, 1989, 1993; Walker, 1992, Delfabbro et al 1998).

However, there are problems associated with this view as well, as the main common finding can be re-interpreted within other perspectives. As Walker (1992) points out, another explanation (and a cognitive one) for the decrease in response rates (betting behaviour) following large wins would be that the gambler believes in the gamblers fallacy. If this is the case, then the gambler would believe that because of the large win, another win is less likely in the near future, and so in the very short term betting tails off.

Some methodological concerns regarding, for example the Dickerson et al (1992) study have also been raised (e.g. Walker 1992, Delfabbro et al 1998). One concern relates to the elicitation of participants' expectancies about the likelihood of success on the following trial. This measurement was only extracted following large wins, and hence this momentary distraction could have been enough to take the attention away from the task at hand, and almost re-set the individuals gambling activity.

Taking the methodological concerns into account, Delfabbro and Winefield re-visited the phenomenon and observed similar findings to the original Dickerson et al (1992) paper. In poker machine play, larger reinforcements appeared to disrupt ongoing behaviour; after a large win gamblers would tend to pause their gambling and do something else for a brief period. It also confirmed that the behaviour of regular players was more habitual or stereotyped than that of occasional players. The interesting point regarding this study was that there was no apparent evidence that players betting behaviour increased as a result of variations in reinforcement as would be predicted by operant conditioning theories (Skinner, 1953).

1.3.4. Cognitive Perspective

Among the competing explanations for heavy involvement in gambling, the cognitive perspective is gaining increasing support (Walker, 1992). As Wagenaar (1988) argued it is not the case that gamblers are a limited group of people who have less than optimal reasoning strategies. He argued that gamblers are "motivated by a way of reasoning, not by defects of personality, education or social environment" (Wagenaar 1988, page 3).

Although the behavioural approach is of value it is also important to look at how the gambler understands and interprets the external events that the gambler experiences. Essentially then, unlike the behavioural approach, the cognitive perspective assumes that gamblers are actively involved with the task, hence an investigation of the decision making involved is also of importance. There is evidence that the strategies used whilst gambling are non-optimal, and often erroneous. For example, Gaboury and Ladouceur (1989)

observed that regardless of people's initial perceptions of the game, participants still produced more irrational verbalisations than rational ones when 'thinking aloud' during play. Furthermore there is evidence that the types of decision strategies used by gamblers do change over time. Scolaris and Brown (1988) for example, report that compulsive gamblers used more bizarre and exotic cognitive distortions than those which are reported below which tend to be common to everybody (Wagenaar, 1988). Chapter 4 will discuss and investigate the role of what are now commonly known as erroneous perceptions or fallacious beliefs.

However, despite the recognition that the beliefs and decision making strategies the gambler employs are important components of the explanation of gambling behaviour, the cognitive perspective currently lacks a specification of the processes involved. One of the main aims of this thesis is to begin to do this.

Wagenaar developed a theory of gambling behaviour in terms of comparing what normative decision theory would predict gamblers to do and what they actually do. He argued that non-gamblers, gamblers and pathological gamblers all have reasoning strategies that result in less than optimal decisions and behaviour.

He argues that normative decision theory can not adequately account for a gambler's behaviour. Normative decision theory decisions are modelled as choices among alternatives. According to the theory, the expectancy related to a choice alternative consists of two elements which are combined. These are the utility of that alternative and an estimated probability that this utility will arise. If one equates the utility of a gambling decision with the expected monetary value then it is clear that the theory would predict no gambling in the first place, as the expected utility would then be negative. Although Prospect Theory (Kahneman and Tversky, 1979) attempts to account for the gambling paradox by introducing the concept of a non-linear curve of money and a non-linear relationship between objective and subjective probabilities, Wagenaar argues there are problems associated with it. Prospect Theory postulates that people overestimate small probabilities. The reasons for this come from the suggestion that people adopt or exclude past experience when estimating their chances of success, and then make their judgements based on alternative reference frames. This perspective accounts well for the fact that people tend to bet more on long shots on the last race (e.g. McGlothin, 1956), because from the reference point of having lost money, a small additional risk could result in the recouping of the days losses. However, it makes no predictions as to when and how many previous outcomes would be included when developing the reference frame from which to make a decision. It also fails to explain sufficiently why people do not adjust their overestimation of small probabilities following the prolonged experience of systematic losses. Wagenaar instead argues that gamblers appear to make decisions with the use of heuristics and biases.

Heuristics and biases are strategies which we have developed to use in everyday reasoning, which are selected on a basis of similarity between the actual situation and previous situations in which a strategy worked out well. Although their place in everyday situations is often relevant and helpful, when the situation and its outcome is determined purely by chance (as in the majority of gambling activities) the use of these heuristics can lead to decisions, and hence behaviours, which are non-optimal.

Wagenaar (1988) stresses however, that gamblers do not gamble because they have a more comprehensive repertoire of heuristics, but rather "because they select heuristics at the wrong occasions" (p.116-117). Chapter 2 investigates the Illusion of Control heuristic, an expectancy of success inappropriately higher than the objective probability would warrant (Langer 1983). Other cognitive distortions include such distortions in which gamblers attribute their past successes to themselves; additionally that they believe that they hold certain skills which can increase the chance of future success.

Illusory correlations are another example of false beliefs which arise when people believe that two or more events covary when in fact they do not. Henslin (1967) reports a

good example of this in that craps players were observed to roll the dice softly if they wanted low numbers and harder if they wanted high numbers.

Heuristics and biases are most associated with the work of Kahneman and Tversky (see Kahneman, Slovic and Tversky, 1982 for a review.) Wagenaar (1988) reports 16 heuristics and biases which he argues "are ripe for misapplication in gambling environments" (Coventry, in press). These are presented in Table 1.1 below.

As Wagenaar (1988) himself argues, there are weaknesses to the heuristic and biases approach. Firstly the conditions which evoke the use of the various strategies are not well specified. Secondly they are not mutually exclusive; a behaviour could be argued to be the result of more than one heuristic. In addition, explanations by the matching of a particular behaviour to a particular heuristic are mostly post-hoc (Wagenaar 1988). Furthermore certain heuristics and biases would predict opposing behaviours. For example, the availability heuristic, which refers to ease with which specific instances can be recalled from memory, predicts that a gambler would continue to bet on the same outcome, (e.g. red in roulette) if it has just been successful. The gambler would also increase bet size when winning is the more available outcome, and would decrease the bets placed after a run of losses. In contrast, the representativeness heuristic, which specifies that people expect small numbers to be representative of population parameters, predicts that if a bet has been successful, then the gambler will choose an alternative prediction (e.g. black), so that the frequencies will even out. This heuristic predicts that after winning, bet size would decrease, as losing appears to be the more likely outcome, and vice-versa.

Table 1.1. Heuristics and Biases cited by Wagenaar (1988).

Availability	Ease at which specific instances can be recalled from memory affects judgements of frequency
Problem Framing	Outcomes are evaluated as deviations from reference points or levels of aspirations. This can interact with the way people evaluate outcomes that are "framed" as losses or gains.
Confirmation Bias	Seeking information that is consistent with one's beliefs and discounting disconfirming information
Fixation on Absolute Frequency	Cue used to judge strength of predictive relations is observed frequency rather than observed relative frequency. Information on "non-occurrences" of an event is often unavailable and frequently ignored when available.
Information Bias	Concrete information (i.e. vivid, or based on experience/incidents) dominates abstract information (e.g. summaries, statistical base rates, etc.)
Illusory Correlation	The belief that two variables co-vary when in fact they do not.
Inconsistency of Processing.	Inability to apply a consistent judgmental strategy over a repetitive set of cases.
Non-linear Extrapolation	Inability to extrapolate growth processes (e.g. exponential) and tendency to underestimate joint probabilities of several events.
Reliance on Habits	Choosing an alternative because it has been previously satisfactory.
Representativeness	Judging the likelihood of an event by estimating the degree of similarity of the class of events of which it is supposed to be an exemplar.
Justifiability	A "processing" rule can be used if the individual finds a rationale to "justify" it.
Reduction of Complexity	When complex decision problems are reduced to simple ones before a decision can be made.
Illusion of Control	Activity concerning an uncertain outcome can by itself induce in a person feelings of control over the uncertain event.
Biased Learning Structures	When observed outcomes yield incomplete information concerning predictive relationships.
Flexible Attribution	The tendency to attribute successes to one's own skill and failures to other influences.
Hindsight Bias	In retrospect, people are not "surprised" about what has happened in the past. They can easily find plausible explanations.

Acknowledging these problems with this approach, it is still the case that the heuristics do have the effect of reducing the uncertainty from the gamblers perspective, and can therefore form part of the reason why the gambler continues, as the individual can believe that there is more personal ability to predict the outcomes than is objectively possible. A further presentation and discussion of the heuristics and bias approach occurs in Chapter 5, along with an investigation of the use of certain heuristics and biases.

A subtly different approach to decision making during gambling to that of heuristics and biases has been outlined by Coventry (in press). Rather than select from a wide range of non-context specific heuristics and biases (as Wagenaar has suggested), Coventry has argued that decision making during gambling unfolds in the specific gambling domain as the gambler gains experience interacting with the specific gambling form played. Furthermore, the strategies themselves are only understandable within the specific gambling context.

In everyday life, one needs to act on the information that is given, even if there is no, or limited, knowledge as to the adequacy of the information. Evidential theories of decision making and reasoning (e.g. Cohen, 1979), would predict that people base their gambling choices on the past information that is available to them in the specific domain. Therefore future decision making is determined by past experience on the task.

There are several lines of evidence for evidential theories. Confidence and risk taking have been shown to increase with exposure to gambling activities, e.g. Ladouceur, Tourigny and Mayrand (1985), Ladouceur, Mayrand and Tourigny (1987), Breen and Frank (1993) and Peterson and Pitz (1988). The evidential perspective would explain this increase in confidence and risk taking by noting the fact that as time and the number of trials have increased, so too has the amount of information available on which to base predictions. Ladouceur, Dube, Giroux, Legendre and Gaudet (1995) and Ladouceur, Paquet, Lachance and Dube (1997) also provide evidence that gamblers make use of past information. They found that participants were prepared to pay a proportion of their payment for taking part, so that they could see what the previous outcomes on the coin flipping trials had been. This suggests that they were therefore unable to apply the principle of independence between events as they were under the belief that knowledge of previous outcomes would improve their performance in predicting subsequent outcomes of tossing the coin. The Ladouceur team believe that this lack of ability to apply the independence of events underpins gambling at both normal and excessive levels of play. Additionally they argue that the beliefs gamblers have, as recorded through the think-aloud method (reviewed in Chapter 4), are related to this core error.

The erroneous strategies and verbalisations may be due to the result of either conscious or unconscious processing. Coventry (in press) argues that a dual process theory of decision making can be applied to gambling decisions and imports Reber's (1986) distinction between two types of learning. Implicit learning refers to how one develops intuitive knowledge about the underlying structure of the complex stimulus environment. This process is unconscious and results in obtaining abstract knowledge about the world. In contrast explicit learning and processes are conscious and non-automatic. Coventry (in press) proposes that both systems are applicable, but that gambling decision making is dominated by the implicit system. This suggests that the erroneous perceptions that are verbalised throughout the gambling experience may only be conscious (explicit) reflections and descriptions of what has occurred during the task. Hence these verbalisations are likely merely to be post-hoc rationalisations, rather than represent the actual beliefs that the individual holds about the task. If the explicit system was the dominant one, then the gambler would reduce or inhibit their own gambling behaviour as losing is the most frequent event overall.

The distinction between implicit and explicit processing maps onto the distinction between Evans' (1993) two types of rationality, labelled Rationality$_1$ and Rationality$_2$. These two notions of rationality were provided whilst reviewing the approaches to the psychology of decision making and reasoning. Rationality$_1$ refers to the rationality of purpose, in that people act in a way to realise the achievement of their goals. Whereas Rationality$_2$ refers to the rationality of process whereby people reason in a way which conforms to an appropriate normative system such as formal logic. Hence erroneous strategies used by gamblers would be defined as irrational by the definition of rationality$_2$, but would, however, not be irrational under the description of rationality$_1$. This is because these strategies can be viewed as part of their goal achievement of, for example, illusory control, viewing themselves to be better at the task than chance would determine, and to enjoy the experience. A view of gambling compatible with this description of rationality

would arise from the fact that people are simply applying the decision making process they use in everyday life, when all the information is rarely available, to the situation at hand; the gambling environment.

The perspective that the implicit dominates the explicit system gives rise to the possibility that anyone could become a problem gambler, given that they were unfortunate enough to have experienced a particular sequence of events.

1.4. An Overview of the Thesis

The adequacy of any theory can be judged by its ability to account for both normal gambling, and also problem or pathological gambling. It appears that none of the theories raised so far have been able to account alone for both of these. They have been unable as yet to distinguish between those who manage to control their gambling, and those who continue to problematic (and out of control) levels.

Essentially there are three hypotheses which this thesis investigates. The first is whether the cognitive perspective alone can offer an account of both why people gamble in the first place, considering the negative expected return, and why some people continue despite systematic losses to a point where their gambling becomes problematic. This hypothesis can be labelled the "strong cognitive hypothesis" in that the cognitive perspective is complete and not needy of integration with other constructs as an explanation of the phenomena. This perspective takes the view that the cognitive processes involved within a task are the result of the experience of the events that occur within the task. If it is the case that cognitive processes alone account for the different levels of play, then the order of the events experienced during a task may be good predictors of the levels of play.

A suitable starting point then is to investigate the nature of the Illusion of Control. The Illusion of Control work tackles the hypothesis that the experience of early wins may be central and crucial to the explanation of continued play. In addition to addressing some methodological concerns regarding the Illusion of Control paradigm, Chapters 2 and 3 will also present the case that gambling activities can be viewed as decision making tasks. It argues that the research to date has ignored a vital element to the structure of the research paradigms, that restrict their resemblance to the real gambling situation and task. A revised methodology is introduced and three tasks with different outcome probabilities are reported. The effects of perceiving these tasks as decision making ones and utilising this methodology are investigated.

Chapter 3 also investigates the existence of any underlying differences in the way that people respond when dealing with either a computer based task (as in Chapter 2) or a manual prediction task. The methodology employed in the previous chapter is re-employed here with the simplest of prediction tasks, that of predicting the outcome of flips of a coin. Comparisons are made therefore between the highest win probability computer task (0.5) and the manual coin task (also with a win probability of 0.5). This comparison addresses the issue of ecological validity of utilising computer presentation of the Illusion of Control paradigm in relation to more physical (and manual) presentations.

The results of the Illusion of Control studies suggest there is little evidence for the strong cognitive hypothesis in the explanation of differential levels of gambling behaviour. The remainder of the thesis considers two other hypotheses. The second hypothesis could be labelled the "weak cognitive hypothesis" in that an additional individual difference element is necessary as a supplement to strong cognitive hypothesis in order to explain differential levels of gambling behaviour. Chapters 4 and 5 examine two types of individual difference measures in relation to varying levels of gambling behaviour. Chapter 4 investigates the role of individual differences in processing style, in the extent to

which people enjoy and engage in the two forms of processing labelled “Rational” or “Experiential”, Epstein (1990).

Chapter 5 investigates the possibility that there are differences in the extent to which gamblers exhibit heuristics and biases when making decisions. Hence it investigates the degrees of bias held by gamblers gambling at varying degrees of frequency; and looks at whether high frequency gamblers are more prone to the use of heuristics and influenced more readily by biases than low frequency players. Furthermore, if this is the case, it was investigated whether high frequency gamblers are affected by these more in the gambling situation specifically, or whether they make use of them more readily generally (even in non-gambling contexts). In other words, do high frequency gamblers exhibit the same biases outside of the gambling context? The results of a further study are reported and discussed with these questions in mind.

Griffiths (1994) argues that a singular cognitive theory is unlikely to account for the observed phenomena. It has been acknowledged in the so called ‘socio-cognitive’ theory of gambling (e.g. Walker 1992) that there are a whole range of variables that need to be included in any sufficient explanation of gambling. However, as yet there has been little evidence for specific models of how these other variables interact with each other, a position which the present thesis aims to correct.

The third hypothesis investigated in the thesis is the “integrative hypothesis” in which although cognitive factors and processes are deemed important, they are only important in relation to and interaction with other variables. Additionally then, Chapters 4 and 5 investigate the role of erroneous beliefs and introduce the concept of dissociation and how the two concepts may interact with loss of control. In Chapter 4 a questionnaire study was devised to investigate these issues in relation to gambling behaviour. A series of models are proposed that could account for the inter-correlations between the variables measured. A factor analysis and Structural Equation Modelling procedure was used to investigate the model that fits the data most appropriately. Chapter 5 also investigates the

issue of whether or not high frequency gamblers hold more erroneous beliefs, become more dissociated and hence lose control more readily.

These last two experimental chapters report studies which involve samples of participants drawn from populations other than solely undergraduate students. Hence these studies bridge the gap to higher frequency gamblers, some recruited from the general population, others from within gambling establishments.

A general discussion of the cognitive perspective and the research findings from the programme of work follows in Chapter 6, along with future research recommendations.

2. Chapter 2: The Illusion of Control

2.1. Introduction

This chapter focuses on the "strong cognitive hypothesis" in that the effects that wins and losses have on people's decision making during the task are investigated. The chapter first provides a short history of the Illusion of Control concept in relation to gambling and how it has been offered as a possible explanation for why some people continue to gamble in the face of systematic losses.

This is then followed by a closer examination of the methodologies used to assess the Illusion of Control within the gambling literature, where a number of concerns are presented. These concerns are then amplified by the presentation and application of Hogarth and Einhorn's (1992) belief adjustment model (from within the information integration literature). The Illusion of Control paradigm is then revisited and viewed in light of the belief revision model, where the rationale for a series of experiments is presented. Three experiments then follow, followed by a combined analysis and general discussion section.

2.2. The Illusion of Control

The Illusion of Control, an elaborated heuristic model, was proposed by Ellen Langer, (1975, 1983). In games involving only skill, the outcome is dependent upon the action taken by the person involved. Hence in these situations it is valid for people to attribute their successes and failures to their own performance. When the outcome is response independent, as in games of chance, people often wrongly attribute the successes to themselves, as we want to see ourselves to be in control of the things that go on around us, (Lefcourt 1973). Likewise, in games of skill, people often attribute their failures to factors other than themselves.

What Langer (1975) showed was that in bringing characteristics of skill games, such as competition, choice, involvement and familiarity, into games where the outcomes are based solely on chance (without these characteristics objectively influencing the outcome) participants saw the games as more controllable, and had therefore developed an 'Illusion of Control' (IoC). She defined this as an:

'expectancy of a personal success probability inappropriately higher than the objective probability would warrant'.

In addition to the order effects using the Langer and Roth (1975) paradigm which will be discussed shortly, other aspects of Langer's Illusion of Control have been researched in separate studies and have replicated her results. Ladouceur and Mayrand (1987) investigated the role of involvement in the level of risk taking adopted by participants. Even when objectively it makes no difference who actually spins the ball on the roulette table, participants who spun the ball themselves bet significantly more than participants who bet on the outcome when the "dealer" spun the ball. What was also of interest with the results of this study, was that the timing of the bet placing, another factor that objectively does not alter the chances of success, affected risk taking. Bets placed once the ball had dropped (with the outcome hidden) were significantly less than bets placed while the ball was still in motion. It appeared that participants were under the impression that they had more chance of success, and therefore took greater risks, when the ball was still spinning. Once the outcome had been decided, even though they could not see it, they were less confident that their number had come up.

Familiarity with the task and its role in risk taking changes has also been studied. Ladouceur and Mayrand (1984) compared the behaviour of regular and occasional players under a roulette task. Increased exposure to the task resulted in the occasional players betting increasingly more such that by the end of the 30 trial session, they were betting similar amounts to the regular players in the study.

Blascovitch, Veach and Ginsburg (1973) observed that blackjack players in the laboratory bet more during the second session of play than during the first session, and that within each session their level of risk increased. The Illusion of Control here relates to the fact that with skill activities, familiarity with the task can improve one's performance. However, in chance determined games, practice can not make perfect and hence a persons' confidence rationally should not rise simply due to increased exposure to the activity. Ladouceur, Mayrand and Tourigny (1987) reported that all participants gambling in their laboratory roulette task gambled more cautiously at the start of the study than they did at the end of the study. They also noted that the increase in risk for the occasional player group was fairly rapid throughout the first session, slowing in subsequent sessions, but still reaching the same level as that of regular players by the fourth session.

Increased exposure leading to increased risk taking has many implications for our understanding of the psychology of gambling and more specifically for the identification of the factors responsible for the acquisition of gambling habits. Participants may not be consciously aware that they bet more as the number of trials they have experienced increases. It might be that they become more liberal with their bet placing, overcoming initial inhibitions which restrict their bet size, (Ladouceur et al, 1987). It may also be that they become more confident in their ability to perform at the task, having created a perception of illusory control. If one is to assume that the major motivation for gambling is for potential financial gain, which the cognitive perspective does, then one would expect bet size to increase in line with subjective confidence in the chosen outcome.

Due to the notion that we are motivated to control the events that occur around us (Lefcourt, 1973) we seek out opportunities where we can have control. In the gambling situation irrational beliefs act as strategies to control or predict the outcome successfully, in order that the participant can win the current trial. If a particular strategy is rewarded with

a win, the belief is reinforced. If a loss occurs, it can still have the effect of reinforcing the belief for the following trial. For example, if the belief is that due to the series of Reds on the roulette wheel, a Black number is more likely, a Black number can easily become "more likely" when the subsequent outcome is Red again, with the participant simply discounting the loss as bad luck. Additionally, as the hindsight bias account would predict, after the outcome is known, the participant would be more confident in their ability to predict that outcome than they would have been prior to receiving the win. Such biases will be addressed in the penultimate chapter. These post-hoc rationalisations, rational or irrational, may contribute to continued play.

While unrealistic estimates of performance are bound to play a role in the explanation of gambling, it could be that the order of events experienced during gambling may lead to differential levels of the illusion of control, and hence differential levels of future estimates of success and future play.

Langer and Roth (1975) demonstrated that the sequence of outcomes, whether positive or negative sequences could also influence and magnify the induction of the IoC. They asked participants to predict the outcome of 30 tosses of a coin, but they rigged the outcome such that the participant either won or lost each particular trial. They therefore had three conditions across which participants won and lost in different orders. Participants in the Descending sequence won predominantly in the first half of these trials, the Ascending sequence participants won predominantly in the second half, and in the Random sequence, participants' wins were distributed randomly throughout the trials. All participants won at a chance rate, such that they all had 15 correct predictions. Figure 2.1 displays the precise sequences used.

At the end of these trials participants were asked questions to assess whether the task was perceived as chance or skill determined. A primacy effect was observed in that participants who had had early wins perceived themselves to be more skilful, gave greater success predictions over future trials, and remembered significantly more wins than the

Figure 2.1. Sequences used by Langer and Roth (1975)

Descending	WWWWLWWWLWLLWWWLLWLLWLWLLLWLLLLW
Ascending	WLLLLWLLLWLWLLWLLWWWLLWLWWWLWWWW
Random	LWWLLWLLWLLWLWWWLWLWLWWLWLWLWLLW

where "W" denotes a win, and "L" denotes a loss.

participants who experienced the other two sequences. This study suggests, in line with the strong cognitive hypothesis, that the sequence of wins and losses alone may predict future levels of play. Furthermore, there is anecdotal evidence (e.g. Custer and Milt 1985) that an early win experience is associated with the development of problem gambling.

This order effect is robust, having been replicated many times within the gambling and the IoC literature, e.g. Coventry and Norman (1998), Reid (1986), Ladouceur, Tourigny and Mayrand (1985), Wolfgang, Zenker and Viscusi (1984). A minority of studies have argued that the lack of significant differences observed between their sequences, demonstrates that the effect is less robust than previously thought. However, these can be re-evaluated. Breen and Frank (1993) for example, manipulated the number of wins across their conditions (heavy win and heavy loss sequences) but failed to control for the order of these wins; the order of wins was randomly determined and duplicated for each participant. The fact that differential illusory control failed to appear demonstrates more precisely the fact that the position of wins is a more important factor than merely the number of wins in the sequence.

Ladouceur and Mayrand (1984) found that participants in their early win sequence were more accurate than other participants, rather than having an exaggerated perception of success. Early win participants were therefore predicting rates of success closer to the objective rate of success determined by the nature of the task, in comparison to late win participants who predicted less than the objective rate of success. However, there is no other plausible reason for why these participants should predict any higher rates of success

than participants in the other sequences. This therefore still stresses the importance of previous win sequence in people's confidence about future success.

Done and Coventry (in press) investigated whether an induced illusion of control, using a similar paradigm to that of Langer and Roth (1975), could transfer to another task when the participant switches between activities. Following experience of a computer presented coin prediction task, participants who had experienced early wins carried their illusion of control over to the second task, that of a computer presented roulette task. Transfer effects were observed in that participants who had won predominantly early on with the coin tossing task, thought they had won significantly more trials on the roulette task, than those who had won predominantly at the end of the coin prediction task. This demonstrated that an early win experience on one task could affect people's confidence on another task, even when the probabilities of success on the two tasks were different.

In summary therefore, the Illusion of Control as assessed with the standard paradigm has been replicated many times within the literature. The experience of predominantly early wins has tended to lead to exaggerated perceptions of future success, even on the chance determined task which have been utilised. It will be argued however that the paradigm that has been used may not be so relevant to the gambling experience itself as the Illusion of Control research to date would seem to suggest. This argument stems from the perspective taken that gambling activities, can and should be, viewed as decision making tasks in which the participant accumulates new information as time goes on.

2.3. Belief Revision, Hogarth and Einhorn (1992)

Before every new trial, people taking part in a gambling activity must make a decision both about which outcome they want to place their bet on, and how much money they wish to risk on that particular outcome. As such, these activities involve people

continuously revising their stakes. The decision about choice of bet size that players have to make is related to how confident they are in their choice of predicted outcome. If one is to assume that gamblers are at least somewhat motivated by potential monetary gain, then in order to maximise gains and minimise (or replenish) losses one would expect players to wager a higher amount on trials in which they are confident in their outcome prediction, and a lesser amount for trials in which they are unconfident. As such gambling can be viewed as belief revision tasks, in which new information is accumulated as time goes on which can have a direct effect on people's confidence and hence the size of one's bet on a particular trial, as the two are likely to be correlated which was confirmed in a brief pilot study [1].

This chapter however will attempt to address how new information, in terms of both precise recent outcomes and wins and losses, can affect people's beliefs and levels of certainty about the next or future trials. The information integration and belief revision literatures should therefore be considered to draw on the knowledge obtained within these fields.

Within the belief revision literature there has been controversy over whether primacy or recency effects obtain following the manipulation of the order in which information is presented. Asch (1946) for example, presented participants with three positive and three negative adjectives (or vice versa) that described an imaginary person. Following receipt of this description, participants were instructed to write a character description of the imaginary person. What resulted was that participants who had received the positive adjectives before the negative, wrote more favourable summaries of the person

[1]. A small questionnaire pilot study was carried out with 14 participants to investigate this assumption. Participants were asked to respond to 16 items. 8 of the items presented a range of potential gambles, the probability of success on which varied from 0.050 to 0.833. Participants were asked how much of £100 they had been given they would bet for each of the items. The other 8 comparable items mimicked the odds of success, but asked participants how confident they would be in predicting the outcome of the gamble. The responses to the bet size items were correlated with the responses to the confidence items. The resulting Pearson Product-Moment correlation was strong and positive, $r=0.443$ and significant, $p<0.001$. This confirmed the assumption that bet size is correlated with confidence. See Appendix 2 for the items.

than those who were presented with the negative items first. The primacy effect has been demonstrated in many domains and different explanations have been offered for these primacy effects.

Asch (1946) explained his primacy effects in terms of the initial information setting up the direction of belief that changes the interpretation of subsequent information. Hence with respect to the gambling literature people's perceptions of long term success and how good they feel at the task, extending Asch's argument to the Illusion of Control concept, the late losses (following the early wins) are interpreted as less important and have less impact on the established direction than when the same losses occur early on, hence establishing the direction themselves.

Anderson's (1981) 'attention decrement' perspective when applied to the Illusion of Control, would account for the primacy effect reported by Langer and Roth (1975) as mainly due to less attention being paid to successive items of evidence. Hence the early win participants would be more confident during the early stages as they appear to be winning a higher proportion of the time. For these participants the later high proportion of losses has less of an effect on confidence simply due to their position in the sequence. Likewise, the late wins inherent with the Ascending sequence would not be sufficient to pull people's confidence back up from the effects of the early losses as less attention would be given to these trials.

Another hypothesis, the "natural presumption hypothesis" (Hogarth and Einhorn, 1992), accounts for primacy effects in terms of participants' perceiving the order of presented stimuli as predetermined and therefore representing the importance of each unit of information. However, in the current paradigm, as in gambling activities per se, each unit of information, whether it be win-loss or precise outcome (e.g. Red or Black) in nature, is determined by chance. Therefore this hypothesis can not be validly applied to the gambling situation.

Although not a strong hypothesis within the gambling context, it has been shown (e.g. Shubin 1977, Custer and Milt 1985) that an early win experience is associated with the development of problem gambling, hence early information may be treated by gamblers as more important, whether they are conscious of this or not.

The controversy within the belief revision literature, however, arises when one considers research conducted by, for example, Stewart (1965). He used essentially the same materials and design as those used by Asch, and observed that participants character descriptions were most influenced by the most recent information they received, hence demonstrating a recency effect.

The only difference between the Asch and Stewart methodologies was the frequency of measurement; Stewart elicited responses following presentation of each unit of information, whereas Asch elicited responses only once all the information had been given to the participants. What becomes clear, even from these early studies, is that the conditions under which primacy or recency effects obtain depend upon the precise conditions and procedures which are employed within the belief-revision paradigm.

Hogarth and Einhorn (1992) go a long way in attempting to specify the precise conditions under which one can expect primacy or recency effects. One important distinction made relevant to the current work is that of their predictions for the occurrence of primacy and recency effects with respect to whether the task involves eliciting responses throughout a task (what they term a Step by Step response mode), or whether the participant accumulates all the information that is to be presented before providing a response (an End-of-Sequence response mode).

Hogarth and Einhorn propose that whenever a Step by Step (SbS) response mode is used, it is reasonable to assume that people must use an SbS process when integrating the information. They further propose that an End-of-Sequence (EoS) response mode, as used in previous IoC studies, may or may not invoke an EoS process. By appealing to the well-established notion of cognitive limitations, they assumed that people will use an EoS

process in the presence of an EoS response mode if this does not exceed their processing abilities. However, with more complex and longer tasks, they will adopt an SbS process.

Based on a task analysis of previous studies they proposed that the response mode makes a difference in the case of short, simple tasks, in which EoS induces primacy, SbS induces recency. They also conclude that primacy seems to obtain when tasks are simple but long (and this is independent of response mode), and that recency is associated with more complex tasks (also independent of response mode).

In the light of their conclusions, one should revisit the initial work conducted by Langer and Roth (1975), and view their work with these notions in mind when studying the methodology employed. The relevance of their conclusions for the current work will also then become clear.

2.4. Langer and Roth (1975) Revisited

A few potential problems need to be raised with the methodology employed in studies such as that of Langer and Roth (1975). Firstly, the method used for controlling the outcome of each flip of the coin was by showing the outcome of the flip only when it resulted in the predetermined win sequence being adhered to. Hence, participants only saw the outcome on 50% of the trials. If participants were only allowed to see the outcome of the toss of the coin when it suited the predetermined win and loss sequence, participants may have started questioning the randomness of the outcomes. With no explanation given for why they would only see the outcome on 50% of the trials, this would seem likely. To overcome this the coin tossing experiment described in the following chapter made use of a double-sided Head and a double-sided Tail coin which were secretly switched (if necessary) before each flip took place, so that the participant could see every outcome of

the flip of the coin. The second concern with the methodology relates to the frequency of measurement.

In the Illusion of Control studies, measurements have only been taken once at the end of all trials. A potential alternative to the early win explanation of the exaggerated success rate predictions may be related to the late losses that are experienced by early-win participants just prior to being asked the IoC measures. Participants may have felt that in order to win at a chance rate, as one would expect with a coin flipping task, they were due a higher proportion of wins over future trials to balance out the number of losses recently experienced. The third point to note is that only long-term measures were elicited. Short-term confidence may also be effected by the win sequence experienced.

One method of overcoming both of these two latter points is to elicit short-term confidence measurements throughout the task. In addition to sorting out which explanation most accurately accounts for the IoC observed, this technique increases the similarity between the paradigm and gambling activities themselves, as the latter involve participants continuously modifying their stake. Note that confidence was observed to be highly correlated with bet size in the pilot study.

Coventry and Norman (1998) utilised the above technique of eliciting short term confidence ratings prior to each predetermined trial. Although the distinction between short and longer term forecasting was not the main focus of their study, there were some interesting differences arising between the measures elicited. At the end of all trials, there were no significant differences between sequences on the short term confidence measure, but the effects observed previously by Langer and Roth were replicated with respect to the longer term confidence measure, as with the other IoC measures elicited only at the end of all trials. Early win subjects predicted significantly higher rates of success over the following 100 trials, than both the other two sequences. What needs to be established is whether or not this discrepancy between measures, was due to the different frequency of elicitation, or something inherent within the measures themselves.

One final note to make regarding the IoC research is that with the majority of studies in this field, generally only male participants have been used, (e.g. Langer and Roth 1975, Wolfgang et al 1984). Other studies do not make the gender of their participants explicit, (e.g. Ladouceur et al 1984), or if they do, they either have unequal numbers of males and females, (e.g. Ladouceur et al 1991) or make no mention of any differences between the sexes in their responses, (e.g. Ladouceur and Mayrand 1984, Letarte et al 1986.) One possible assumption (though not explicit) being made with these studies is that male and female participants are unlikely to respond in different ways to the experience of wins and losses. However, investigating sex effects is an important step such that the validity of this assumption can be evaluated.

Blascovitch et al (1973) believed that individuals playing in a group risked more in order to achieve status. That social norm may not be the same for women as for men; Ladouceur et al (1985) did not find that participants playing in a group bet more. The difference between the two studies lay primarily in the samples used. Ladouceur et al used both males and females whereas Blascovitch used only males. The use of female participants in the Ladouceur study may have therefore masked the effect of playing in a group. This adds further support for motivation to investigate potential differences between the way the two sexes interact with the task and respond to the outcomes.

The implications that the Hogarth and Einhorn predictions have on the current research are very apparent. In the IoC studies that follow, frequency of measurement was manipulated so that responses were either elicited on a SbS or an EoS basis. In accordance with the predictions made by Hogarth and Einhorn, it was hypothesised that there would be a recency effect observed with the SbS measure, and a primacy with the EoS. Within the current paradigm there are also other IoC measures which are elicited that are not involved in this manipulation, and as such are only asked at the end of all trials, similar to those utilised by Langer and Roth (1975). What needs to be clarified is whether the exaggerated

expectations of success are indeed due to the early wins as previously reported, and whether the IoC develops under varying frequencies of measurement. What also needs to be clarified is whether or not there is any differential effect of previous win sequence on short or longer-term confidence measures. Confidence may be related to bet size and the longer term Next 100 measure related to how quickly a gambler would return to the gambling environment, but are the two measures affected similarly by both the sequence of wins and losses and by the frequency at which they are measured? Hogarth and Einhorn made no reference to what effect employing both forms of response mode within the same task would have on the occurrence of primacy or recency effects. The EoS measure may or may not be affected by the presence of the SbS measure taken throughout the sequence. This manipulation may also generalise to responses to questions in the battery elicited at the end of the task, e.g. memory of past success and how good people think they are at the chance task.

It was hypothesised that the early win sequence would induce a greater illusion of control than the late and random win sequence, but that this illusion of control induced would be dependent upon both the measure used to assess it, and the frequency of that measurement.

For the EoS measures, i.e. those measures not continuously elicited throughout the task, it was hypothesised that a primacy effect would obtain, hence replicating the findings of Langer and Roth (1975) in terms of their questions asked.

With the SbS measures (either short or longer-term confidence) a recency effect would obtain, in that participants, due to being asked to continuously revise their beliefs about their confidence and probability of success, would have paid more attention to the most recent outcomes when evaluating their confidence in comparison to the former trial, in line with predictions made and replicated by Hogarth and Einhorn (1992).

The final aim of the following three experiments was to investigate the validity of the assumption that males and females respond similarly to the experience of wins and losses.

2.5. Overview of Methodology used in Experiments 1, 2 and 3

Due to the fact that the methodology for the following three experiments was essentially identical, this particular section provides an overview of both the task that was used for the studies, and the procedure by which each experiment was undertaken.

The task and methodology employed for each study were identical to each other in every respect other than the percentage of wins and losses experienced by the participant. In all studies participants won at a chance rate over the 32 trials, the precise number of wins therefore being dependent upon the number of available outcomes. For Experiment 1, participants could choose from two possible outcomes and so won 16 out of the 32 trials, hence winning 50% of the time. Experiment 2 was characterised by offering four possible outcome options so here the participant won 8 out of the 32 trials, with a win rate therefore of 25%. The final probability manipulation arose in Experiment 3 where participants were offered 8 outcome options to choose from; in this experiment they won 4 out of the 32 trials.

The positions of the wins and losses were controlled so that three specific win sequences could be employed. These were the Descending, Ascending and Random sequences. In the Descending sequence, participants experienced an early win sequence, in which they won predominantly in the first half of the trials, winning the majority (a minimum of 68% across the three Experiments) of their due wins in the first half of the sequence. They therefore lost predominantly in the latter half of the trials. The Ascending sequence participants experienced the reverse of the Descending sequence, hence they lost predominantly in the first half of the trials, but began winning progressively more as they approached the end of the sequence. The Random sequence had its wins and losses spread out throughout the trials in a random fashion. The same random sequence was employed for all participants in this sequence. The precise order of wins and losses for each of the experiments can be seen under their relevant methodology sections.

So that the task itself could be kept constant across the experiments, thereby reducing the likelihood of any potential differences in responses being due to a change of task characteristics, a task had to be designed in which the proportion of wins and losses could be manipulated, whilst keeping everything else equal. As highlighted within the discussion of Langer and Roth's methodology, one concern raised was that the way in which the outcomes were controlled could well have left the participants suspicious as to the randomness of the outcomes. Alongside this concern there was the fact that as the number of available outcomes increases from Experiment 1 to Experiment 3, so does the complexity of controlling these outcomes in a manual based task. Any methodology utilised to control the outcomes with an increasing number of available outcomes in a manual task would at best be messy and at worst would reduce participants' confidence in the trials being determined purely by chance.

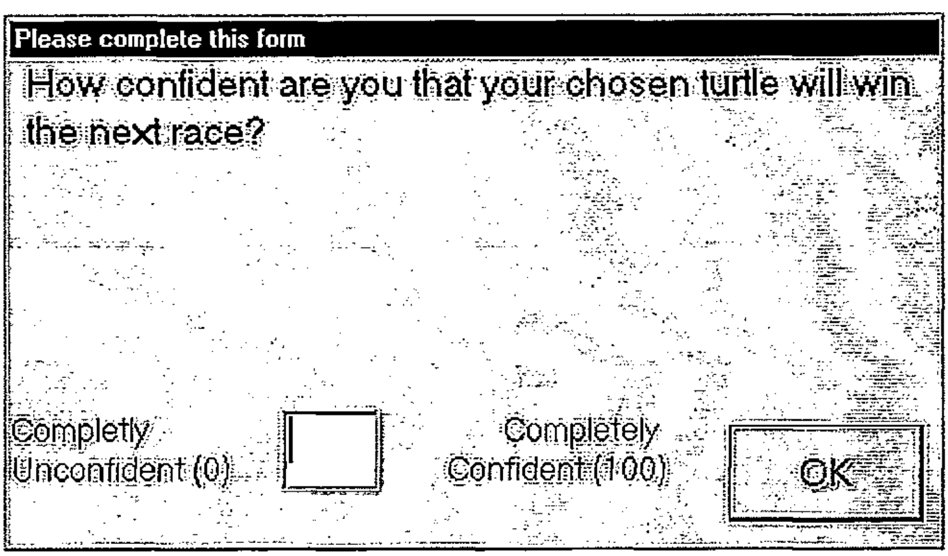
To overcome these concerns a computer task was designed. It was then commissioned to be written on a consultancy basis by Dr Nick Outram, of the Centre for Intelligent Systems, University of Plymouth.

The turtles were programmed to move in a random direction for a random distance, but with a small weighting such that they tended to move towards the perimeter. The program was designed such that if the participant was due for a win on a particular trial, and had predicted that the Red Turtle would win the next race, all the other Turtles in the race other than the Red would be restricted from leaving the circle, thereby restricted from crossing the "finishing line".

The turtles could move in any direction and could also rebound before touching the winning line and travel in an alternative direction, hence allowing for near-misses to arise. Near-misses occurred at random intervals across all conditions. Their movement therefore made the random motion appearance very realistic.

After having made their selection of Turtle for the next race, another window appeared on the screen asking them either how confident they were that they would win the next trial, or how many trials they thought they would win over the next 100 trials. They responded to this by typing a number in the input box using the computer's keyboard. See Figure 2.4 for an example snap shot.

Figure 2.4. Example of Window appearing before the start of each race.



The question they were asked depended upon which Response Mode they were under. Two Response Modes were utilised. Half of the participants responded to the short term confidence measure throughout the trials, on step by step basis, followed by responding to the longer term measure of success rate prediction over the next 100 trials, at the end of the sequence. Whereas the short term measure was therefore elicited 33 times (a baseline was also elicited before any trials had taken place, as was confidence after the final win or loss had taken place), the longer term measure was only elicited once, at the end of the sequence.

The other half of the participants were exposed to the opposite Response Mode, such that longer term estimates of success were elicited on a Step by Step (SbS) basis, and the shorter term measure on an End of Sequence (EoS) basis. Although this measure was taken at the end of all trials, the participant was not informed that the last trial they had just experienced was in fact their last trial; that there would not be a further trial. Once they had expressed their confidence for the next trial, they were then informed that there would then be a series of questions.

The two Response Modes will, from here on, will be referred to St/lt and Lt/st respectively.

For Experiments 1, 2 and 3, both the short term confidence in the next trial and the Next 100 predictions were measured on the same 0 to 100 scale. Short term confidence ranged from Completely Unconfident (0) to Completely Confident (100). The Next 100 measure simply reflected how many trials out of the hypothetical next 100 trials the participant thought that they would win.

Once participants had selected their chosen turtle, had responded to the appropriate SbS measure, and hit the Enter key on the keyboard, the turtles appeared in the centre of the screen, and the race started. The Turtles would then move about the circle in the fashion described above, see Figure 2.5 for a mid-race snap-shot.

Once a turtle had crossed the "finishing line" (the edge of the circle), the words "You Win" or "You Lose" appeared on the screen, see Figure 2.6, dependent upon where the participant was in the particular win sequence. After 2 seconds, the participant was prompted to click on the "Go" button which then appeared on the screen. On doing so, the window offering the same Turtles in the next race appeared in order that the participant could make a selection for the new race, followed then again by the presentation of the appropriate SbS measure.

Once all trials had taken place, the prediction and SbS measure for the 33rd trial was elicited. However, this trial did not take place. Rather, what followed was the elicitation of the appropriate EoS measure, (short term confidence or Next 100 success prediction), which was then followed a series of questions including those used in previous studies. These questions further assess the Illusion of Control and the participants' memory of past success:

1. 'How many correct predictions do you think you've had on these trials?'
2. 'How many trials do you think there have been?'
3. 'How good do you think you are at predicting these outcomes?'
4. 'How many trials do you think you would win after a lot of practice?'
5. 'Imagine you were watching your favourite television programme. How many trials do you think you would win over the next 100 trials ?'
6. 'Imagine you are watching someone else doing this task, how many trials do you think they would predict correctly over the next 100 trials?'

The last question addresses the level of involvement issue. The greater the difference between participants own predicted Next 100 success rates and answers to this question, the greater the participant believes that the personal involvement factor can influence their chances of success. Having elicited responses to these questions, the participants were debriefed, during which Participants were asked whether they currently gambled or not.

The British Psychological Society (1992) provide a code of practice governing all forms of research with human participants. The use of the Psychokinesis cover and the predetermining of the outcomes needs some discussion, particularly in relation to ethical considerations.

Participants were informed that the Turtles moved in a random fashion which they did. Indeed, all participants won at a rate at which they would have expected to win if each subsequent outcome had been determined purely by chance. However, to reliably assess the effect of particular win sequences on people's confidence both throughout and at the end of the trials, participants could not be informed that whether or not they would win on a particular trial was predetermined. This was a necessary step to ensure that the positions of wins and losses could be controlled for in the investigation of primacy and recency effects. This increased the possibility that any differences appearing in responses from participants in the different sequences, were due to the sequences themselves, and not some other confounding variable.

The use of the Psychokinesis cover (as a more ethical alternative to the use of money) could be construed as a use of deception. Participants could not be informed of the real use of the cover; not only to increase involvement but also to increase arousal associated with the task. Indeed, Coventry and Norman (1998) found that the use of the Psychokinesis methodology produces arousal increases during the task similar to those observed during electronic gaming machine tasks. Both these factors represent a level of deception not uncommon in the literature.

Participants were informed of their right to withdraw at any time from the study without penalty, that all their responses would be treated with complete confidentiality and were fully debriefed once they had finished the task. This debriefing included an explanation that whether or not they had won on a particular trial depended upon where they were in the predetermined sequence. They were informed about the aim of the investigation researching the effects of the positions of wins and losses on people's short and longer term confidence measures. They were also informed that they had won at a chance rate and that because the win sequence was predetermined it made no difference which Turtle they had chosen for that particular race. No one expressed concern (neither the pilot participants prior to commencing the study or those that are reported within the results) over having experienced this level of deception. Furthermore, ethical clearance had been sought and received for each of these studies from the Faculty of Human Sciences Ethical Committee, University of Plymouth.

2.6. Experiment 1

2.6.1. Method

Participants

60 male and 60 female Undergraduate psychology students were recruited one by one, and equally distributed to the three sequences, such that there were 20 males and 20 females in each sequence. 10 males and 10 females in each sequence would therefore respond on a St/lt or a Lt/st basis. Participants received a small financial incentive to take part, (receipt of which was not dependent upon their performance in the task).

Materials

The Turtle task, as described above, was utilised with two Turtles in each race. The two Turtles that were available to choose between were a Red and a Green Turtle.
The sequence lasted for 32 trials, out of which the participants won 16. The win sequences resembled the ones used by Langer and Roth (1975) although they were adapted slightly to allow for 32 rather than 30 trials. This adaptation was necessary so that a constant 1 in 4 and a 1 in 8 win rate for the Experiments 2 and 3 could be specified. The precise win sequences for each of the sequences in this Experiment are depicted in Table 2.1 below, where "W" stands for a win, and "L" for a loss, on that trial.

Table 2.1. Sequence of Outcomes for each Sequence. Experiment 1

	Sequence		
Trial	Descending	Ascending	Random
1	W	W	L
2	W	L	W
3	W	L	W
4	W	L	L
5	L	L	L
6	W	W	W
7	W	L	L
8	W	L	L
9	L	L	W
10	W	W	L
11	L	L	L
12	L	W	W
13	W	L	L
14	W	L	W
15	W	W	W
16	L	L	W
17	L	L	L
18	W	W	W
19	L	W	L
20	L	W	W
21	W	L	L
22	L	L	W
23	W	W	W
24	L	L	L
25	L	W	W
26	L	W	L
27	W	W	W
28	L	L	L
29	L	W	W
30	L	W	L
31	L	W	L
32	W	W	W

Procedure

Participants were seated near the experimenter, in the same small room, one at a time. The procedure followed the common procedure outlined in the overview.

2.6.1. Results and Discussion of Experiment 1

Participants were asked at the end of the Experiment whether they currently gambled or not. 65 participants reported that they gambled on one form or another, whereas 55 reported that they did not gamble at all. These were approximately evenly distributed across the three Sequences, see Table 2.2 below for the number of observations in each group.

Table 2.2. Breakdown of Frequency of Gambling and Non-Gambling Participants, by Sequence and Sex

	Gambles ?					
	Male		Female		Total	
	Yes	No	Yes	No	Yes	No
Descending	11	9	10	10	19	21
Ascending	9	11	12	8	19	21
Random	12	8	9	11	17	23
Totals	32	28	31	29	55	65

The analysis of the data set was broken up into four sections. Firstly an analysis of baseline values followed by an analysis to evaluate whether an Illusion of Control had been induced, and to see how the short term Confidence and the Next 100 measures were affected by the two modes of responding, Step by Step (SbS) or End of Sequence (EoS). Thirdly, an analysis was conducted to see how the two measures fluctuated throughout the task following the progressive experience of each of the win Sequences. This analysis is labelled the Step by Step Analysis as it investigates changes in the SbS measures over four time periods.

The fourth stage of the analyses consists of an investigation into the effects of the variables on the measures that were not previously involved in the frequency of measurement manipulation, namely the question battery items.

2.6.2.1. Baseline Values

Participants' responses prior to any trial having taken place, and hence no outcome information being available at the point of measurement, were analysed to ensure that there were no pre-existing differences in the baseline confidence and Next 100 responses between Sequences or between males and females. Participants responded to both scales on the 0 to 100 scale. A three-way [2(Response Mode) x 3(Sequence) x 2(Sex)] analysis of variance (ANOVA) was conducted on baseline responses. Response Mode specified which measures were elicited throughout and at the end of the trials which therefore stipulated in this analysis whether the baseline value was the short term Confidence or the Next 100 measure. The Sequence variable specified which of the Descending, Ascending or Random sequences the data referred to. See Appendix 3a for the ANOVA table.

There was no main effect of Response Mode; prior to the start of the trials there was no difference between the two measures of "How confident in next trial" and estimates of success over the "Next 100"; $F(1,108)=0.14$, $p=0.709$. Also there were no main effects of either Sequence $F(2,108)=1.68$, $p=0.191$, or Sex $F(1,108)=0.11$, $p=0.744$.

Any differences that are observed in the following analyses can not be attributed to starting values, and one can therefore attribute them to the experience of the task itself.

2.6.2.2. Illusion of Control: Confidence and Next 100 responses at the End of the Trials

In this Experiment, the two measures, that of Confidence in the next trial, and the longer term Next 100 predictions, were elicited from participants either throughout the task before each trial, or at the end of the sequence only after the final trial. It was of interest to

investigate what effect these two Response Modes would have on these two measures at the end of the trials.

If Langer and Roth's (1975) Illusion of Control findings are robust, then one should observe exaggerated future success rate predictions (Next 100 measure) at the end of the task for those participants in the Descending Sequence as compared to those in the Ascending Sequence. It was also of interest to investigate whether the shorter term Confidence measure was affected in a similar way.

If Hogarth and Einhorn's (1992) model of belief revision is robust and complete, and applicable to the gambling scenario, then with respect to the Descending Sequence, when the Response Mode was St/lt, one would expect elevated Next 100 predictions (primacy) and decreased Confidence in next trial response (recency); and when under the Lt/st one would expect elevated short term Confidence (primacy) and decreased Next 100 predictions (recency), as in the early stages the participants in this sequence won early and lost late.

The reverse would be expected for responses from participants in the Ascending sequence; elevated Confidence and decreased Next 100 responses under the St/lt Response Mode, and elevated Next 100 and decreased Confidence under the Lt/st.

In summary, therefore, a four-way ANOVA with a 2(Response Mode) x 3(Sequence) x 2(Sex) x 2(Measure) design, with the alpha level of significance set to $p<0.05$, was conducted to see if indeed an Illusion of Control with respect to people's confidence both in the short term and in the longer term was induced, and to see what effect utilising a SbS process in conjunction with an EoS response elicitation would have on the two measures. See Appendix 3b for the ANOVA table.

The Between-participant variables used in the current analysis were: Response Mode, defined which measure was elicited throughout and which was measured just once (at the end of the sequence); Sequence, defined whether the participant experienced the Descending, Ascending or Random sequence; and Sex.

The Measure (within-participant, two level) variable stipulated whether the data referred to the Confidence or the Next 100 measure. For the first 60 participants (those under the St/lt), the SbS measure after the final trial was of Confidence whilst the EoS measure was the Next 100 success rate predictions. For the second 60 participants (those under the Lt/st), the SbS measure was the Next 100, whereas the single EoS measure was the short term Confidence. Response Mode was counter-balanced in this way and thereby specified which measure was taken with which frequency.

A main effect of Measure resulted, $F(1,108)=11.40$, $p=0.001$. Confidence in the next trial was significantly higher than Next 100 predictions, means of 60.26 and 53.23 respectively. The two way interaction between Response Mode and Measure would provide information on how the two measures were affected by the frequency of measurement manipulation, collapsed across the three sequences. This interaction was not significant, $F(1,108)=0.06$, $p=0.808$. This suggests that whether or not a particular measure was elicited throughout made no significant difference to the size of the response at the end of the task. Specifically the current data set demonstrated that for the End of Sequence measure there is no impact of the frequency of measurement variable.

Of relevance to the Illusion of Control issue, is whether there was a main effect of Sequence, or whether this variable interacted in any significant way with the Response Mode and the Measure variables. The lack of Sequence effect $F(2,108)=0.01$, $p=0.941$, demonstrates that collapsed across both measures and Response Modes, the early win effect had no significant effect on people's responses. Participants winning early on did not hold exaggerated beliefs at the end of the trials. This is in direct contrast to the findings of Langer and Roth (1975) who observed elevated responses for those in the early-win sequence. It appears additionally that this is the case for both the Confidence and the Next 100 measures, as the three way interaction between the variables Response Mode, Sequence and Measure was also not significant, $F(2,108)=0.11$, $p=0.895$.

Thus with the current methodology, there appears to have been no Illusion of Control effect induced with respect to these measures. This may be due to the Illusion of Control effect itself being less robust than previously believed, or it may have something to do with the specific methodology utilised. Getting people to respond throughout the task on any measure, may have got people to focus more intently on the outcome of local trials, hence preventing a primacy effect to occur. However, a recency effect also failed to occur, in that by the end of all trials, there were no differences observed between the sequences. This suggests that the Illusion of Control is a less robust phenomenon than previously thought, specifically that the results obtained in previous research may have been more of an artefact of the methodologies used rather than a true Illusion of Control effect, as the current methodology more closely resembles the gambling situation.

In line with Hogarth and Einhorn's (1992) model, with the SbS measures, no primacy effect occurred. However, no recency effect (order effect) occurred either. For the current data to fit their model perfectly, both SbS measures should have been higher at the end of the trials for participants in the Ascending Sequence (due to winning late), and lower for those in the Descending (due to losing late). Similarly, to fit the model (with respect to primacy effects) there would have had to have been elevated responses for the EoS measures for those in the Descending Sequence (winning early) and decreased responses for those participants in the Ascending Sequence (due to losing early on).

These results suggest that the belief adjustment model (Hogarth and Einhorn 1992) may either have to be adapted, or that their model of information integration is not applicable to this form of decision making, to gambling tasks, or to Illusion of Control type studies such as the current paradigm. This issue will be returned to later in the general discussion section.

Although there were no differences at the end of the task, there may have been differences between the measures during the task whilst experiencing the different win sequences. The following analysis investigates this, and attempts to shed light on the

validity of the alternative possible explanation offered for Langer and Roth's (1975) findings with respect to the long term success rate predictions.

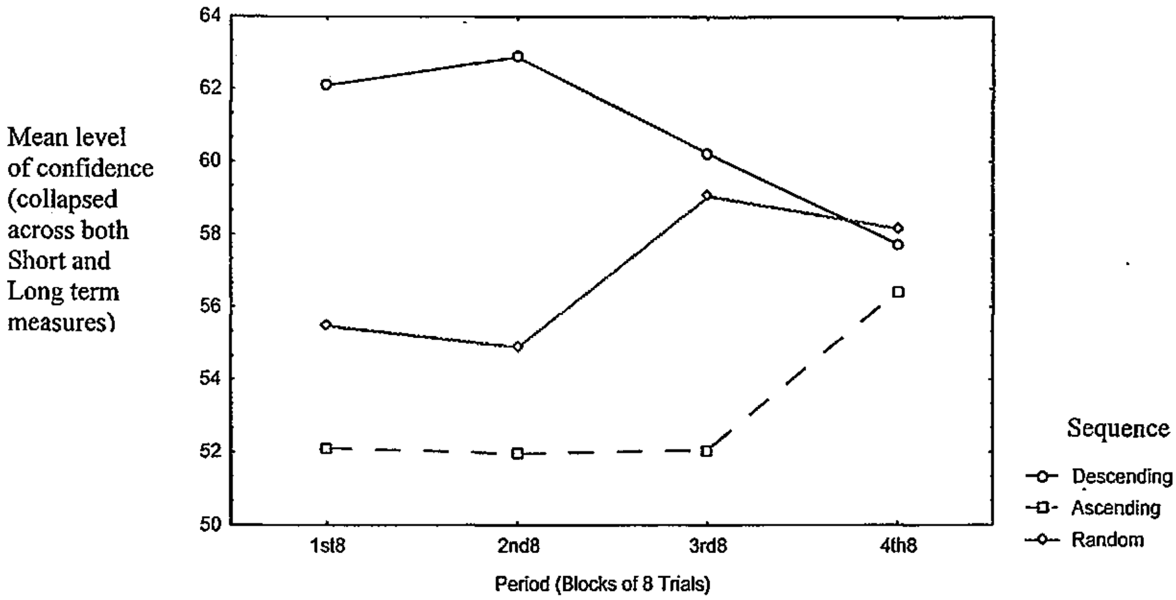
2.6.2.3. Step by Step Analysis

One of the concerns raised with the Langer and Roth (75) study was that of the frequency of measurement. In their study they only elicited the longer term Next 100 success rate predictions and they only took this at the end, once all winning and losing had taken place. As discussed earlier, one potential explanation for the elevated predictions observed may be due to Participants under the Descending sequence feeling that as they had lost a lot recently (just prior to measurement), they were due for a series of wins, therefore increasing their predictions for the next batch of trials.

Having utilised the current methodology, the validity of this alternative explanation and how the two measures fluctuate according to periods of high and low winning could be investigated.

In order to investigate how Participants' responses were affected by the particular win sequences throughout the trials, their responses to the 32 trials were averaged across groups of 8 trials. The trials were averaged in this fashion so that confidence during groups of trials during which participants across the sequences won at different local rates could be investigated. A four-way ANOVA [2(Response Mode) x 3(Sequence) x 2(Sex) x 4(Period) was then conducted. Period, the within-participant factor, refers to the group of 8 trials, namely the first, second, third or fourth block of eight trials. Appendix 3c presents the ANOVA table for this analysis.

Figure 2.7. Graph Illustrating the Two-way Interaction Between Sequence and Period for the Step by Step Analysis in Experiment 1.



There was a main effect of Response Mode, F(1,108)=10.95, p=0.001. Short term confidence was significantly higher than the "Next 100" responses, (means of 62.13 and 51.73 respectively).

A significant interaction resulted between Sequence and Period, F(6,324)=2.74, p=0.013. However, before investigating this interaction further, the issue of sphericity needs to be addressed, as the within participants measures for the four periods are likely to be correlated with varying strengths. Mauchly's test for sphericity resulted in a highly significant p value (p<0.001), indicating that the ANOVA assumption was not upheld. Using a correction for this, Greenhouse Geisser conservative degrees of freedom of (2,108), the ANOVA did not result in a significant p value, p<0.070 at the 5% level. However as it approached significance and this technique is deliberately over-conservative, the effect that the Huynh Feldt correction technique had was investigated. With (4, 255) degrees of freedom, the interaction between Sequence and Period was still significant, p<0.020. Hence this indicates that there is ample evidence to suggest that the effect is actually there, and the original (uncorrected) ANOVA test was significant not only because

of the unequal dependence (correlation) between the four time periods (within participants).

From Figure 2.7 it is clear that the greatest difference arose in the early stages of the sequences, but by the end of the sequences these differences between the sequences were minimal. Follow up analysis using the LSD method confirmed this. For the first block of 8 trials, the Descending sequence resulted in significantly higher responses (collapsed across both measures) than both the Ascending and Random sequences, (means of 62.09, 52.11, and 55.47 respectively). Although there was a slight increase over the next eight trials, the Descending sequence responses subsequently fell throughout the remainder of the trials. The difference between the first and the last block of trials was of marginal significance, $p=0.052$, means of 62.09 and 57.74 respectively.

For the Ascending sequence participants, their average responses stayed relatively similar throughout the first three periods, but rose throughout the last; the difference between the third and fourth block of trials was of marginal significance, $p=0.05013$, means of 52.05 and 56.43.

Comparing the responses for the Random and Ascending sequences, the only significant difference resulted across the third block of trials, such that the Random sequence resulted in significantly higher responses, means of 59.12 and 52.05 respectively. Although the Random sequence responses were higher once the task was completed as compared to their start points, the responses over the four periods were not significantly different to each other. See Table 2.3 below for a summary of the means for the Sequences and Periods.

Table 2.3. Summary of Means for the Two-way Interaction between Sequence and Period for the Step-by Step Analysis in Experiment 1.

	Period			
	1st 8	2nd 8	3rd 8	4th 8
Descending	62.09	62.87	60.23	57.74
Ascending	52.11	51.96	52.05	56.43
Random	55.47	54.93	59.11	58.17

In summary, there were some distinctive differences between the sequences following the experience of the wins and losses, whilst the differences within the Sequences are much less marked, although show a clear trend in that in blocks where wins occurred scores were the highest for that sequence.

Additionally, the lack of any significant interaction between Response Mode and Period suggests that both measures were acting in similar ways to the experience of the win sequences. The participants in the early win (Descending) sequence were more confident and were predicting higher rates of success throughout the early stages than they were towards the later stages. Even though the amount of decrease in the responses between the first and last block of eight trials did not quite reach significance, the decrease in the repeated measure responses whilst losing a progressively higher proportion of local trials was apparent. The reverse was true for the late win (ascending) participants, the greatest increase in their responses did not arise until the final period, in which they experienced a high local win rate.

These results can be explained by a Bayesian approach in the sense that people's confidence (more specifically, their response to the step by step measure) is directly related to the ratio of wins and losses that they have experienced. Hence, by the end of the trials when everybody has won the same proportion of trials, participants' responses across the three sequences have balanced out. A true recency effect as predicted by the Hogarth and Einhorn model would have appeared by the Descending sequence participants providing significantly higher responses at the end of the trials which did not result.

It has been claimed in previous research that experience with a task in itself can induce greater confidence (e.g. Ladouceur et al 1987). The data from the Random sequence participants supports this notion. Throughout the last half of the trials, Participants in the Random sequence were higher with their Confidence and Next 100 scores than they were throughout the first half, when the task was new to them. This increase through experience with the task contributed to the finding that by the end of the trials, there were no significant differences between the win sequences.

In terms of the validity of the possible alternative explanation for Langer and Roth's findings one needs to look primarily at responses during the latter trials for Descending sequence participants. The fact that these Participants did not increase in confidence during the period in which they were losing the most (the latter trials), and generally became less confident the more they lost, suggests that the late losses explanation does not hold. The most plausible explanation therefore is that their findings, using their methodology, are in fact due to the early wins, and not due to the late losses. Hence a primacy effect of the early outcomes would explain the elevated success rate predictions. This conclusion would fit perfectly into the Hogarth and Einhorn model from which, as discussed earlier, one would predict primacy effects when utilising an EoS response mode. Their model would also have predicted a recency effect when utilising a Step by Step elicitation.

However under the current conditions neither a primacy effect with the EoS measure, or a recency effect with the SbS measure at the end of the task resulted. The lack of a primacy effect observed here under the current conditions is easier to explain in terms of the model. This is primarily because the model does not make any predictions when two modes of processing are used within the same task. As argued earlier, gambling tasks can be viewed as belief-revision tasks and as such their model would need to be re-addressed so that it can provide an account of how the two processing modes would interact to affect the existence of primacy and recency effects. The fact that participants had to re-evaluate one measure throughout the task, may have affected (primed) the single measure when elicited at the end. The current methodology would have drawn participants' attention to the importance of local outcomes, rather than the overall series of events.

While recency effects throughout the task were clearly in evidence for the SbS measures, the lack of a distinctive recency effect at the end of the task was due to later trials having the effect of reversing the effect of the early trials. This would be expected due to the nature of the sequences and due to the fact that generally confidence is higher following a win than following a loss. Thus utilising a SbS response mode would seem to have focused people's attention on the recent outcomes. The extent of the difference between sequences for the SbS measure at the end of the task was restricted due to people focusing on the local outcome information.

2.6.2.4. Battery Items Analysis

An analysis was conducted on the question battery items relating to the perception of success in the longer-term under various imagined conditions, followed by an analysis on the memory questions, using Response Mode, Sequence, and Sex as the independent between-participant variables in the analysis. See Appendix 3d for all the ANOVA tables for this analysis.

Longer Term Items

Firstly an ANOVA was run on the longer-term items. A four-way ANOVA [2(Response Mode) x 3(Sequence) x 2(Sex) x 3(Measure)] was carried out, comparing the three levels of the within-participant repeated measure variable; participants' own predicted

success rates, their success rates if distracted, and their perceptions of how many trials another person would win.

The variables of Response Mode, Sequence and Sex had no differential effect on the three longer term measures. However, the main effect of Measure was significant, $p<0.001$, $F(2,216)=22.26$. Follow up analysis using the LSD method revealed that Participants thought that someone else would perform significantly worse than themselves, (means 48.72 and 53.23) and that they would win significantly fewer trials if distracted as compared to being allowed to concentrate, (means 42.61 and 53.23 respectively). Participants responded to the question (Question 6) regarding someone else's predicted performance in a fashion that implies that the participants believe that the more involvement that one has with the task, the better the success rate would be. This factor clearly has no direct influence on the objective probability of success on any particular trial, although participants still felt that taking an active role in predicting the outcome on this chance task would result in a better success rate than a passive role, when someone they knew predicted the outcome. Additionally participants believed that concentration on the task was necessary to improve predicting performance. Again, on a chance determined task, any degree of concentration would have no positive effect in terms of performance on the task. Both of these findings replicate those observed by Langer and Roth (1975). These findings seem to suggest that with respect to these particular measures, it appears that participants in the early win sequence had developed some degree of an illusion of control. A point to note however, is that there was no interaction with Sequence, which suggests, as there were no apparent order effects in the current study for the EoS measures, that this is a feature of the task generally.

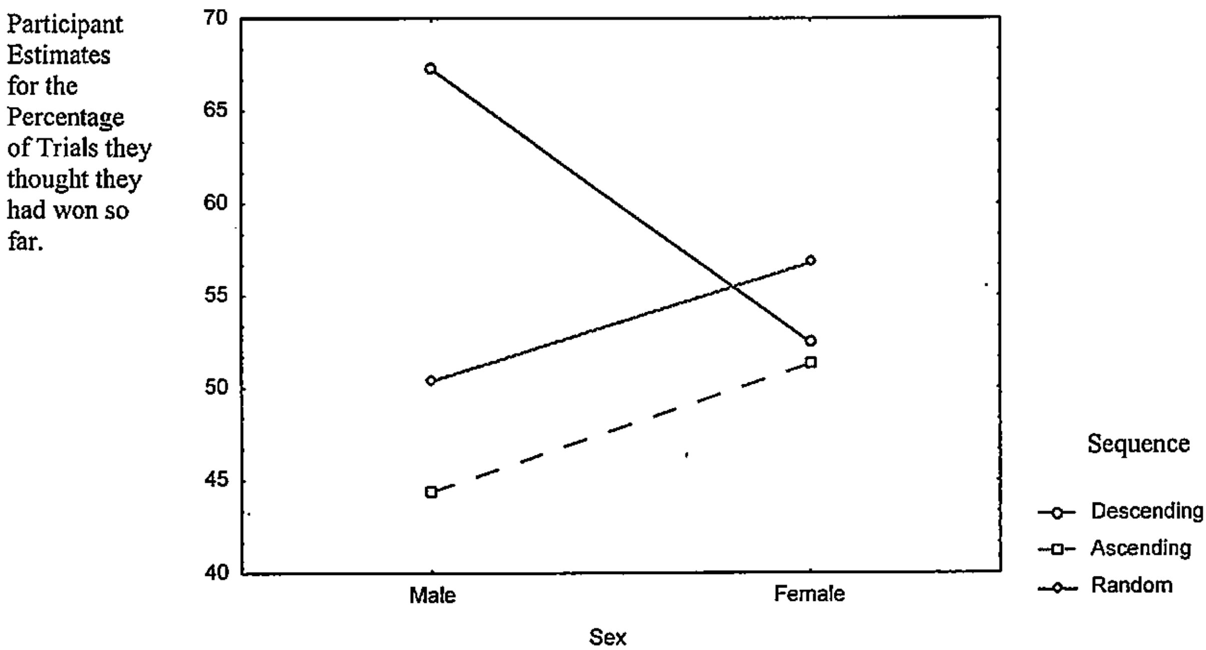
Percentage of Trials

Secondly a three-way ANOVA [2(Response Mode) x 3(Sequence) x 2(Sex)] was conducted on people's estimates of the percentage of trials that they thought they had won. This percentage was calculated by dividing the number of trials they thought they had won (Question 1) by the number of trials that they thought there had been (Question 2), expressed as a percentage.

A main effect of Sequence resulted, $F(2,108)=5.94$, $p=0.004$. Descending sequence participants thought they had won a significantly higher percentage (59.85%) of the trials than the Ascending sequence participants, (mean of 47.84%). The Random sequence participants did not differ significantly from either of the other two sequences, (mean of 53.66%). This suggests that the experience of the early trials are important when establishing one's perception of how many trials people think they have won, and less attention appears to be paid towards the later trials.

The interaction between Sequence and Sex also reached significance, $F(2,108)=6.32$, $p=0.003$. See Figure 2.8. From the figure, it appears that males and female participants were reacting in similar ways to the Ascending and Random sequences, but differently when having experienced the Descending sequence. Follow up analysis using the LSD method confirmed this - males and females only differed significantly in their responses under the Descending condition.

Figure 2.8. Graph Illustrating the Two-way Interaction between Sequence and Sex for the "Percentage of Trials" Analysis for Experiment 1

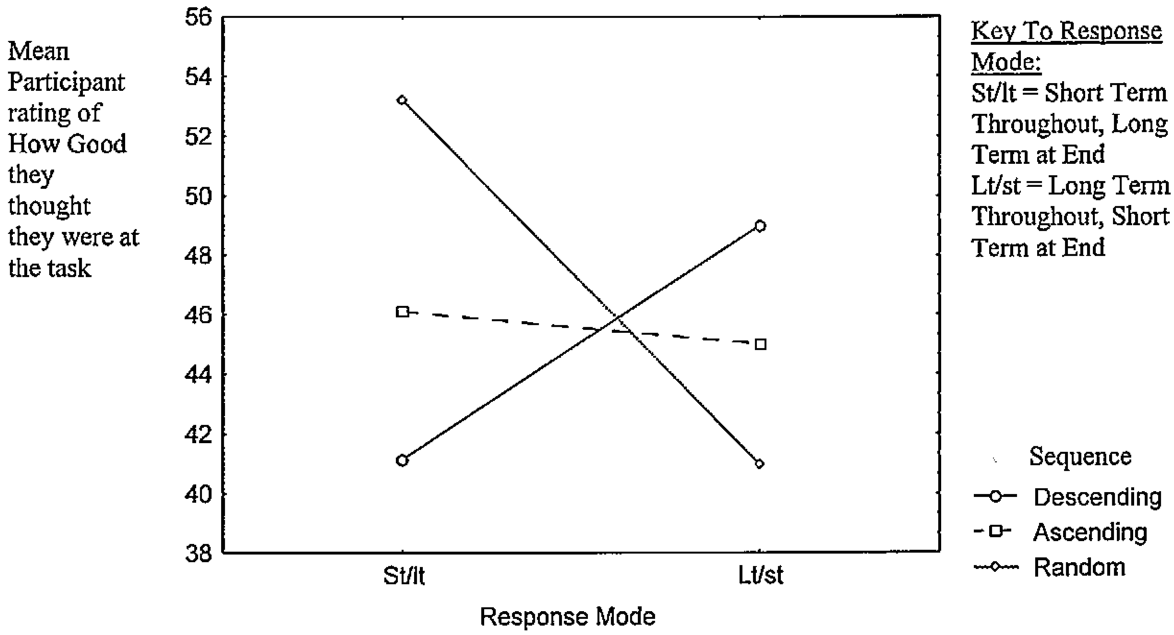


How Good?

Thirdly, a three-way ANOVA [2(Response Mode) x 3(Sequence) x 2(Sex)] was conducted on perceptions of How Good participants thought they were was then carried out.

The interaction between Response Mode and Sequence was significant, F(2,108)=3.91, p=0.023. See Figure 2.9.

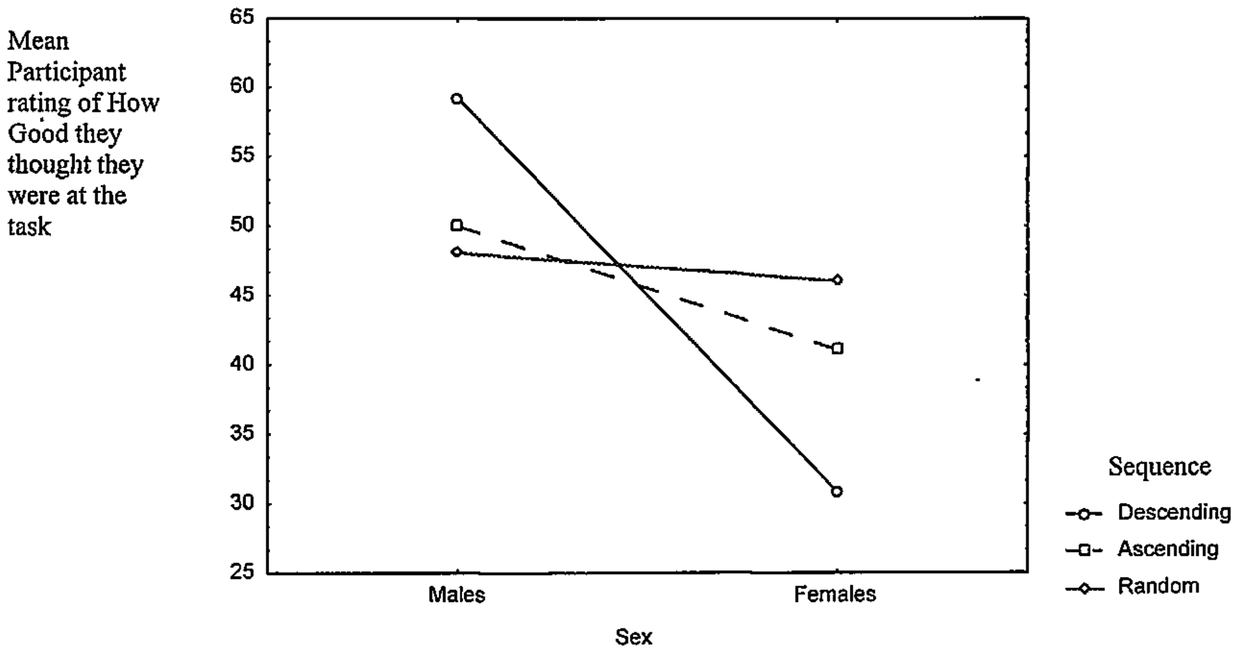
Figure 2.9. Graph Illustrating the Two-way Interaction between Response Mode and Sequence for the "How Good" Analysis in Experiment 1



LSD follow up analysis revealed that there were no differences between the responses to the measure when the Next 100 measure was taken throughout. When the Confidence measure had been taken throughout, the participants in the Random sequence thought they significantly better at the task than those participants in the Descending between two response modes.

A main effect of Sex resulted, $F(1,108)=20.02$, $p<0.001$. Males thought they were significantly better at the task than their female counterparts, means of 52.47 and 39.35 respectively. An interaction between Sequence and Sex also resulted, $F(2,108)=7.20$, $p=0.001$. See Figure 2.10.

Figure 2.10. Graph Illustrating the Two-way interaction between Sequence and Sex for the "How Good" Analysis in Experiment 1



From the figure, in addition to the finding that males responded generally higher than females, it is again apparent that the largest difference arose due to the Descending sequence. Whereas males and females did not differ following the experience of the Ascending or Random sequence, males in the Descending sequence responded with significantly higher responses (mean of 59.25) than the female participants in the same sequence, (mean of 30.90).

Whereas Langer and Roth observed differences between their sequences with respect to this How Good measure, the current experiment only resulted in significant differences for the female participants, and in the opposite direction. Follow up analysis revealed that this was indeed the case. Female participants in the Descending sequence thought that they were significantly worse at the task than their counterparts in the other two Sequences.

However, the difference between Descending and Ascending responses on the How Good measure for the male participants did approach significance, p=0.071, and in the predicted direction. Langer and Roth (1975) reported that they used only male participants.

By not running female participants through the paradigm, it narrows down the generalisability of the results. As has been demonstrated here, male and female participants did not respond identically following the experience of the win sequences (on this measure).

The difference may have something to do with the female participants responding to this item in relation to the most recent trials, whereas the males might have tended to be more susceptible to the primacy effect of the early wins.

In summary therefore, the order effect was not replicated within the current methodology. At the end of the sequence participants who won predominantly early on in the task did not predict significantly higher success rates or were not significantly more confident in the next trial, than participants who lost predominantly early on. The Hogarth and Einhorn model of belief revision would also need to be modified if it were to be applied to the gambling scenario, particularly with respect to predictions that it would make when two modes of responding are utilised.

Although this is the case (that the order effect did not result with respect to the short or the long term measures of confidence) both measures (but particularly the longer term estimates) were high in absolute terms, suggesting an exaggerated perception of how well people thought they would perform on future trials. There were further additional signs of an illusion of control being developed, but only with respect to measures which were not involved in the frequency of measurement manipulation. Generally participants indicated that they thought that someone else would be worse at the prediction task than themselves and that if distracted, they would also have performed significantly worse than if they were allowed to concentrate. Both these are signs of the Illusion of Control; however the importance of the early win experience was not relevant for these measures, in that this variable did not interact with the sequence variable. This suggests that what ever the win sequence the participant was exposed to had no bearing on these measures. Specifically however, the win sequence played a significant role in people's memory of

past success. Hence although the argument that the early wins may be a precursor to continued play with respect to the two former measures was not supported by the current data, the data does suggest a primacy effect of the early wins for an exaggerated perception of past success. If people base their future judgements on how well they have performed to date, and their perceptions of their performance to date can be manipulated by the early outcome information, even though an Illusion of Control was not replicated in this study, it does confirm that early information is still important.

In relation to this, from the step by step analysis, it became that clear that the largest differences between the win sequences occurred in the early stages. Whilst winning, descending sequence participants' SbS measures were consistently higher than their counterparts in the ascending sequence, who predominantly experienced losses in the first stages. The difference between these two sequences reduced as the trials continued and the participants win rate equalled out. This was the case for the short term confidence measure, which one would expect, but also for the longer term "Next 100" measure.

There appeared to be some differences in the way males and females respond to the experience of the three sequences, and hence to the experience of a win or a loss. This stresses the importance of controlling for any sex effects that may arise when conducting research of this kind. Later in Chapter 3 it will be demonstrated that there are some clear differences in the way that males and females react to the experience of a win or a loss.

2.7. Experiment 2

The lack of effects in the first experiment may have been due to the combination of the nature of the task and that participants won 50% of the trials; there were only two outcomes available from which to choose. It might also have been due to the two response modes utilised with the 1 in 2 probability, both a step by step and an end of sequence measure.

To be a robust phenomenon, the Illusion of Control (and order effects specifically) should be replicable in many different tasks with differing probabilities of success. Gambling activities in the real world for example, cover a wide range of probabilities, both between the tasks, and within the tasks themselves. The probability of success when betting on horse racing depends largely upon the number of horses in a race, while the Roulette player can choose to bet on a single number (1 in 37) or can decide to bet on a colour, Red or Black (approximately 1 in 2). Experiment 1 only evaluated the Illusion of Control concept within a 1 in 2 probability type task.

What needs to be evaluated is the validity of the Illusion of Control concept within tasks which are characterised by different probabilities of success, thereby reflecting the nature of real world gambling activities. The following Experiment therefore examined the same variables, but using the turtle task with four turtles in each race, and with a 1 in 4 probability of success on any trial. Experiment 3 further reduces this probability to 1 in 8 (with eight turtles in each race).

2.7.1. Method

Participants

A different batch of 120 Undergraduate students were recruited one by one, and equally distributed to the three Sequences, such that there were 20 males and 20 females in each Sequence. Of each of these 20, 10 males and 10 females would therefore respond on a St/lt , whilst the other 10 males and 10 females would respond on a Lt/st basis. Participants received credit towards their first year undergraduate programme. The 60 participants who were under the St/lt Response Mode were run at a different time, by Dr Kenny Coventry and Anna Norman as part of their work whilst investigating the role of erroneous perceptions, (Coventry and Norman, 1998). Participants received a small financial incentive to take part.

Materials

The Turtle task was utilised again. This time however there were four Turtles in each race. The four Turtles that were available to choose between were Red, Green, Blue and Yellow.

The sequence lasted for 32 trials, out of which the participants won 8. The precise win sequences for each of the sequences in this Experiment are depicted in Table 2.4 below, where "W" stands for a win, and "L" for a loss, on that trial.

Table 2.4. Sequence of Outcomes for each Sequence, Experiment 2

	Sequence		
Trial	Descending	Ascending	Random
1	W	L	L
2	W	L	L
3	L	L	W
4	L	L	L
5	W	L	L
6	L	L	L
7	W	L	W
8	L	L	L
9	L	L	L
10	W	L	L
11	W	L	W
12	L	L	L
13	W	L	L
14	L	L	W
15	L	L	L
16	W	L	L
17	L	W	L
18	L	L	L
19	L	L	W
20	L	W	L
21	L	L	L
22	L	W	L
23	L	W	W
24	L	L	L
25	L	L	L
26	L	W	L
27	L	L	W
28	L	W	L
29	L	L	L
30	L	L	W
31	L	W	L
32	L	W	L

Procedure

Participants were recruited by advertisements being posted around the University campus and by asking people to take part verbally. The procedure followed the common procedure outlined in the overview.

2.7.2. Results and Discussion of Experiment 2

Participants were asked at the end of the Experiment whether they currently gambled or not. 73 participants reported that they gamble on one form or another, whereas 47 reported that they did not gamble at all, see Table 2.5 below for the number of observations in each group. There were no apparent large differences between the distribution of "gamblers" and "non-gamblers" between the participants run by Coventry and Norman (1998) and participants reported herein.

Table 2.5. Breakdown of Frequency of Gambling and Non-Gambling Participants, by Sequence and Sex

	Gambles ?					
	Male		Female		Total	
	Yes	No	Yes	No	Yes	No
Descending	12	8	10	10	22	18
Ascending	11	9	14	6	25	15
Random	13	7	13	7	26	14
Totals	36	24	37	23	73	47

An identical analysis was conducted on the data collected in this Experiment as was conducted on Experiment 1.

The analysis of the data set was broken up into four sections. Firstly an analysis of baseline values was carried out. This was followed by an analysis to evaluate whether an Illusion of Control had been induced, and to see how the short term Confidence and the Next 100 measures were affected by the two modes of responding, Step by Step or End of Sequence.

Thirdly, an analysis was conducted to see how the two measures fluctuated throughout the task following the progressive experience of each of the win sequences. This analysis is labelled the Step by Step Analysis as it investigates changes over four time periods.

The fourth stage of the analyses consisted of an investigation into the effects of the variables on the measures that were not previously involved in the frequency of measurement manipulation, namely the question battery items.

2.7.2.1. Baseline Values

Firstly baseline responses prior to any outcome information were analysed to ensure no pre-existing group differences.

A three-way [2(Response Mode) x 3(Sequence) x 2(Sex)] ANOVA was conducted on baseline responses was conducted, with the alpha level of significance set at $p<0.05$. Again, Response Mode specified which measures were elicited throughout and at the end of the trials which therefore stipulated in this analysis whether the baseline value was the short term confidence or the Next 100 measure. The Sequence variable specified which of the Descending, Ascending or Random sequences the data referred to. See Appendix 3e for the ANOVA table.

No main effect of Sequence or Sex resulted. With this data however, short term Confidence was significantly higher than Next 100 predictions at the outset, (main effect of

Response Mode, F(1, 103)=34.20, p<0.001, means 51.24 and 31.75 respectively). However, as this variable did not interact with Sequence, there was no cause for concern. Although the participants who responded to the Confidence measure (as their SbS measure) were run by Coventry and Norman (1998) whereas the participants who responded to the Next 100 measure were run by the author, the instructions given to both groups were essentially identical. The reason for why this difference arose is therefore more likely to be something to do with people's ability (or lack of) to adjust the measures in a similar fashion when exposed to a task in which the probability of success on any given trial is reduced.

This argument receives support later in Experiment 3 when the probability of success is further decreased, and the difference between participants responses to the two measures of confidence widens.

2.7.2.2. Illusion of Control: Confidence and Next 100 responses at the End of the Trials

The rationale behind the current analysis was again to see whether an Illusion of Control had been induced with the current methodology, and to see how the Confidence and the Next 100 measure were affected by the frequency of measurement variable.

The Between-participant variables used in the current analysis were: Response Mode, defined which measure was elicited throughout and which was measured just once (at the end of the sequence); Sequence, defined whether the participant experienced the Descending, Ascending or Random sequence; and Sex.

The Measure (within-participant, two level) variable stipulated whether the data referred to the Confidence or the Next 100 measure. For the first 60 participants (those under the St/lt), the SbS measure after the final trial was of Confidence whilst the EoS

measure was the Next 100 success rate predictions. For the second 60 participants (those under the Lt/st), the SbS measure was the Next 100, whereas the single EoS measure was the short term Confidence. Response Mode was counter-balanced in this way and thereby specified which measure was taken with which frequency.

The responses to the SbS measure after the final trial and the EoS measure were analysed using this four-way [2(Response Mode) x 2(Sequence) x 2(Sex) x 2(Measure)] design. See Appendix 3f for the ANOVA table.

No main effects of Response Mode, $F(1,105)=0.11$, $p=0.746$, Sequence, $F(2,105)=1.87$, $p=0.160$, or Sex, $F(1,105)=0.01$, $p=0.932$ resulted. However, a main effect of Measure, $F(1,105)=148.84$, $p<0.001$, did result. Confidence was significantly higher than Next 100 predictions, means of 53.36 and 26.34 respectively. At the end of the task, participants appeared to lower their longer term estimates of success towards that which the objective probability would predict (25%), however their Confidence responses did not follow suit.

The interaction between Response Mode and Measure was not significant, $F(1,105)=2.0424$, $p=0.156$, which demonstrates that there is no evidence to suggest that the two measures, collapsed across the three sequences, reacted any differently to each other to the frequency of measurement variable. The fact that both the main effect of Sequence, and its interaction with Response Mode and Measure were insignificant, $F(2,105)=0.4624$, $p=0.632$ informs that whether or not either measure had been elicited throughout, at the end of the sequence, there was no difference between the win sequences. The early win (Descending sequence) experience did not lead to significantly higher responses (at the end of the trials) than responses from participants in the Ascending Sequence. Thus leading to the conclusion that an Illusion of Control was not induced with respect to these measures in this Experiment. Langer and Roth's finding that the Descending Sequence participants had exaggerated perceptions of future success rates was not replicated here.

Again the Hogarth and Einhorn model would have predicted a recency effect with respect to the SbS measure. As in Experiment 1, this did not result, further supporting the necessity for the model to be adapted so that it can account for what happens when both a SbS and an EoS response mode are utilised within the same task. In line with the model however, no primacy effect occurred for the SbS measure.

A further point to note however on the exploratory nature of the research methodology with the current data set, is the marginal significance of some interactions involving the Sex variable. The three way interaction between Sequence, Sex, and Measure was of marginal significance, $F(2,105)=2.90$, $p=0.059$ (Figure 2.11), as was the interaction between Response Mode, Sequence and Sex, $F(2,105)=3.02$, $p=0.053$, (Figure 2.12). On first appearance is it tempting to suggest that as an increase in the available outcomes occurs in line with a decrease in the probability of success on any particular trial, the Sex factor seems to play a more important role. This will be returned to later in the general discussion. The Figures are produced here for later comparison with the results from Experiment 3.

Figure 2.11. Graph Illustrating the Three-way Interaction between Sequence, Sex and Measure for the Illusion of Control Analysis in Experiment 2

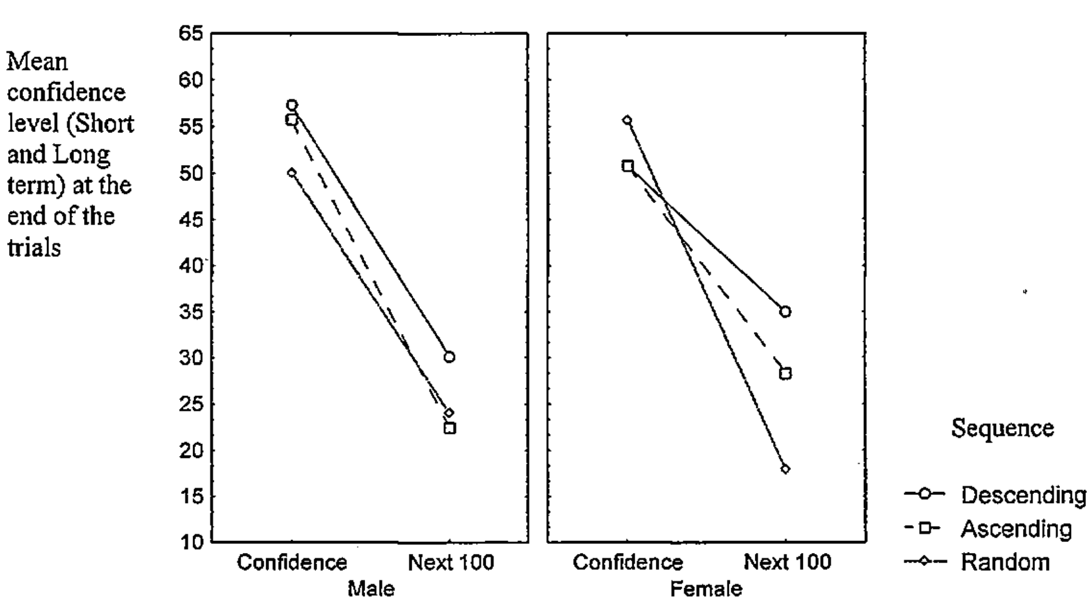
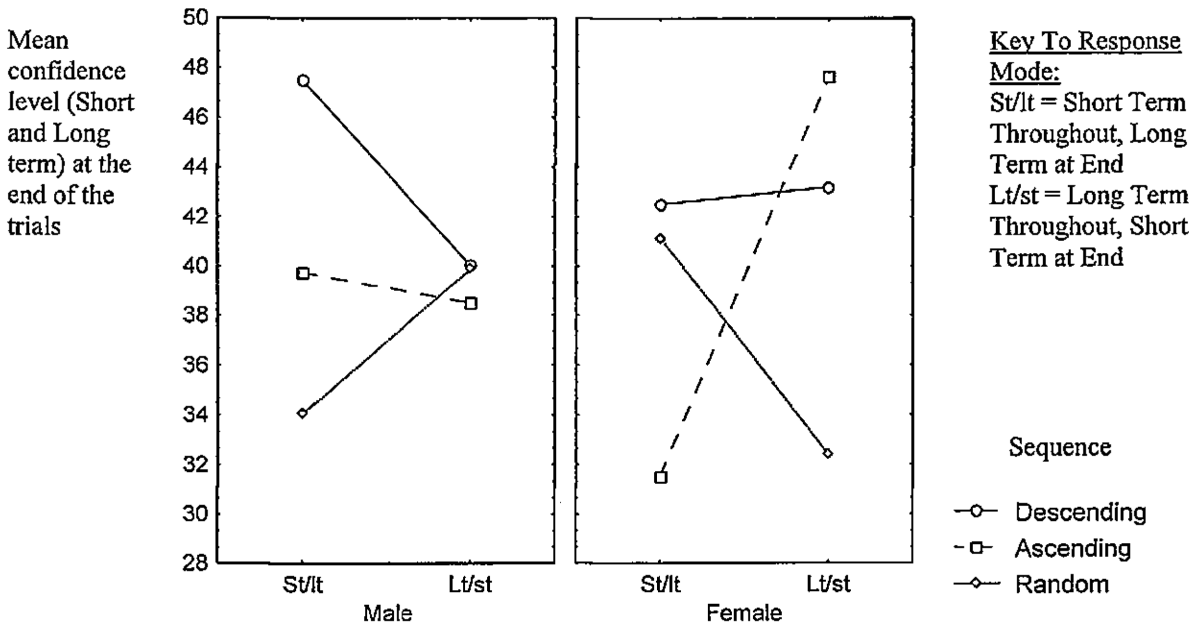


Figure 2.12. Graph Illustrating the Three-way Interaction between Response Mode, Sequence and Sex for the Illusion of Control Analysis in Experiment 2



2.7.2.3. Step by Step Analysis

In order to investigate how Participants' responses were affected by the particular win sequences throughout the trials, their responses to the 32 trials were averaged across groups of 8 trials. The trials were averaged in this fashion so that confidence during groups of trials during which participants across the sequences won at different local rates could be investigated. A four-way ANOVA [2(Response Mode) x 3(Sequence) x 2(Sex) x 4(Period) was then conducted. Period, the within-participant factor, refers to the group of 8 trials, namely the first, second, third or fourth block of eight trials. See Appendix 3g for the ANOVA table.

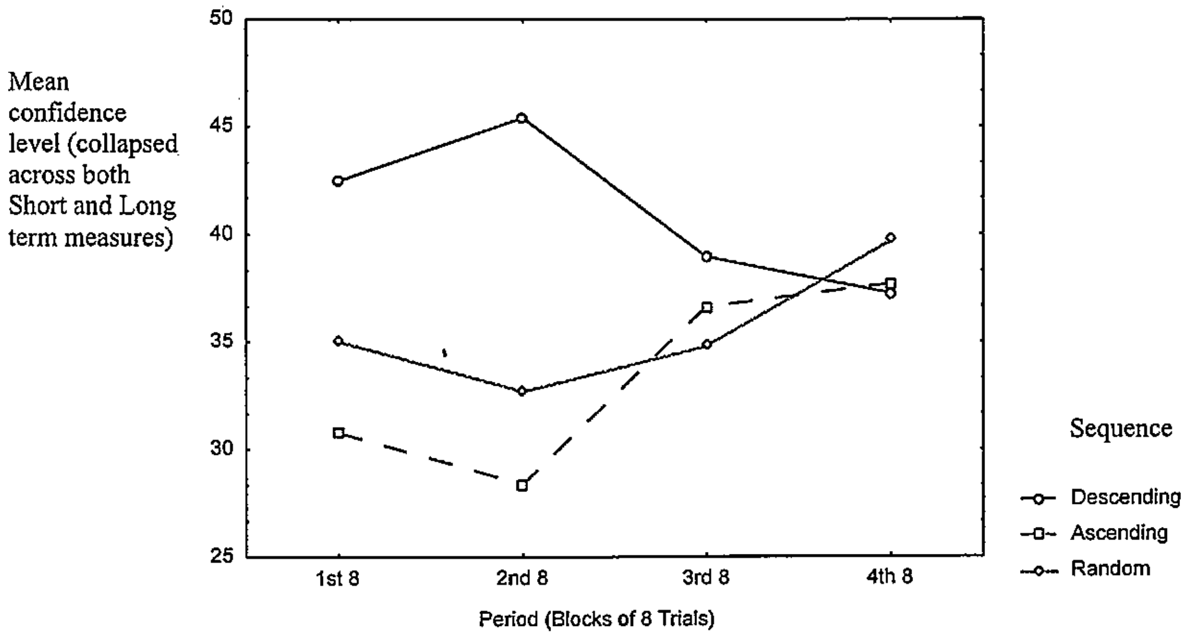
A main effect of Response Mode resulted, $F(1,85)=41.96$, $p<0.001$. The short term Confidence responses were significantly higher than participants' Next 100 predictions, with means of 46.05 and 27.31 respectively. This effect reiterates the fact that participants

appear to have adjusted their predictions for the performance over the next 100 trials, but have not been able to adjust their short term confidence to the appropriate objective level of 25%. One would expect that confidence on any particular trial in a chance determined outcome task would be directly related to the number of outcome options available. With the current paradigm one would expect therefore participants' short term Confidence to decrease to approach the objective probability of 25%. One could also argue that the ease at which people can respond to both measures might be different. This would then account for this difference by suggesting that the Confidence measure is harder to use than the Next 100. The above suggested inability to adjust responses appropriately according to changes in objective probabilities will be discussed later in the general discussion section.

There was a significant interaction between Response Mode and Period, $F(3,255)=4.39$, $p=0.005$. Again, to overcome the sphericity assumption being violated, the very conservative Greenhouse Geisser correction was used. With (1,85) degrees of freedom this interaction was still significant at the 5% level, $p=0.039$, Throughout the blocks of four trials, Next 100 estimates of success did not increase or decrease significantly, remaining essentially constant (the first block mean was 29.06, the last 26.72). However, short term Confidence did increase over the four periods such that by the fourth block, participants were significantly more confident ($p=0.004$, mean 49.84) than they were at the start (mean 43.18).

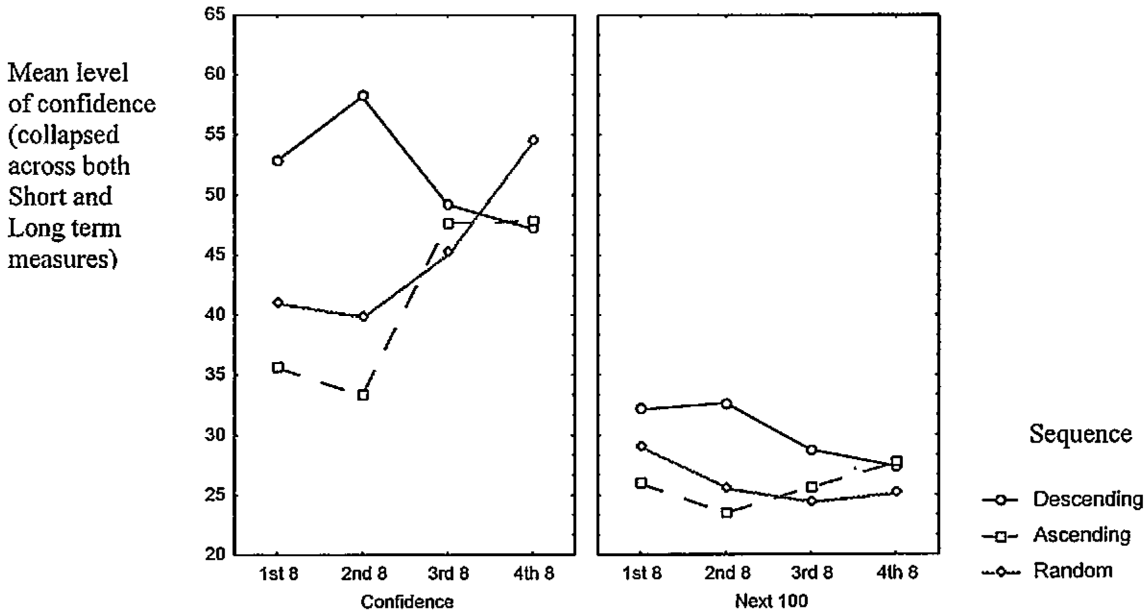
A significant interaction resulted between Sequence and Period, $F(6,255)=6.45$, $p<0.001$, see Figure 2.13; significant too with conservative (2,85) degrees of freedom, $p=0.003$. From the graph it is clear that the largest differences between the win sequences were again in the early stages of the trials. Throughout the first half of all trials the Descending sequence participants were responding significantly higher than those in either of the other two sequences. Furthermore, the responses throughout the second half of the trials were no different to each other. This was confirmed by follow up analysis using the LSD method.

Figure 2.13. Graph Illustrating the Two-way Interaction Between Sequence and Period for the Step by Step Analysis in Experiment 2



The current Period analysis was therefore similar to that which occurred in Experiment 1. Even though the probability of success had changed, specifically decreased, the two measures elicited on a SbS response mode fluctuated similarly throughout the experience of the win sequences.

Figure 2.14. Graph Illustrating the Three-way Interaction between Response Mode, Sequence and Period for the Step by Step Analysis in Experiment 2



The significant three-way interaction between Response Mode, Sequence and Period, $F(6,255)=2.56$, $p=0.019$ represented by Figure 2.14, provides some more information on how the measures fluctuated across the periods. As this also approached significance at the 5% level with Greenhouse Geisser conservative degrees of freedom (2,85) $p=0.083$, Huynh Feldt correction was used to account for the lack of sphericity in this analysis. With degrees of freedom (5,239) this interaction was still significant, $p=0.020$.

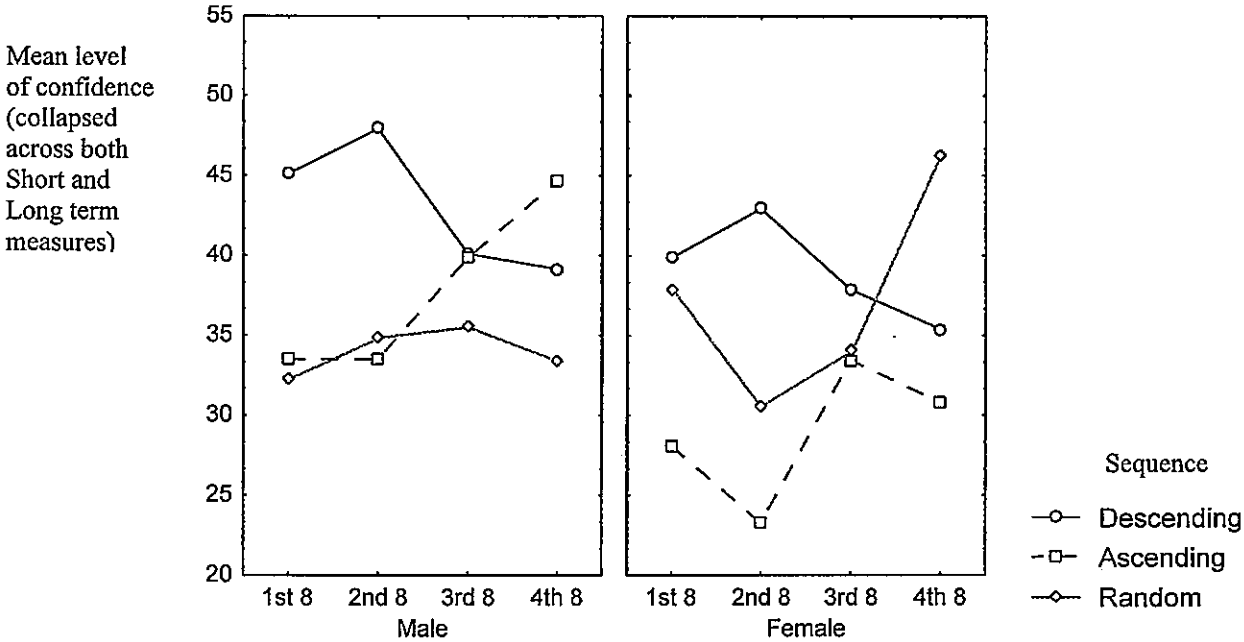
From viewing the graph it appears that the two measures responded to the Descending and to the Ascending sequences in much the same way (although the effects were more dramatic for the short-term measure). However there appears to be a difference in the way that the responses to the two measures fluctuate under the Random sequence. Using the LSD method, follow-up analysis confirmed that for the Next 100 measure there were no significant differences between the periods, whereas Confidence was significantly higher at the end of the trials than at the start, for this sequence.

Furthermore, the short term Confidence responses for the Descending sequence across the four periods were not significantly different to each other. However, this is not the case with respect to the other two sequences. For the Ascending sequence, the responses elicited in the second half of the trials were significantly higher than those in the first two blocks of eight trials. For the Random sequence, the average of the responses in the last block of eight trials were significantly higher than the first block, and demonstrate a general upward shift in confidence throughout the trials. This differential effect of the Random sequence on the two measures is of some importance.

People's longer term estimates of success may explain why people return to the gambling environment sooner; if people have elevated estimates of their success rates, then they would be irrational not to return to reap the associated rewards, even though the belief itself may be fallacious. The finding that the Next 100 predictions did not increase with experience of the task for the random sequence suggests that experience alone may not account for people returning to the gambling environment sooner. However, what is important to note is that with this 1 in 4 probability task, Confidence on the other hand did increase with experience with the task. This provides an account for why it has been observed that bet size increases with pure experience of the task (Ladouceur et al, 1987; Blascovitch et al 1973), and this particular task differentiates between the two measures. This difference did not occur in the 1 in 2 probability (Turtle 2) task.

Another three-way interaction also resulted between Sequence, Sex and Period, $F(6,255)=2.66$, $p=0.016$, which is represented in Figure 2.15. Huynh Feldt correction for lack of sphericity using conservative (5,239) degrees of freedom still resulted in significance, $p=0.020$. From the figure it appears that under the Descending and Ascending sequences males and females respond to the wins and losses (collapsed across both measures) in a similar fashion.

Figure 2.15. Graph Illustrating the Three-way Interaction between Sequence, Sex and Period for the Illusion of Control Analysis in Experiment 2



The cause of this interaction appeared to be two fold. Firstly, at the start of the sequence, males in the Descending sequence were more confident across both measures, than their counterparts in the Ascending sequence. By the end of the trials, this was no longer the case; Ascending male participants were more confident than Descending male participants. This cross over effect did not occur for the female participants; Descending participants were more confident throughout all four periods than their Ascending sequence counterparts. This suggests that males are more volatile in their confidence; more directly influenced by their success or failure on the most recent trials than female participants. When the wins and losses were spread out evenly throughout the sequence as they were in the Random sequence, male participants stayed relatively constant in their confidence throughout. Female participants decreased their responses in the early stages and then continued to rise throughout the remainder of the sequence. This offers the second explanation for why this interaction reached significance. This suggests that it is the females that rise in confidence due to exposure to the task, rather than to the experience of wins and losses themselves. Whereas males react more directly to the recent outcomes.

2.7.2.4. Battery Items Analysis

Analysis was conducted on the question battery items relating to the perception of success in the longer-term under various imagined conditions, followed by an analysis on the memory questions. See Appendix 3h for all the ANOVA tables for this analysis.

Longer Term Items

Firstly an ANOVA was run on the longer-term items. A four-way ANOVA [2(Response Mode) x 3(Sequence) x 2(Sex) x 3(Measure)] was carried out, comparing the three levels of the within-participant repeated measure variable; participants' own predicted success rates, their success rates if distracted, and their perceptions of how many trials another person would win.

A main effect of Response Mode resulted, $F(1,108)=14.61$, $p<0.001$. Collapsed across the three measures, when Confidence had been elicited throughout the task responses were significantly lower (mean of 24.02) than when Next 100 estimates have been elicited throughout (mean of 31.44).

Sequence also had a significant effect on responses, $F(2,108)=11.21$, $p<0.001$. LSD follow-up revealed that the Descending sequence scores were significantly higher than both the Ascending and the Random sequences; means of 33.93, 26.33, and 22.93 respectively, whilst the difference between the two latter sequences was not significant.

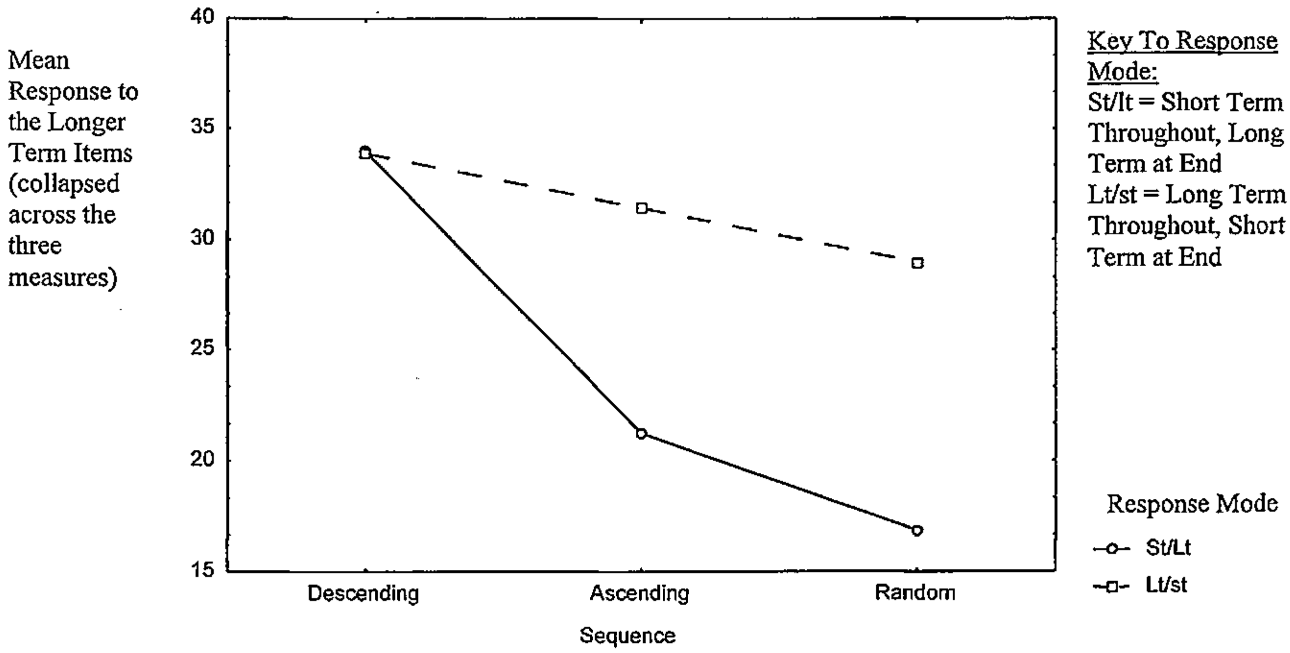
A significant main effect of Measure also resulted, $F(2,216)=39.46$, $p<0.001$. Collapsed across the win sequences, participants thought that they would perform significantly worse if they were distracted (mean of 20.68) than if able to concentrate (26.41), but thought that someone else would perform significantly better to themselves

(36.11). This latter finding is in contrast to that observed with Experiment 1, in which the fact of being directly involved with the task increased people's success rate predictions. This difference may have arisen due to the probability of success change or more specifically due to the fact that, due to this change, the decrease in the absolute number of wins. This will be returned to later in the general discussion section.

Significant interactions between Response Mode and Sequence, $F(2,108)=3.82$, $p=0.025$, and between Response Mode and Measure, $F(2,216)=21.89$, $p<0.001$ resulted. LSD follow up analysis on the former revealed that when long term estimates of success (Next 100) have been elicited throughout, there were no differences between the three win sequences (when the measures are collapsed). However, when the short term confidence measure was the one that was elicited throughout, the Descending sequence (mean 33.96) induced significantly higher responses than the Ascending (mean 21.23), which in turn was higher (although not significantly) than the Random sequence (mean 16.87). For the Ascending and Random sequences, the responses for when the long term measure was taken throughout (means of 31.43 and 29.00) were significantly higher than those for when the short term confidence was elicited throughout (means of 21.23 and 16.87 respectively). See Figure 2.16.

Follow up analysis on the interaction between Response Mode and Measure revealed that the only significant difference lay between participants perceptions of how someone else would perform, dependent upon which measure had been elicited throughout the trials. Participants who had experience with the long term measure throughout the trials responded significantly higher on this measure (mean 46.30) than those who had responded with the short term measure throughout, (mean 25.92).

Figure 2.16. Graph Illustrating the Two-way interaction between Response Mode and Sequence for the "Longer Term Items" Analysis in Experiment 2



The above interactions provide evidence for the notion that even though the "distraction" and "someone else" measure were not involved in the frequency of measurement manipulation, there was some influence of the SbS measure on these otherwise EoS measures.

Percentage of Trials

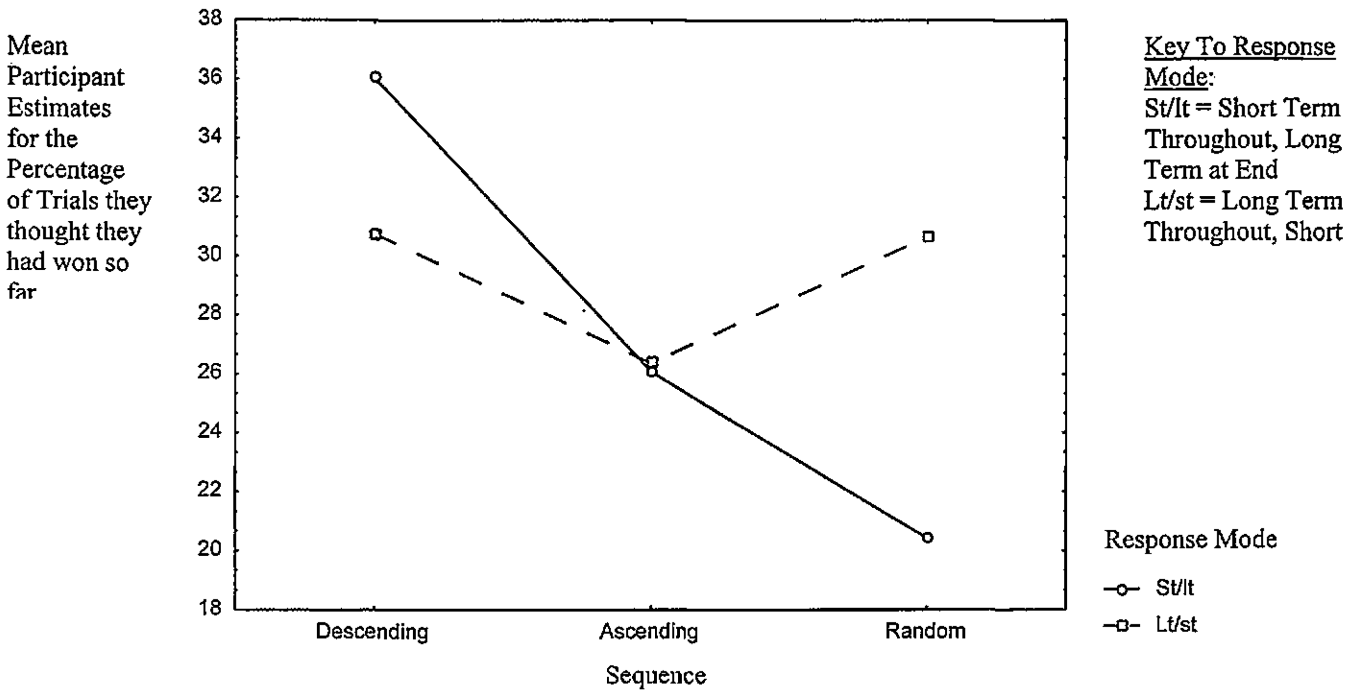
Secondly a three-way ANOVA [2(Response Mode) x 3(Sequence) x 2(Sex)] was conducted on people's estimates of the percentage of trials that they thought they had won. This percentage was calculated by dividing the number of trials they thought they had won (Question 1) by the number of trials that they thought there had been (Question 2), expressed as a percentage.

A main effect of Sex resulted, $F(1,108)=5.19$, $p=0.025$. Observing the means revealed the fact that Males believed they had won a significantly higher percentage of trials than Females (means 30.40% and 26.38% respectively).

A main effect of Sequence also resulted, $F(2,108)=8.12$, $p<0.001$. LSD Follow up analysis revealed that Descending sequence responses (mean of 33.41) were significantly higher than both the Ascending (mean of 26.22) and Random (mean of 25.54) sequences.

A significant interaction between Response Mode and Sequence resulted, $F(2,108)=6.59$, $p=0.002$. Follow up analysis revealed that when long term estimates of success were elicited throughout, there was no effect of Sequence on participants beliefs about previous success rates. However, when confidence was elicited throughout, there was an effect of win Sequence, such that Descending sequence responses were significantly higher than Ascending sequence responses which were in turn significantly higher than those from the Random sequence, (means of 36.06%, 26.09%, and 20.43% respectively, see Figure 2.17.) This strongly supports the notion that there was an effect of previous measure as the responses to this memory item were different as a function of the previous SbS measure. When the Next 100 estimates had been elicited throughout, the win sequence had no effect, however, when it had not been elicited throughout, and was treated purely as an EoS measure, the differences between the sequences became apparent.

Figure 2.17. Graph Illustrating the Two-way Interaction between Response Mode and Sequence for the "Percentage of Trials" Analysis in Experiment 2



How Good ?

Thirdly, a three-way ANOVA [2(Response Mode) x 3(Sequence) x 2(Sex)] was conducted on perceptions of How Good participants thought they were.

A significant main effect of Sequence resulted such that the Descending sequence resulted in significantly higher responses than both the Ascending and Random sequences, means 40.00, 30.93 and 28.98 respectively; $F(2,108)=3.64$, $p=0.030$. For this measure therefore the win sequence under which a participant experienced the task did make a difference. This fits with Hogarth and Einhorn's model (1992) as this measure was an EoS measure. People who experienced early wins believed they were significantly better at the task than those who won later in the task.

2.8. Experiment 3

2.8.1. Method

Participants

Participants were recruited by asking Undergraduate students on University Campus to take part verbally. Another 60 male and 60 female were recruited one by one, and equally distributed to the three sequences, such that there were 20 males and 20 females in each sequence. 10 males and 10 females in each sequence would therefore respond on a St/lt or Lt/st basis. Participants received a small financial incentive to take part.

Materials

The Turtle task was utilised again. This time however there were eight Turtles in each race. The eight Turtles that were available to choose between were Red, Green, Blue, Yellow, Purple, White, Brown, Turquoise.

The sequence lasted for 32 trials, out of which the participants won 4. The precise win sequences for each of the sequences in this Experiment are depicted in Table 2.6 below, where "W" stands for a win, and "L" for a loss, on that trial.

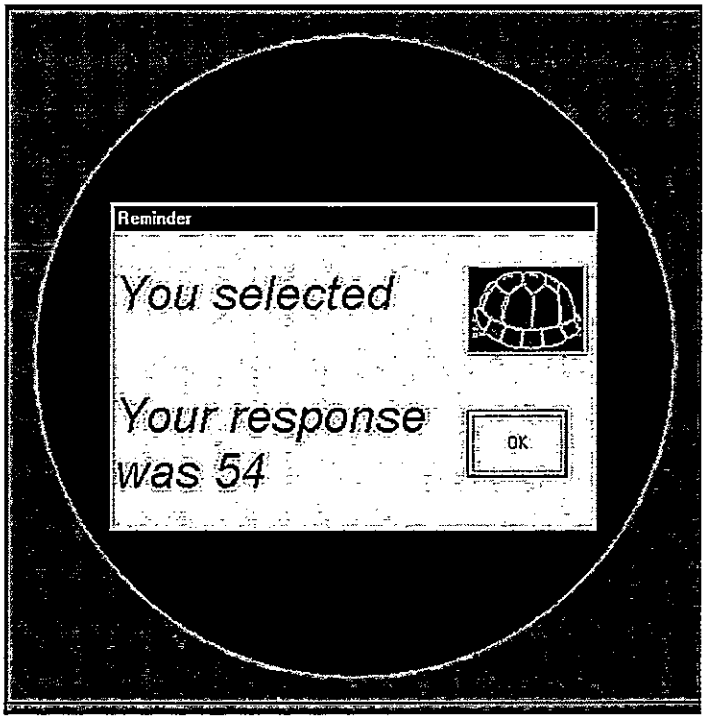
Table 2.6. Sequence of Outcomes for each Sequence, Experiment 3

	Sequence			
Trial	Descending	Ascending	Random	Extra Play
1	W	L	L	L
2	L	L	L	L
3	W	L	L	L
4	L	L	W	W
5	L	L	L	L
6	W	L	L	L
7	L	L	L	L
8	L	L	L	L
9	L	L	L	L
10	W	L	L	L
11	L	L	W	L
12	L	L	L	W
13	L	L	L	L
14	L	L	L	L
15	L	L	L	L
16	L	L	L	L
17	L	L	L	L
18	L	L	L	L
19	L	L	L	L
20	L	L	L	W
21	L	L	W	L
22	L	L	L	L
23	L	W	L	L
24	L	L	L	L
25	L	L	L	L
26	L	L	L	L
27	L	W	L	L
28	L	L	L	W
29	L	L	W	L
30	L	W	L	L
31	L	L	L	L
32	L	W	L	L

Procedure

The procedure followed the common procedure outlined in the overview. This Experiment also incorporated another measure at the end of all the trials and question battery items. This involved an "Extended Play" or "Willingness to Continue" measure, as utilised by Ladouceur (personal correspondence). Following the final question of the battery, the participant was reminded of their last prediction and the response that they gave, which they were asked just prior to the battery of questions. This appeared on the screen and they were prompted to click on the "Ok" button to acknowledge that they had been reminded. See Figure 2.18 for a snap-shot. The Experimenter then told the participant that that was the end of the Experiment, and that the Experimenter had to leave the room for a minute or two to get the small financial incentive that the participant was due for taking part.

Figure 2.18. A snap shot of the reminder of the participant's last prediction and response



Whilst the Experimenter was away, participants were told that they could either continue, read the paper (the current daily paper was made available) or sit and wait until the Experimenter's return. The Experimenter then left the room and returned exactly four minutes later. If the participant clicked on "Ok" to continue with the trials, the sequence of outcomes followed a pattern similar to that experienced by those in the Random Sequence. The precise sequence is depicted in the "Extra Play" column of Table 2.6 above. The participant either continued "playing" until they wished to stop, or until the Experimenter came back in the room, whichever was the sooner. The number of trials that the participant took part in during this Extra Play session was recorded.

2.8.2. Results and Discussion of Experiment 3

Participants were asked at the end of the Experiment whether they currently gambled or not. 68 participants reported that they gamble on one form or another, whereas 52 reported that they did not gamble at all. These were approximately evenly distributed across the three Sequences, see Table 2.7 below for the number of observations in each group.

Table 2.7. Breakdown of Frequency of Gambling and Non-Gambling Participants, by Sequence and Sex

	Gambles ?					
	Male		Female		Total	
	Yes	No	Yes	No	Yes	No
Descending	11	9	10	10	21	19
Ascending	13	7	11	9	24	16
Random	12	8	11	9	23	17
Totals	36	24	32	28	68	52

The analysis of the data set was broken up into five sections. Firstly an analysis of Baseline values followed by an analysis to evaluate whether an Illusion of Control had been induced, and to see how the short term confidence and the Next 100 measures were affected by the two modes of responding, Step by Step or End of Sequence.

Thirdly, an analysis was conducted to see how the two measures fluctuated throughout the task following the progressive experience of each of the win sequences. This analysis is labelled the Step by Step Analysis as it investigates changes over four time periods.

The fourth stage of the analyses consists of an investigation into the effects of the variables on the measures that were not previously involved in the frequency of measurement manipulation, namely the question battery items.

The final stage of the analysis investigates the amount of continued play by participants, to evaluate whether any of the independent variables have the effect of increasing participants willingness to continue with the prediction task.

2.8.2.1. Baseline Values

Participants' responses prior to any trial having taken place, and hence no outcome information being available at the point of measurement, were analysed to ensure that there were no pre-existing differences in the baseline confidence and Next 100 responses between Sequences or between males and females. A three-way [2(Response Mode) x 3(Sequence) x 2(Sex)] analysis of variance (ANOVA) was conducted on baseline responses, with the alpha level of significance set at $p<0.05$. Response Mode specified which measures were elicited throughout and at the end of the trials which therefore stipulated in this analysis whether the baseline value was the short term Confidence or the Next 100 measure. The Sequence variable specified which of the Descending, Ascending or Random sequences the data referred to. See Appendix 3i for the ANOVA table.

A main effect of both Response Mode ($F(1,108)=29.09$, $p<0.001$) and Sex $F(1,108)=5.48$, $p=0.021$, resulted. Confidence was significantly higher than Next 100 predictions (means 47.37 and 26.93 respectively). Males were significantly less confident (collapsed across both measures) than Females, (means 32.72 and 41.58).

Before the experience of any wins or losses the main effect of Response Mode represents again the fact that the participants were not able to adjust their ratings of confidence to an appropriate degree. The win rate for the current Experiment as there were 8 Turtles in each race, was 12.5%. Both the predictions for the Next 100 and Confidence in

the first trial were inappropriately higher for a chance determined task such as the one utilised.

The lack of a Sequence effect again suggests that any differences that are observed in the following analyses can not be attributed to starting values, and one can therefore attribute them to the experience of the task itself.

2.8.2.2. Illusion of Control: Confidence and Next 100 responses at the End of the Trials

The rationale behind the current analysis was again to see whether an Illusion of Control had been induced with the current methodology, and to see how the Confidence and the Next 100 measure were affected by the frequency of measurement variable.

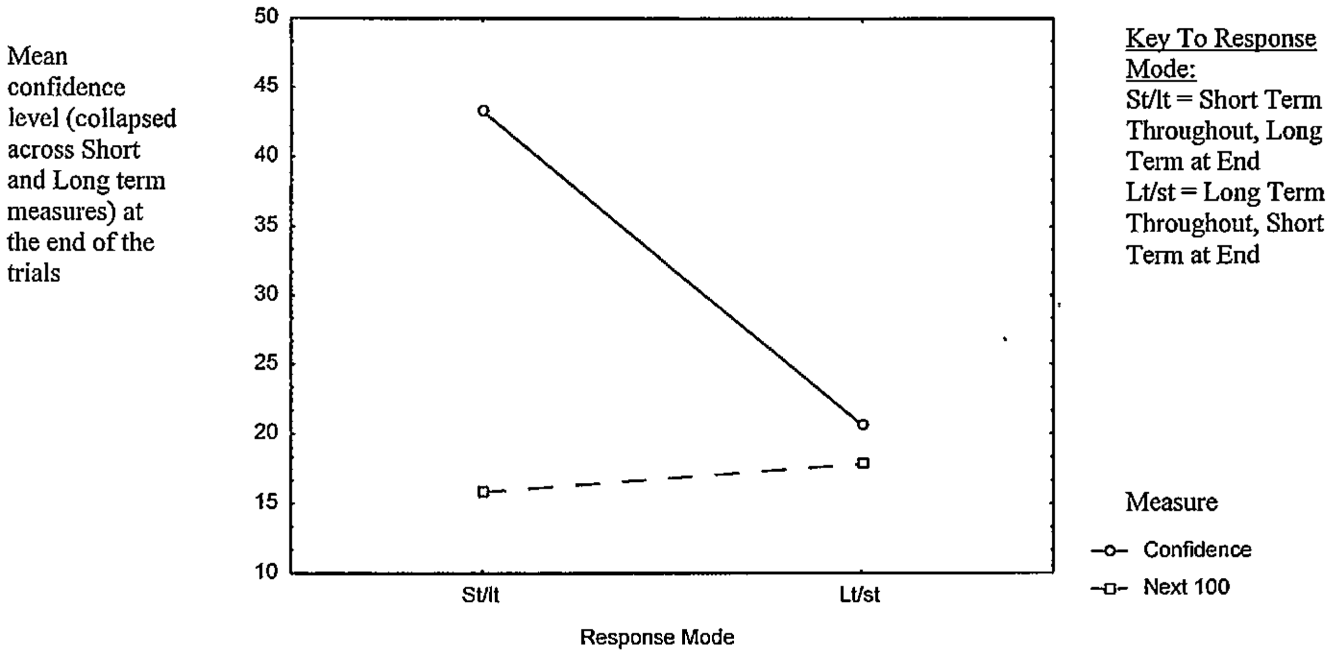
The Between-participant variables used in the current analysis were: Response Mode, defined which measure was elicited throughout and which was measured just once (at the end of the sequence); Sequence, defined whether the participant experienced the Descending, Ascending or Random sequence; and Sex. The Measure (within-participant, two level) variable stipulated whether the data referred to the Confidence or the Next 100 measure. For the first 60 participants (those under the St/lt), the SbS measure after the final trial was of Confidence whilst the EoS measure was the Next 100 success rate predictions. For the second 60 participants (those under the Lt/st), the SbS measure was the Next 100, whereas the single EoS measure was the short term Confidence. Response Mode was counter-balanced in this way and thereby specified which measure was taken with which frequency.

The responses to the SbS measure after the final trial and the EoS measure were analysed using this four-way [2(Response Mode) x 2(Sequence) x 2(Sex) x 2(Measure)] design, with the alpha level of significance set to $p<0.05$. See Appendix 3j for the ANOVA table.

A significant main effect of Response Mode resulted, $F(1,108)=10.74$, $p=0.001$ as well as a significant main effect of Measure, $F(1,108)=40.62$, $p<0.001$. Confidence in the next trial (mean 31.96) was significantly higher than Next 100 predictions (mean 16.83) at the end of the sequences. The interaction between these variables was also significant (Response Mode and Measure, $F(1,108)=27.04$, $p<0.001$) which is represented in Figure 2.19, demonstrating a difference in the way the two measures are affected by the frequency of measurement manipulation. Follow up analysis using the LSD method revealed that when the Next 100 measure had been elicited throughout the trials, there was no difference between the measures by the end of the trials, (mean Confidence of 20.63, and Next 100 of 17.85). However, when the short term Confidence had been elicited throughout, there was a large and significant difference between the two measures, (Confidence mean 43.28, Next 100 mean 15.82). When short term Confidence was the SbS measure, at the end of the trials it was significantly higher than when it had not been elicited throughout, means 43.28 and 20.63 respectively. This differential effect of Response Mode was not observed in Experiment 1 or Experiment 2. There was no significant interaction between Response Mode, Sequence and Measure, so there was no evidence to suggest that the responses reacted differently towards each of the particular win sequences, or the frequency of measurement manipulation.

The lack of this interaction suggests that again, there was no Illusion of Control induced with respect to these measures, again failing to replicate the findings of Langer and Roth (1975). Participants in the Descending sequence were no more confident, or predicted indifferent Next 100 success rates, than participants in the other sequences.

Figure 2.19. Graph Illustrating the Two-way Interaction between Response Mode and Measure for the Illusion of Control Analysis in Experiment 3



There was also a significant three-way interaction between Response Mode, Sequence and Sex, $F(2,108)=3.15$, $p=0.047$, see Figure 2.20, and between Sequence, Sex and Measure, $F(2,108)=3.25$, $p=0.043$.

The interaction between Sequence, Sex and Measure (represented in Figure 2.21) shows that irrespective of whether a particular measure was elicited throughout the trials, for males, the Sequence did not have a significant effect on either measure. Males however responded with significantly higher Confidence ratings than they did for the Next 100 predictions in all sequences. However for females this was not the case. For females, their Next 100 predictions differed significantly between the Descending and Random sequence (in the predicted direction), but not between the Ascending and the Random. For their Confidence, Ascending sequence responses were significantly higher than those in the Random confidence, but the difference between the Descending and the Random (and Descending and Ascending) was not significant in the follow up analysis. Female Ascending and Random Confidence was also significantly higher than the respective Next 100 responses. Males responded in the same way as Females in this respect.

Figure 2.20. Graph Illustrating the Three-way Interaction between Response Mode, Sequence and Sex for the Illusion of Control Analysis in Experiment 3

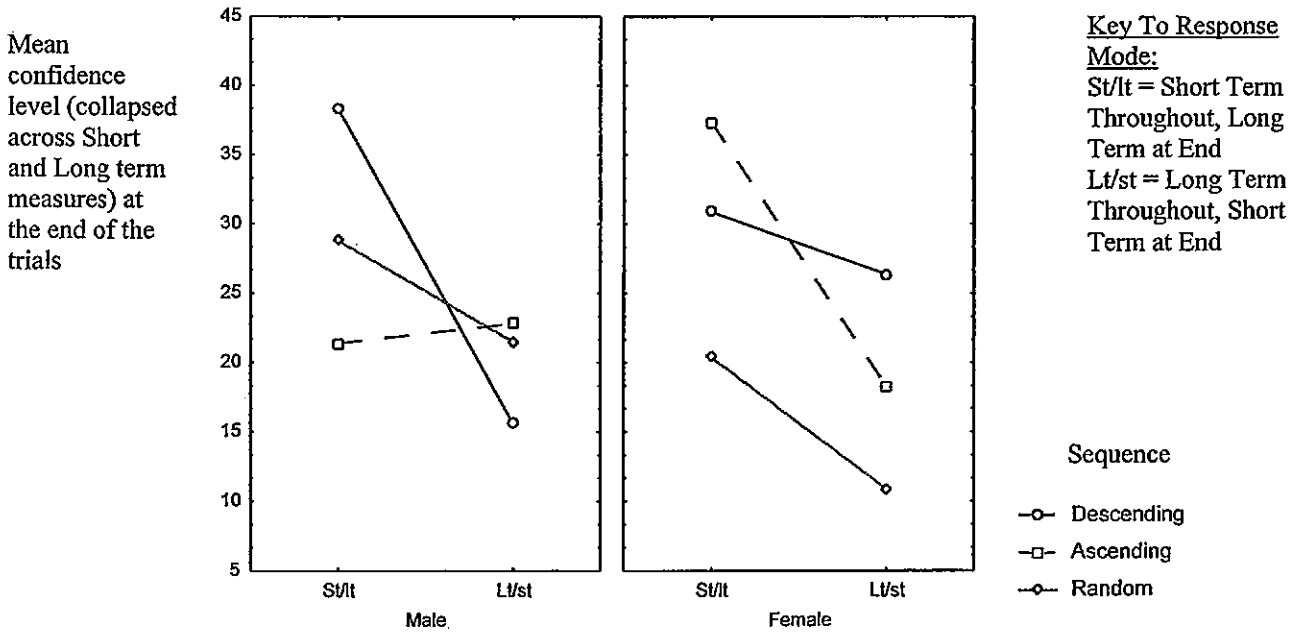
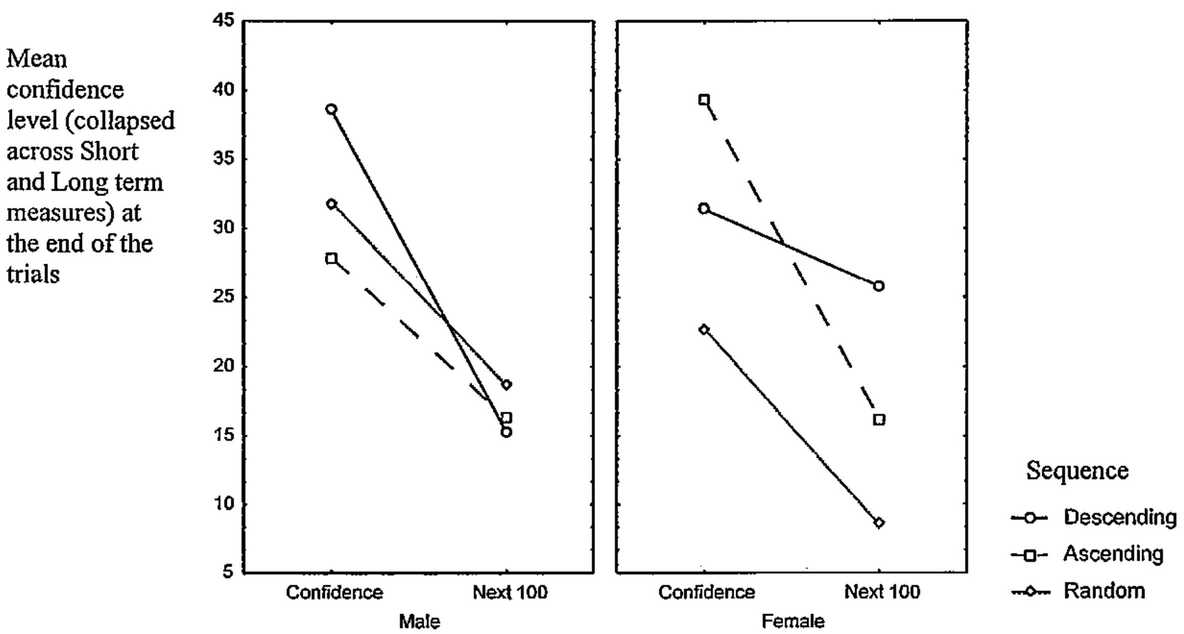


Figure 2.21. Means for the Three-way Interaction between Sequence, Sex and Measure for the Illusion of Control Analysis in Experiment 3



2.8.2.3. Step by Step Analysis

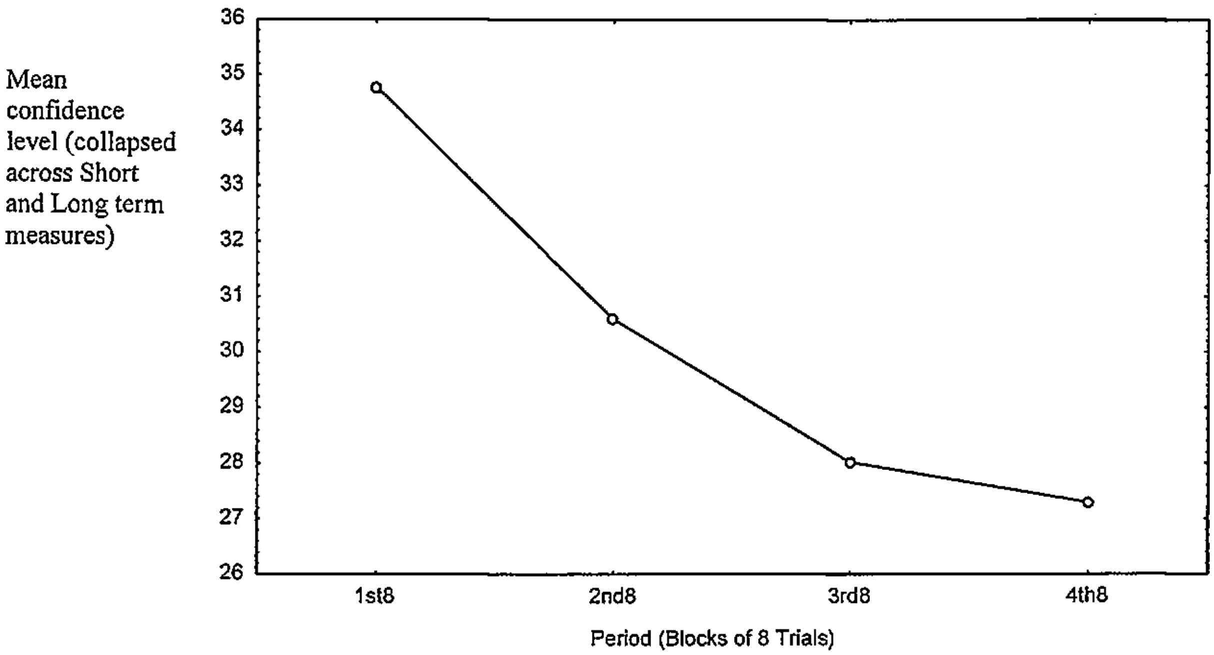
An identical procedure was undertaken as was done previously for Experiments 1 and 2. A four-way ANOVA [2(Response Mode) x 3(Sequence) x 2(Sex) x 4(Period) was conducted. Period, the within-participant factor, refers to which group of 8 trials, namely the first, second, third or fourth block of eight trials. The alpha level of significance was set at $p<0.05$. See Appendix 3k for the ANOVA table.

Across the four blocks of eight trials, again Confidence was significantly higher than Next 100 predictions (main effect of Response Mode $F(1,108)=43.98$, $p<0.001$, means 40.89 and 19.46 respectively). A main effect of Period also resulted, $F(3,324)=14.25$, $p<0.001$. See Figure 2.22. Due to lack of sphericity, Greenhouse Geisser correction with conservative degrees of freedom (1,108) was investigated, and was still significant, $p<0.001$.

The LSD follow up analysis revealed that, collapsed across all other variables, short and longer term confidence measures were the highest over the first period, but then fell significantly over each subsequent period except between the third and fourth periods when it fell but not significantly (means of 34.77, 30.60, 28.03 and 27.30 respectively).

One would have expected this to be the case, simply due to the very small number of wins that this particular paradigm involves, namely 4 out of the 32 trials. Due to this, all sequences have long runs of losses, broken up only by four win trials.

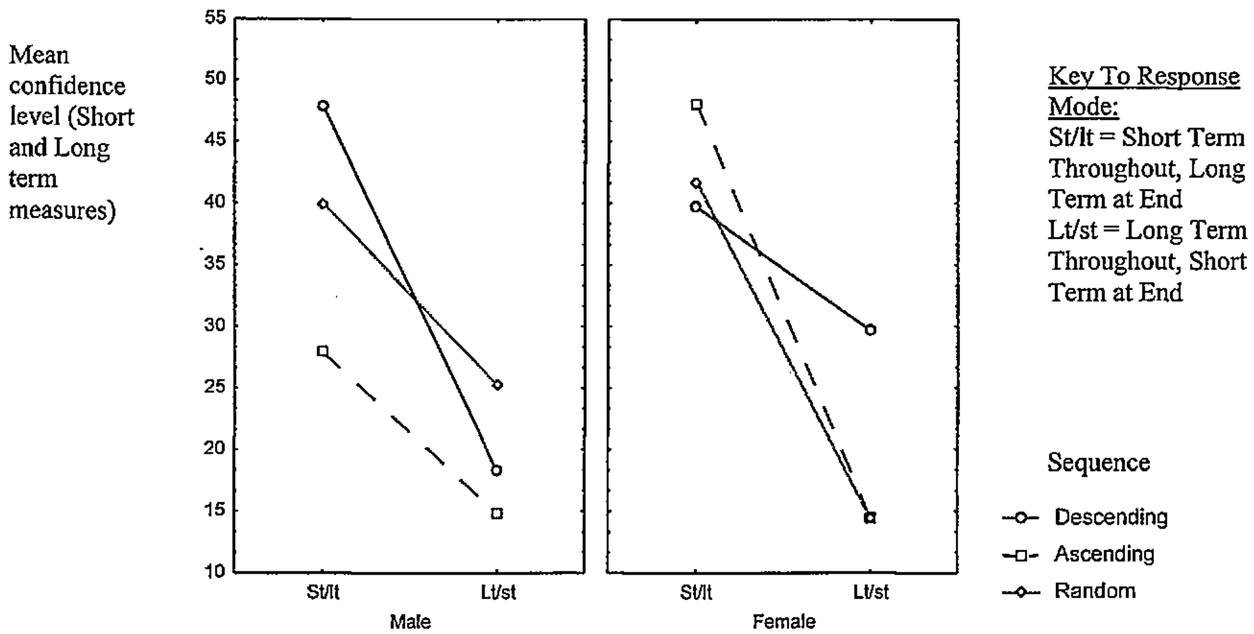
Figure 2.22. Graph Illustrating the Main effect of Period for the Step by Step Analysis in Experiment 3



A significant three-way interaction resulted between Response Mode, Sequence and Sex, $F(2,108)=3.59$, $p=0.031$ which is represented in Figure 2.23.

LSD method follow up analysis revealed that for the males in the Descending sequence there was a significant difference between the two measures (Confidence mean of 47.90 was higher than Next 100 mean of 18.22) but, although in the same direction, this difference did not approach significance for the female participants, (means of 39.77 and 29.67 respectively). This finding was reversed with respect to the Ascending sequence, where it was the females who responded with significantly higher Confidence ratings (48.15) than Next 100 predictions (14.48). For the Random sequence, both males and females responded with significantly higher Confidence ratings than they did with Next 100 predictions.

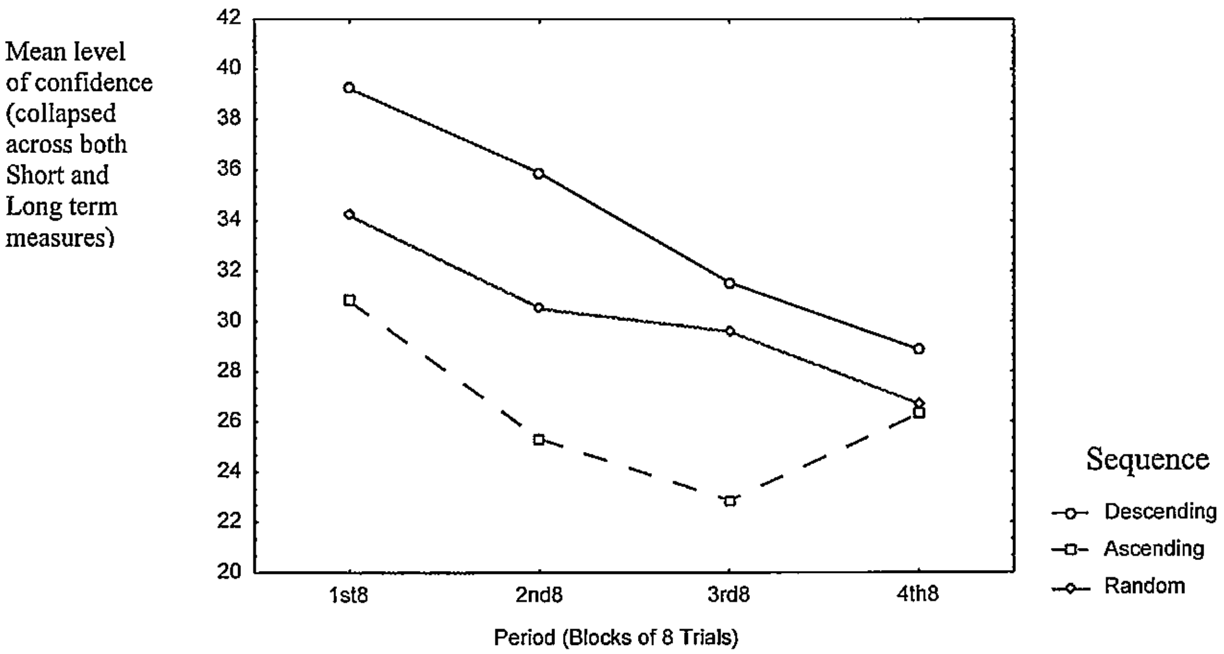
Figure 2.23. Graph Illustrating the Three-way Interaction between Response Mode, Sequence and Sex for the Step by Step Analysis in Experiment 3



The two way interaction between Sequence and Period did not reach significance, but a look at the graph does suggest that the measures are reacting to the sequences in a not too dissimilar fashion to those taking part in the two previous Experiments (see Figure 2.24). The Descending sequence participants decrease their responses throughout the task, whilst participants in the Ascending sequence decrease in the early stages, but increase throughout the last period. One interesting difference with this task however, is that participants in the Random sequence do not follow the trend highlighted in the previous two experiments. Whereas before, Random sequence participants generally increased their responses with increasing experience with the task, participants here decreased their responses consistently. This suggests that pure experience on the task can not increase confidence and other responses alone, that there have to be a certain number of wins occurring. This may fit into the value of erroneous perceptions and the building of strategies as an explanation of continued play. There are likely to be a limited number of failures of the strategies before people would discount them, and run out of new ones.

However, if they are confirmed more often this might account for increased confidence during the other tasks.

Figure 2.24. Graph Illustrating the Insignificant Two-way Interaction Between Sequence and Period for the Step by Step Analysis in Experiment 3



Due to the fact that Participants only predicted the winner of the race on four out of the 32 occasions, their win rate was particularly poor. Participants were therefore exposed to long and regular sequences of losses, only occasionally being broken up by a win. Additionally this win was never followed by another win, so participants never experienced a sequence of wins. This could explain why the above interaction did not reach significance, as one would expect much less fluctuation in both measures throughout the trials, as the general outcome is a loss.

In relation to the Hogarth and Einhorn model although this interaction was not significant, the figure does indicate that participants were influenced by the most recent outcomes when responding on the SbS measures. However, again the lack of a true recency effect at the end of the trials, was not observed, hence the results from this Experiment do not fit their model completely. This issue will be addressed later.

2.8.2.4. Battery Items Analysis

Analysis was conducted on the question battery items relating to the perception of success in the longer-term under various imagined conditions, followed by an analysis on the memory questions. See Appendix 31 for the ANOVA tables for this analysis.

Longer Term Items

Firstly an ANOVA was run on the longer-term items. A four-way ANOVA [2(Response Mode) x 3(Sequence) x 2(Sex) x 3(Measure)] was carried out, comparing the three levels of the within-participant repeated measure variable; participants' own predicted success rates, their success rates if distracted; and their perceptions of how many trials another person would win.

A main effect of Measure was observed, $F(2,216)=9.10$, $p<0.001$. The LSD follow up method confirmed that whereas participants' predictions as to their own success (mean 16.83) did not differ from their predictions when someone else was performing the task (mean 14.48), their predictions when distracted were significantly lower than both these other two measures, (mean 11.27).

The results for when distracted were similar therefore to both Experiments 1 and 2. However, the three experiments differ in relation to participants' beliefs as to someone else's performance at the task. With the two turtle task, participants thought that they would do significantly better, with the four turtle task they thought they would perform significantly worse, and with the eight turtle task there was no significant difference.

A main effect of Sequence, $F(2,108)=4.25$, $p=0.017$, resulted; means of Descending: 17.58, Ascending: 13.98 and Random: 11.03. Follow up analysis revealed that the significant difference lay between the responses of participants in the Descending and Random sequences.

There was also a significant interaction between Sequence and Sex, $F(2,108)=6.68$, $p=0.002$. Female participants responded significantly higher (collapsed across the three measures) when under the Descending sequence than their female counterparts in the other two conditions, and than male participants in all sequences. See Table 2.8 for the means of these comparison groups. Males on the other hand did not differ across the three sequences in their average responses.

Table 2.8. Means for the interaction between Sequence and Sex.

	Male	Female
Descending	12.80	22.37
Ascending	12.57	15.38
Random	14.43	7.62

Percentage of Trials

Secondly a three-way ANOVA [2(Response Mode) x 3(Sequence) x 2(Sex)] was conducted on people's estimates of the percentage of trials that they thought they had won. This percentage was calculated by dividing the number of trials they thought they had won (Question 1) by the number of trials that they thought there had been (Question 2), expressed as a percentage.

A main effect of Sequence resulted, $F(2,100)=7.453$, $p<0.001$. Descending sequence participants responded significantly higher than those in both the Ascending and Random sequences, means of 27.30%, 13.11% and 15.47% respectively. Early winning therefore led participants to believe they had won a significantly higher percentage of the trials. From the following interaction it can be seen that the cause of this appears to be due to the female participants.

A significant interaction resulted between Sequence and Sex, F(2,108)=4.03, p=0.020. Follow up analysis revealed that although male and female perceptions did not differ between the Ascending and Random sequences, their responses did differ having experienced the Descending sequence. Female participants thought they had won a significantly higher percentage of trials than their male counterparts, means 36.10% and 18.49% respectively.

How Good ?

Thirdly, a three-way ANOVA [2(Response Mode) x 3(Sequence) x 2(Sex)] was conducted on perceptions of How Good participants thought they were was then carried out.

Figure 2.25. Graph Illustrating the Two-way Interaction between Response Mode and Sequence for the "How Good" Analysis in Experiment 3

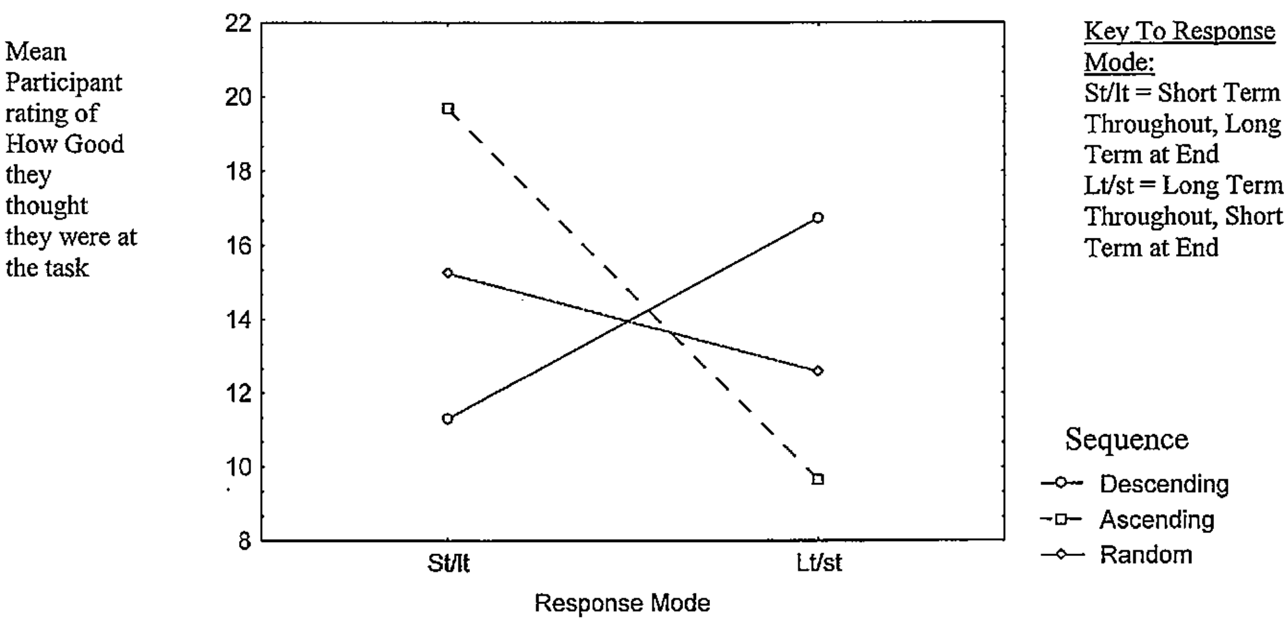
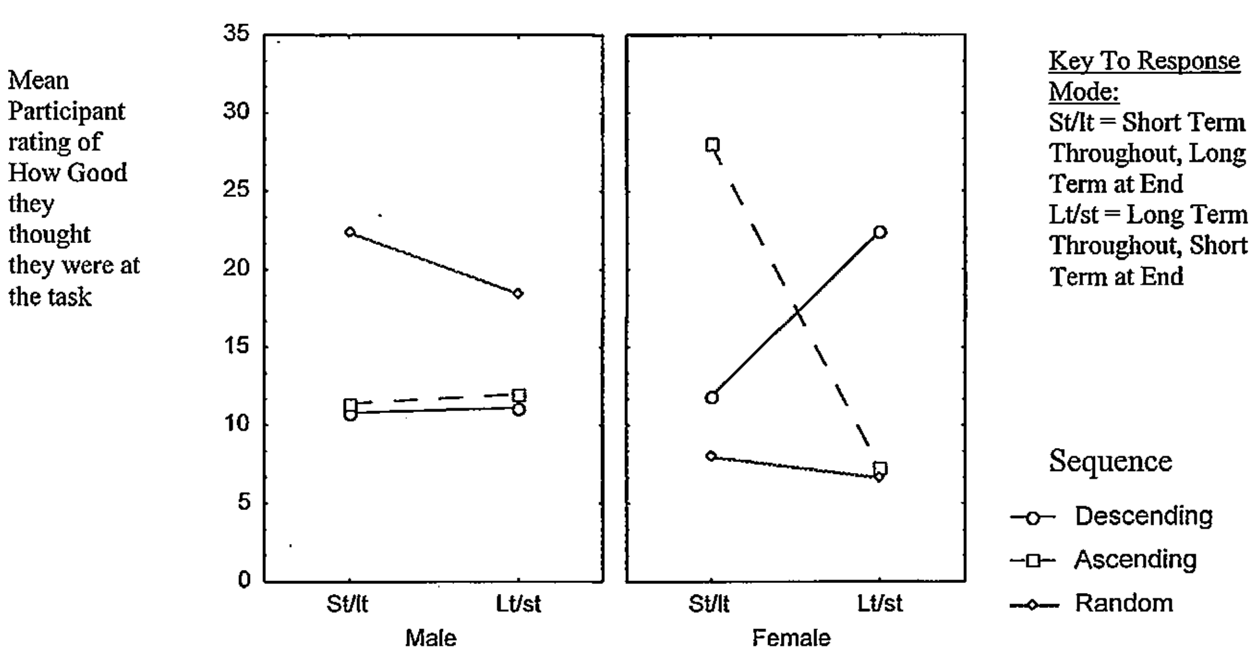


Figure 2.25 above represents the two way interaction between Response Mode and Sequence that resulted, F(2,108)=3.65, p=0.029. LSD follow up analysis confirmed that

the only significant difference that resulted was between the way that the How Good measure reacted to the Descending (mean 11.30) and the Ascending (mean 19.70) sequence when short term Confidence had been elicited throughout and Next 100 responses at the end of the sequence only. The finding that there was no significant difference between responses when the Next 100 measure was elicited throughout seems to suggest that the How Good measure is reliant to some extent upon longer term estimates of success.

The interaction between Sequence and Sex was also significant, $F(2,108)=7.38$, $p<0.001$. However, the interaction between Response Mode, Sequence and Sex, was also significant, $F(2,108)=4.11$, $p=0.019$, and is represented by Figure 2.26 below. This shows that the difference reported in the two way interaction above was due to the female participants. Whereas males did not differ when under the two modes of responding, females responses did. This was particularly the case with respect to the Descending and Ascending sequences. The important point to extract from this interaction is that again there were sex differences occurring on this lower probability of success task.

Figure 2.26. Graph Illustrating the Three-way Interaction between Response Mode, Sequence and Sex for the "How Good" Analysis in Experiment 3



2.8.2.5. Continued Play

Table 2.9 shows the frequency at which participants continued to play after the Experimenter had left the room, in terms of the number of trials that they took part in.

Table 2.9. Frequency distribution of Number of Trials of Continued Play

No. of Trials	No. of Participants	Cumulative Count	Percentage
0	60	60	50.00
1	21	81	17.50
2	8	89	6.67
3	2	91	1.67
4	3	94	2.50
5	5	99	4.17
6	6	105	5.00
7	5	110	4.17
8	4	114	3.33
9	3	117	2.50
10	3	120	2.50

Half of the participants chose to continue to play, suggesting that for these participants at least, there was no need for participants to have won a high number of trials for them to continue to play. A third of these participants (21) only played for one additional trial but there were many that continued playing past this. It was of interest to see whether these participants were primarily in the Descending sequence; more precisely to investigate whether the early win experience was more likely to lead to continued play than the other two win sequences.

Finally then, a 3-way [2(Response Mode) x 2(Sequence) x 2(Sex)] ANOVA was run on the number of trials that participants took part in whilst the Experimenter was out of the room. This measure represents their willingness to continue with the task, and it was hypothesised that there would be some relationship between people's perceptions of future success, and the number of trials that they took part in on their own accord. One question

asked was whether the early winning experience lead participants to play for longer. However, there was no effect of any of the variables on the number of trials played.

In terms of investigating any possible relationship between participants short and longer term confidence and the number of trials that they participated in, Pearson Product Moment correlations were computed, with alpha set at the 5% level. Participants Next 100 predictions correlated significantly with the number of trials taken part in ($r=0.19$, $p=0.035$). Although the correlation was weak, the greater their own success rate predictions the greater the number of trials they played once the Experimenter had left the room. A weak but significant correlation also resulted ($r=0.18$, $p=0.04$) with participants Confidence in the next trial. Again, the more confident they were the greater the number of extra trials they played.

The lack of Sequence effects was not surprising following the lack of such effects in the earlier analyses. If indeed early winning had led to significant increases in participants Next 100 predictions for example, then one would expect to have seen Sequence effects with respect to the number of trials that participants engaged themselves in, in preference to waiting or reading the available newspaper.

These correlations are important observations in that they suggest that people's confidence as to their perceptions for how many trials they think they would over an extra hypothetical series of outcomes is actually linked to their behaviour, with respect to their willingness to continue.

2.9. General Discussion and Combined Analysis of Experiments 1, 2 and 3

2.9.1. Introduction

This section serves to address the issue of the robustness of the Illusion of Control concept with respect to sequence effects. It also aims to investigate the value of the Hogarth and Einhorn belief adjustment model (1992) for these types of paradigm in the light of the results from the three Experiments. The individual analyses reported served to examine whether the Illusion of Control effects were present at particular probabilities, and whether the effects occur only under specific circumstances. However, a combined analysis of the experiments is necessary in order to evaluate whether the effects present in each experiment are unique to particular probabilities of success, or are general across all probabilities.

In order to meaningfully compare experiments, participants' responses from the three Experiments had to be converted so that they were proportional in terms of the objective probability of success in the task which they experienced, hence creating ratios of objectivity. The closer to 1 their converted responses were, the more objectively they had responded. A figure higher than 1 therefore represented an exaggeration of the measure and a figure less than 1, an under-evaluation. For Experiment 1 participants, responses were divided by 50 (represented by the 50% probability of success), Experiment 2 responses by 25 and Experiment 3 participant responses divided by 12.5. This process allowed for comparable analysis across the three Experiments, accounting for the number of trials that they had won.

The process of analysing the three experiments together also reduces the number of individual significance tests carried out thereby reducing the possibility of having observed false positives in the individual analyses.

This combined analysis is only interested in meaningful differences between the three Experiments. Due to the notion of power and the sample size, even if effects were significant in one individual analysis and not in another does not necessarily mean that the responses were in fact behaving differently across the Experiments. In other words, for the differences that arose between the Experiments arising from the individual analyses to actually exist, in the combined analysis there would need to be an interaction with the Experiment variable.

Additionally this combined analysis could show up some differences between the Experiments which are not particularly remarkable and so care will be taken to avoid making claims about observed effects where effect size is small.

2.9.2. Illusion of Control: Confidence and Next 100 responses at the End of the Trials

An identical analysis was conducted as in the individual Experiments, with the additional Between-participants variable of Experiment, which specified whether there were 2(Experiment 1), 4(Experiment 2) or 8(Experiment 3) turtles in each race. The five-way ANOVA 3(Experiment) x 2(Response Mode) x 3(Sequence) x 2(Sex) x 2(Measure) was conducted. See Table 2.10 for the ANOVA table (also in Appendix 3m).

Table 2.10. ANOVA Table for the Illusion of Control Analysis in the Combined Analysis of Experiments 1, 2 and 3

1-EXPERIMENT, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX, 5-MEASURE

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	2	40.0798	324	1.576883	25.4171	.000000
2	1	13.1274	324	1.576883	8.3249	.004173
3	2	5.0335	324	1.576883	3.1920	.042384
4	1	.0002	324	1.576883	.0002	.990062
5	1	112.9867	324	.926442	121.9576	.000000
12	2	14.1982	324	1.576883	9.0040	.000156
13	4	1.7976	324	1.576883	1.1400	.337591
23	2	1.7016	324	1.576883	1.0791	.341125
14	2	.1605	324	1.576883	.1018	.903234
24	1	.1150	324	1.576883	.0729	.787279
34	2	2.7685	324	1.576883	1.7557	.174428
15	2	19.6226	324	.926442	21.1806	.000000
25	1	22.0290	324	.926442	23.7781	.000002
35	2	.2440	324	.926442	.2634	.768591
45	1	.1394	324	.926442	.1505	.698297
123	4	.1792	324	1.576883	.1136	.977682
124	2	.1133	324	1.576883	.0719	.930678
134	4	2.7528	324	1.576883	1.7458	.139630
234	2	3.1848	324	1.576883	2.0197	.134364
125	2	18.3904	324	.926442	19.8505	.000000
135	4	.6719	324	.926442	.7252	.575227
235	2	.6827	324	.926442	.7369	.479382
145	2	.0737	324	.926442	.0795	.923587
245	1	.2101	324	.926442	.2268	.634221
345	2	2.5365	324	.926442	2.7379	.066202
1234	4	5.9114	324	1.576883	3.7488	.005357
1235	4	.4481	324	.926442	.4836	.747765
1245	2	.3942	324	.926442	.4255	.653835
1345	4	3.2036	324	.926442	3.4580	.008739
2345	2	.1793	324	.926442	.1935	.824143
12345	4	1.8615	324	.926442	2.0093	.092921

A main effect of Sequence resulted, $F(2,324)=3.19$, $p=0.040$. Although responses from all the Sequences had a ratio greater than unity, suggesting an overall exaggeration of responses (collapsed across the two measures), Participants in the Descending Sequence were significantly less objective (mean of 1.69) in the exaggerated direction, than Participants in the Random Sequence, mean of 1.40. The difference between the Descending and Ascending (mean of 1.56) sequences was not significant. This provides weak evidence for order effects and the Illusion of Control. While the Descending responses were the highest as one would expect, the Ascending sequence was not behaving in a way consistent with past studies, not being significantly different from either of the

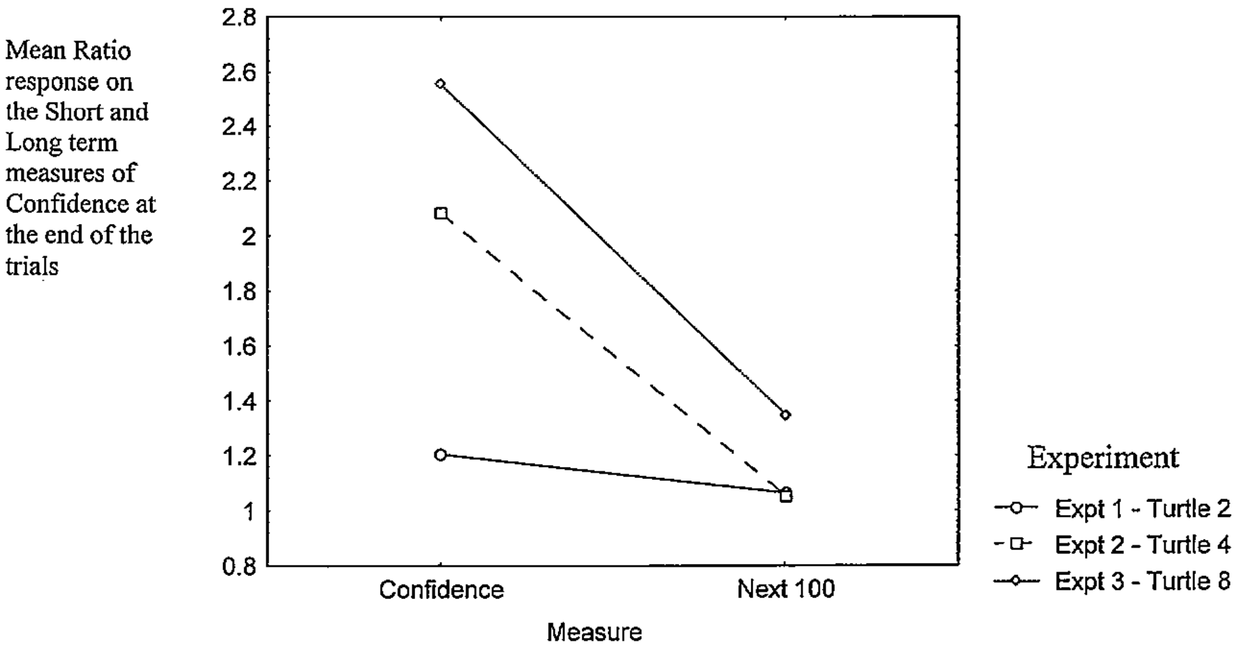
two other sequences. However, the responses to all sequences were substantially higher than the objective probability would predict.

The lack of a significant two-way interaction between Experiment and Sequence suggests that across the three experiments the effect of Sequence was similar, i.e. that there was no significant difference between the Descending and Ascending sequences, thus confirming the individual analyses.

A main effect of Experiment resulted, $F(2,324)=25.42$, $p<0.001$. Participants who experienced the two-turtle task (hence the 1 in 2 probability of success) were the most objective in their responses, with a mean objectivity ratio of 1.13. The four-turtle task resulted in a mean of 1.57 whereas the eight-turtle task a mean of 1.95. All groups were significantly different from each other in the follow-up analysis using the LSD method. This suggests that the greater the number of possible outcomes in a task the greater the exaggeration in people's perception the likelihood of success on future trials.

Of particular interest was the main effect of Measure, $F(1,324)=121.96$, $p<0.001$, which represented the finding that collapsed across the other variables in the analysis, Participants' responses to the Confidence measure were significantly less objective (and exaggerated) than their Next 100 predictions. This suggests that people were more able to be objective when it came to thinking about longer term success (mean of 1.16), than they were when considering their confidence in the very next trial (mean of 1.95). This effect differed between the three Experiments as the two-way interaction between Experiment and Measure was significant $(F2,324)=21.18$, $p<0.001$. Figure 2.27 shows that for the Confidence measure the difference between the Experiments is greater. What is again interesting to note, is that as the probability of success decreases the difference between participants' objectivity on the two measures increases. This demonstrates again that as the probability of success decreases, people tend to become less objective and exaggerate more their Confidence and Next 100 responses, but that this is particularly the case with respect to people's short term confidence.

Figure 2.27. Graph Illustrating the Two-way Interaction between Experiment and Measure for the Illusion of Control Analysis in the Combined Analysis of Experiments 1, 2 and 3



A main effect of Response Mode resulted, $F(1,324)=8.32$, $p=0.004$, representing the finding that when short term Confidence had been elicited throughout, at the end of the trials, people were less objective (collapsed across the two measures, mean of 1.69) than when the longer term measure of Next 100 predictions had been elicited throughout, (mean of 1.42).

The interaction between Response Mode and Measure was also significant, $F(1,324)=27.78$, $p<0.001$. LSD follow up analysis revealed that the Next 100 measure at the end of the task was not affected significantly by manipulation of frequency of measurement; there were no differences between whether it had or had not been elicited throughout the trials. When the Confidence measure had been elicited throughout, it was significantly higher than when it was it the first time that this measure had been presented, (as an EoS measure). Table 2.11 below provides the means from this comparison.

Table 2.11. Means for the Interaction between Response Mode and Measure at the end of the trials

Response Mode

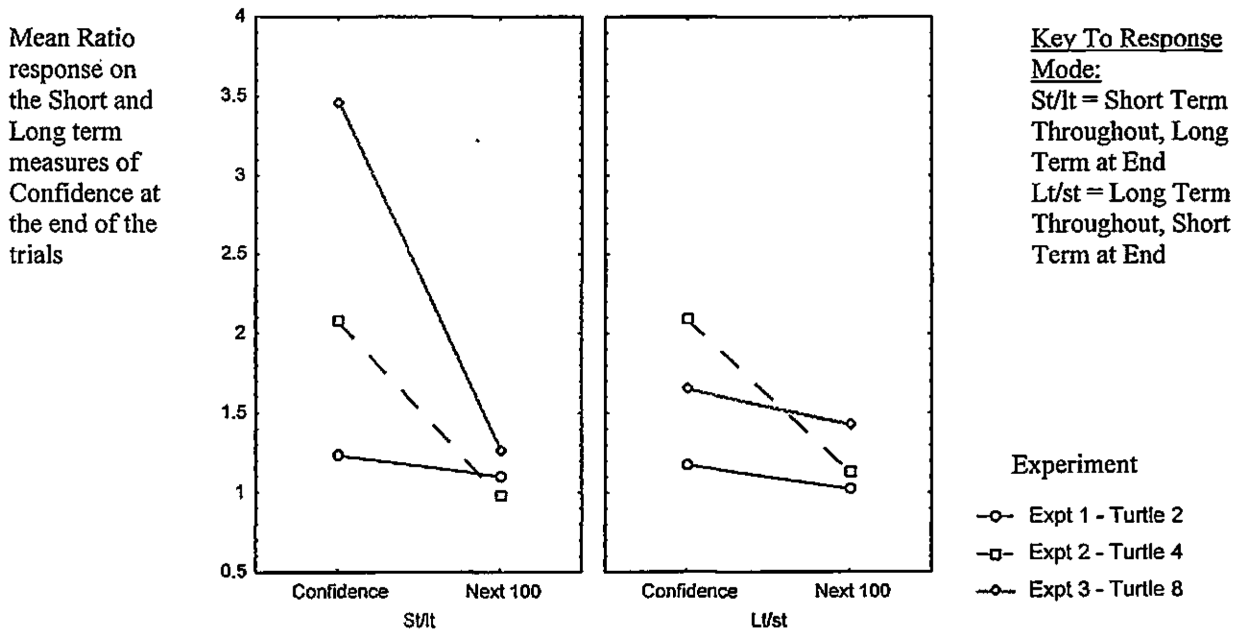
Measure	St/lt	Lt/st
Confidence	2.26	1.64
Next 100	1.12	1.20

Key To Response Mode:
St/lt = Short Term Throughout, Long Term at End
Lt/st = Long Term Throughout, Short Term at End

The two way interaction between Experiment and Response Mode was also significant, $F(2,324)=9.00$, $p<0.001$. However, these two way interaction effects differed between the three Experiments, as the significant three-way interaction between Experiment, Response Mode and Measure was also significant; $F(2,324)=19.85$, $p<0.001$, see Figure 2.28.

The figure shows that the responses from Experiment 1 (Turtle 2) appeared to be acting in very similar ways for both the Confidence and the Next 100 measures with respect to both of the Response Modes. There appears also to be no effect of Response Mode with Experiment 2 (Turtle 4) although Confidence measures appear to be significantly higher than those from Experiment 1. The three way interaction comes out

Figure 2.28. Graph Illustrating the Three-way Interaction between Experiment, Response Mode and Measure for the Illusion of Control Analysis in the Combined Analysis of Experiments 1, 2 and 3



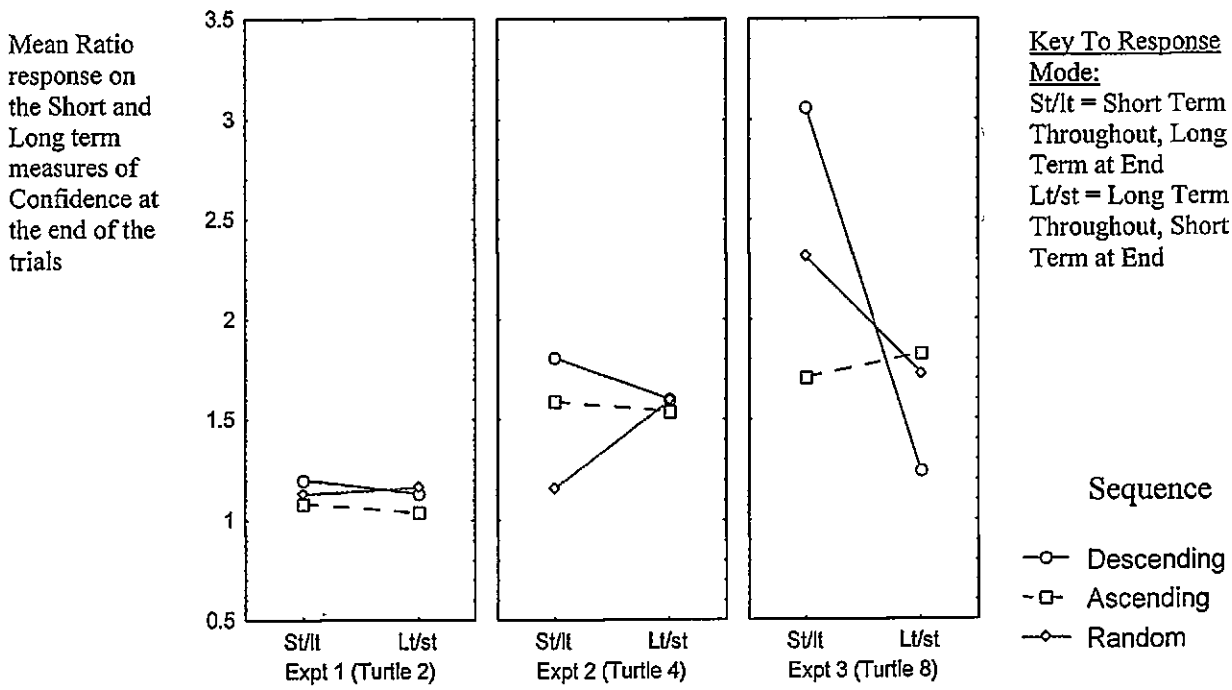
mainly due to the responses from under Experiment 3, in which there was a massive difference between the measures when the short term Confidence had been elicited throughout. LSD follow-up analysis confirmed this.

Thus participants were unable to adjust their short term confidence appropriately, even though they were able to adjust their longer term estimates of success. Hence it appeared that across all three Experiments, but particularly as the probability of success decreased, when focusing on the next trial, participants were not taking into account the fact that in the long run they would only win at chance rates, even though when these longer term estimates were elicited, they were obviously very aware of this fact.

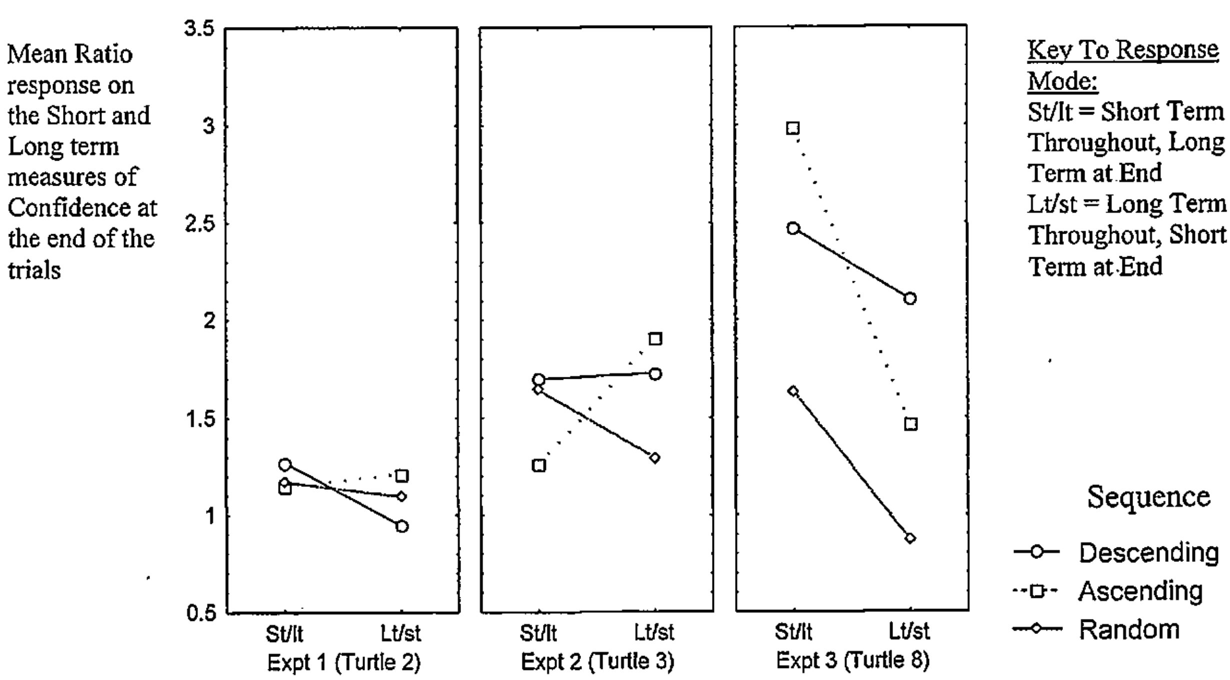
There was also a significant interaction between Experiment, Response Mode, Sequence and Sex, $F(4,324)=3.75$, $p<0.005$, Figure 2.29.

Figure 2.29. Graph Illustrating the Four-way Interaction between Experiment, Response Mode, Sequence and Sex for the Illusion of Control Analysis in the Combined Analysis of Experiments 1, 2, and 3

Male Participants



Female Participants



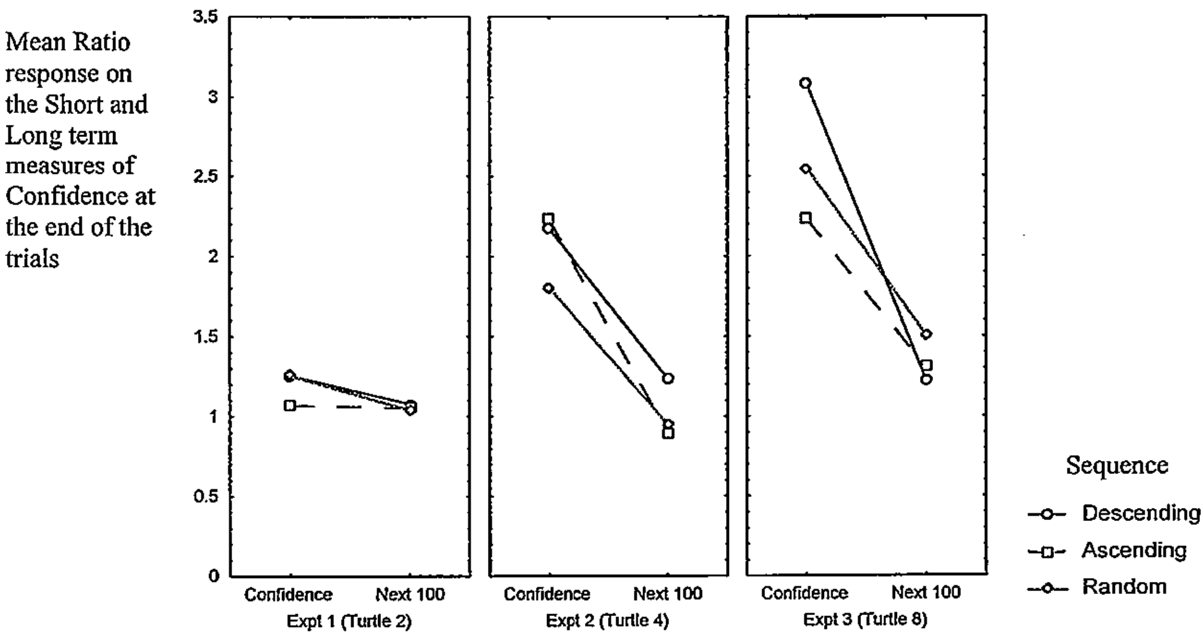
Although this four way interaction is difficult to interpret, it does demonstrate the finding that as the probability of success in the task decreases, males and females responded differently to the frequency of manipulation measures across the sequences. In Experiment 2, the female participants' responses were in the opposite direction to those of their male counterparts. With Experiment 3 there are massively greater differences appearing between the Response Modes and this is particularly the case with respect to the Ascending sequence.

The four-way interaction $F(4,324)=3.46$; $p=0.009$ between Experiment, Sequence, Sex and Measure adds further support to the necessity of controlling for sex effects in these kinds of experiments. From observing the figure below (Figure 2.30) it can be seen that as the probability of success decreases Sex effects become more apparent. In Experiment 1 there are no major differences to note with respect to this analysis. The largest differences appeared with Experiment 3 when there were eight Turtles. Specifically, the Confidence and Next 100 measures differed greatest in response to the Descending sequence.

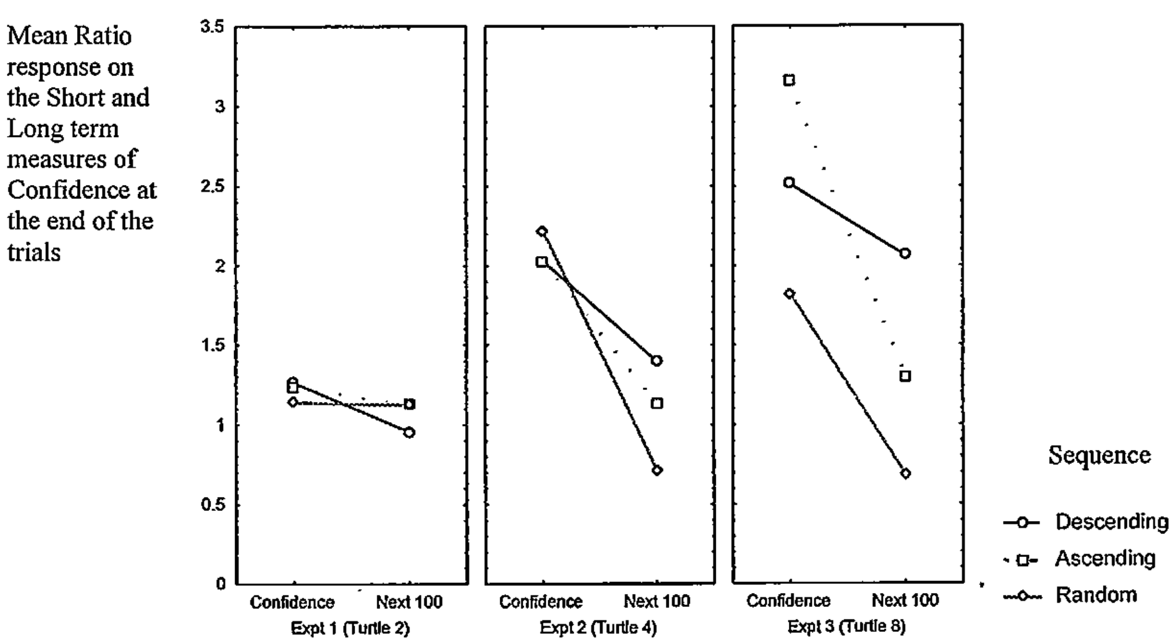
This interaction reiterated the observation that under Experiment 3 with the lowest probability of success, the interaction between Sex and Sequence became more apparent.

Figure 2.30. Graph Illustrating the Four-way Interaction between Experiment, Sequence, Sex and Measure for the Illusion of Control Analysis in the Combined Analysis of Experiments 1, 2 and 3

Male Participants



Female Participants



Again this four way interaction is hard to interpret, although it does appear that in Experiment 3 there appears to be a primacy effect with respect to the Confidence measure, in that the Descending sequence lead males to be more confident than males in the other

two sequences. However, an interesting Sex difference appears, in that this did not occur for females. Females in the Ascending sequence, who had won the most recent trials prior to being asked, expressed elevated confidence responses as compared to those in the other two sequences. Thus it appears that females were affected more by the outcomes of recent trials than their male counterparts.

2.9.2.1. Summary of Findings

One of the main findings to extract from this combined analysis is that although the effects were not entirely consistent with previous studies, there were some effects of Sequence on these measures. People who had experienced the early win sequence did have significantly elevated Confidence and Next 100 measures at the end of the task as compared to the Random sequence, irrespective of which measure had been elicited throughout. One explanation of why the Descending sequence did not result in significantly higher responses than the Ascending sequence, as in previous studies, is that the result was a function of having utilised a Step by Step response mode throughout the sequences. Hogarth and Einhorn's belief revision model predicts that a primacy effect would result with the EoS measures, and a recency effect would result with the SbS measures. This would account for why the two sequences were not significantly different from each other, as in addition to the primacy effect occurring for the Descending sequence, the effect of the late wins inherent within the Ascending sequence would also result in elevated responses for this condition.

A further point to extract from this analysis is that people tended to be over inflated with respect to short term confidence, particularly as the probability of success in any particular trial decreased. In comparison, people tended to be better able to re-adjust their longer term perception of future success in relation to the probability inherent within the task. Furthermore, when focusing on these longer term measures throughout, participants did not display as over inflated responses as when the people were encouraged to focus on their confidence in the next trial.

2.9.3. Step by Step Analysis

A five-way ANOVA was conducted on the measures averaged over the four blocks of eight trials, 3(Experiment) x 2(Response Mode) x 3(Sequence) x 2(Sex) x 4(Period). See Table 2.12 for the ANOVA table (also in Appendix 3n).

Table 2.12 ANOVA table for the Step by Step Analysis in the Combined Analysis of Experiments 1, 2 and 3

1- EXPERIMENT, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX, 5-PERIOD

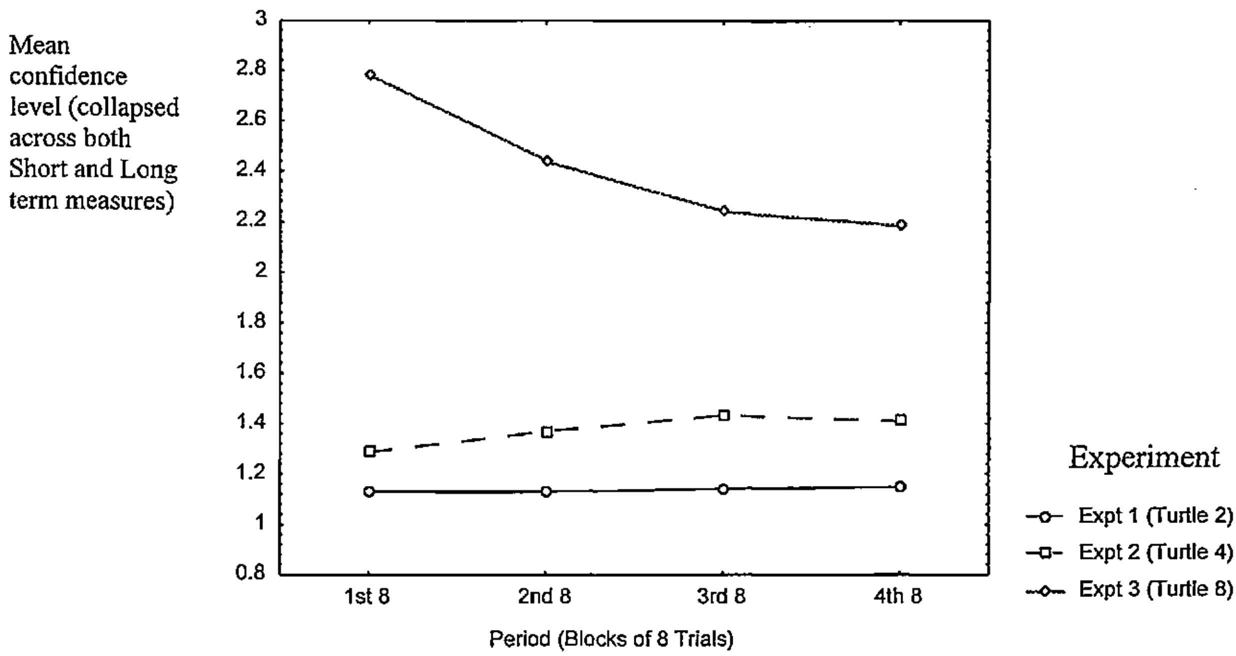
	df Effect	MS Effect	df Error	MS Error	F	p-level
1	2	222.3423	324	3.336715	66.63509	.000000
2	1	243.2688	324	3.336715	72.90668	.000000
3	2	12.2807	324	3.336715	3.68048	.026271
4	1	.2430	324	3.336715	.07284	.787422
5	3	1.7301	972	.341837	5.06120	.001755
12	2	75.0927	324	3.336715	22.50499	.000000
13	4	2.5757	324	3.336715	.77194	.544099
23	2	.1469	324	3.336715	.04402	.956936
14	2	2.4445	324	3.336715	.73261	.481448
24	1	.1995	324	3.336715	.05978	.807004
34	2	1.9243	324	3.336715	.57671	.562320
15	6	3.7040	972	.341837	10.83549	.000000
25	3	.0259	972	.341837	.07565	.973108
35	6	2.3785	972	.341837	6.95802	.000000
45	3	.2915	972	.341837	.85288	.465150
123	4	.4191	324	3.336715	.12559	.973156
124	2	2.7611	324	3.336715	.82750	.438061
134	4	7.1586	324	3.336715	2.14540	.075010
234	2	13.5944	324	3.336715	4.07417	.017885
125	6	1.1068	972	.341837	3.23792	.003723
135	12	.5655	972	.341837	1.65427	.071923
235	6	.4643	972	.341837	1.35820	.228599
145	6	.8831	972	.341837	2.58350	.017295
245	3	.1470	972	.341837	.43004	.731526
345	6	.4532	972	.341837	1.32570	.242675
1234	4	9.5063	324	3.336715	2.84899	.024051
1235	12	.4014	972	.341837	1.17432	.296739
1245	6	.4546	972	.341837	1.32997	.240784
1345	12	.3891	972	.341837	1.13815	.324802
2345	6	.1742	972	.341837	.50956	.801426
12345	12	.2436	972	.341837	.71257	.740216

Similar main effects resulted of Sequence, Experiment and Response Mode, as those previously mentioned. A main effect of Sequence resulted, $F(2,324)=3.68$, $p=0.026$. Collapsed across all periods, participants in the Descending sequence (mean 1.805) were significantly less objective (and exaggerated) than participants in the Ascending sequence, mean of 1.185. Neither of these means were significantly different from the Random sequence, mean of 1.63. A main effect of Experiment resulted, $F(2,324)=66.64$, $p<0.001$. Collapsed across the other variables in the analysis, although all response were over-inflated, responses from participants in Experiment 3 (mean of 2.41) were significantly higher than both Experiment 1 (mean of 1.14) and Experiment 2 (mean of 1.36). This suggests again that overall, participants experiencing the task with the lowest probability of success were the least objective in their responses, in the inflated direction. A main effect of Response Mode resulted, $F(1,324)=72.91$, $p<0.001$. Again confirming that Confidence was significantly higher than the Next 100 responses (means of 2.05 and 1.23 respectively).

A main effect of Period resulted, $F(3,972)=5.06$, $p=0.002$. The only period, collapsed across all other measures in this analysis, which was significantly different (and higher) than the other periods, was the first one (mean of 1.73). The information that the participants received over the first 8 trials led participants to give particularly over-inflated responses, mean of 1.73, as compared to the 2nd, 3rd and 4th periods (means of 1.65, 1.60, 1.58 respectively).

Of more interest was the significant interaction between Experiment and Period, $F(6,972)=10.84$, $p<0.001$, see Figure 2.31 below. With conservative degrees of freedom (2,324), to adjust for the fact that the sphericity assumption for conducting an ANOVA was violated, this interaction still resulted in a significant p value; $p<0.001$.

Figure 2.31. Graph Illustrating the Two-way Interaction between Experiment and Period for the Step by Step Analysis in the Combined Analysis of Experiments 1, 2 and 3

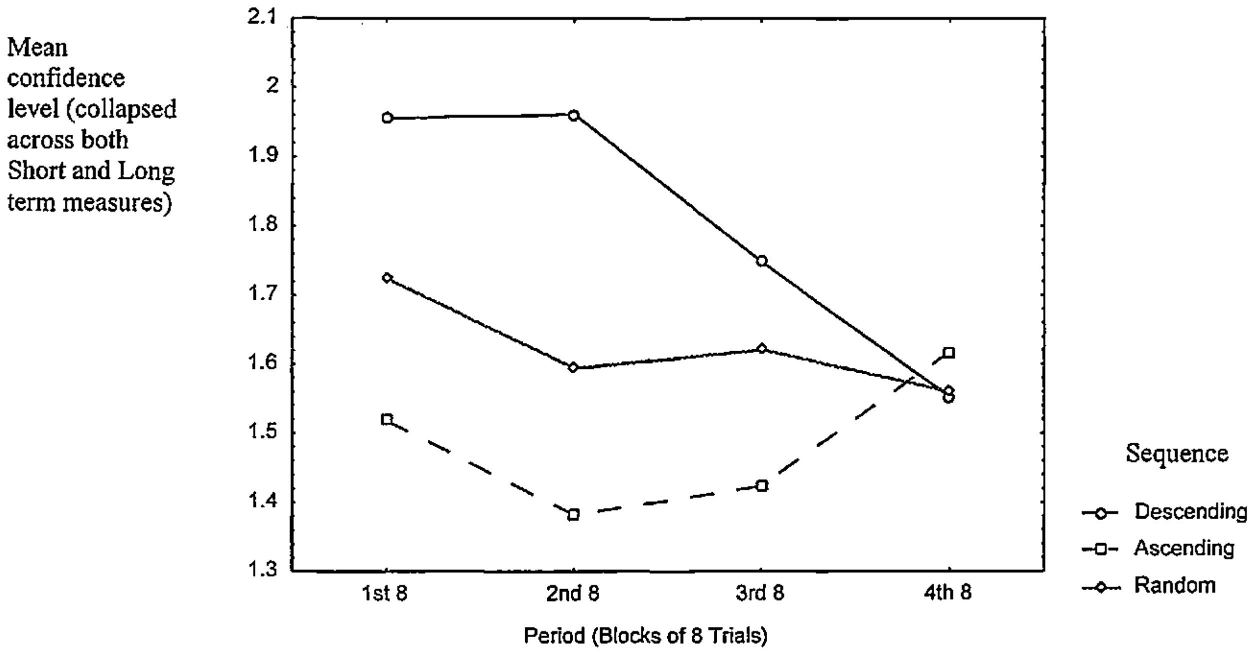


When the task involved a 50-50 chance of success (Experiment 1) participants responded with values that approximated the objective probability of success, resulting in a ratio close to unity, throughout the four periods. When there were four turtles in the task so that participants only won at a 25% rate, it appeared they became less objective believing they would win more and were more confident than objective probability would predict, and showed some increase in their responses over the trials. Experiment 3 Participants started off with particularly over inflated estimates, but there was a marked decrease in these estimates with progression through the task.

Caution must be taken however when interpreting these ratio figures. This is because a ratio of 1 is only objective if the participants interpret the response scales as the probability of being correct, but we can not be sure that they do this. For the short term confidence measure the participants were instructed that a 0 response would suggest that they were completely unconfident that they would win, where a 100 response would suggest that they were completely confident that they would win. As the probability of success decreases in the task across the three Experiments, it is very plausible that the reason for why their responses did not follow the decline in probability, was that participants did not equate their confidence in the next trial with the actual probability of success. Strong evidence that the confidence measure does not equate with probability is provided when looking at the interaction between Experiment, Response Mode and Period presented shortly.

Of particular importance to note was the two-way interaction between Sequence and Period which was also significant, $F(6,972)=6.96$, $p<0.001$, and was still significant with Greenhouse Geisser's conservative degrees of freedom (2,324); $p=0.001$. Figure 2.32, confirms (as was observed within the individual analyses) that the SbS measures (when collapsed across both) react in similar ways throughout the task; i.e. the same pattern of responses for the SbS measures arise in all three experiments. For the Descending sequence, participants provided highly over inflated responses in the early stages whilst they were winning a high proportion of the trials, but lowered their responses with progression through the task. The Ascending sequence fell in the confidence measures during the early stages whilst they were losing, but then gradually increased as they began to win more and more. The responses from those in the Random sequence displayed a minor decline over the four periods.

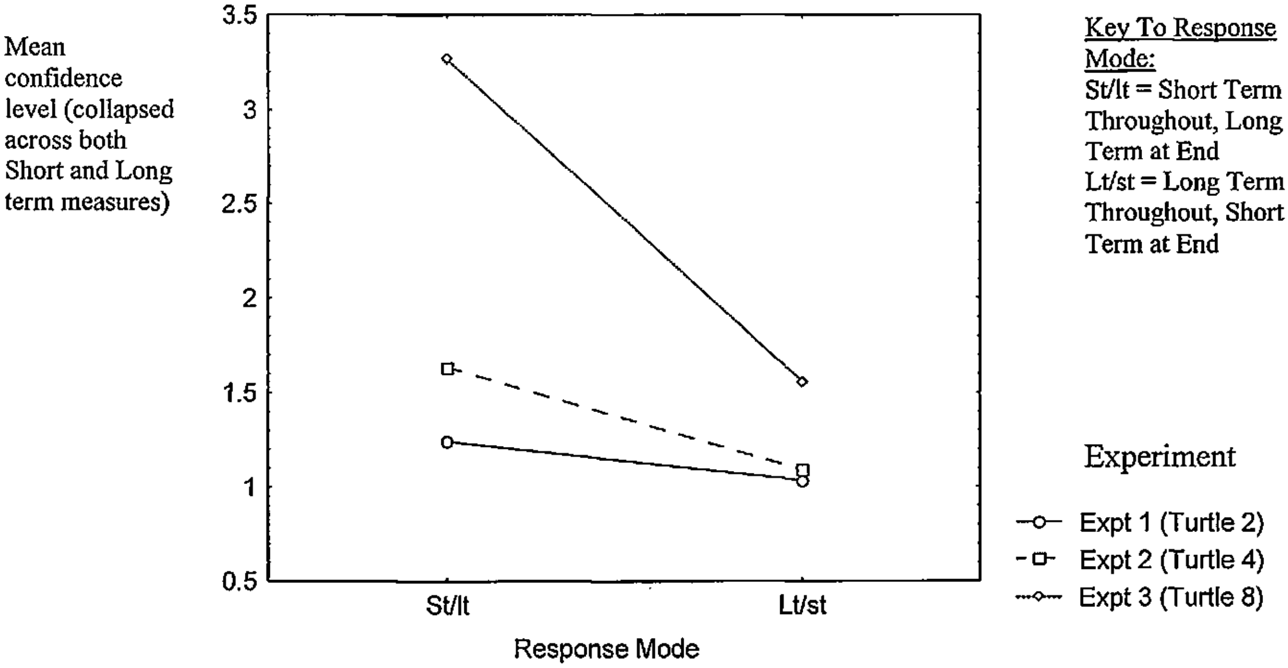
Figure 2.32. Graph Illustrating the Two-way Interaction between Sequence and Period for the Step by Step Analysis in the Combined Analysis of Experiments 1, 2 and 3



The fact that the three-way interaction between Experiment, Sequence and Period did not reach significance lends further support to the notion that the measures respond similarly across the three Experiments. This alleviates the concern regarding the lack of a significant two-way interaction between Sequence and Period in Experiment 3, and offers support to the notion that the reason for the lack of effect was due to the minimal number of wins that participants under that paradigm experienced, which masked the presence of the effect.

The interaction between Experiment and Response Mode was significant, $F(32,324)=22.50$, $p<0.001$, Figure 2.33. This interaction points to the finding that there was little difference appearing with respect to how the Next 100 measure reacted to the probability of success in the task, whereas there were marked differences between the Experiments with respect to the Confidence level, specifically with respect to Experiment 3.

Figure 2.33. Graph Illustrating the Two way Interaction between Experiment and Response Mode for the Step by Step Analysis in the Combined Analysis of Experiments 1, 2 and 3

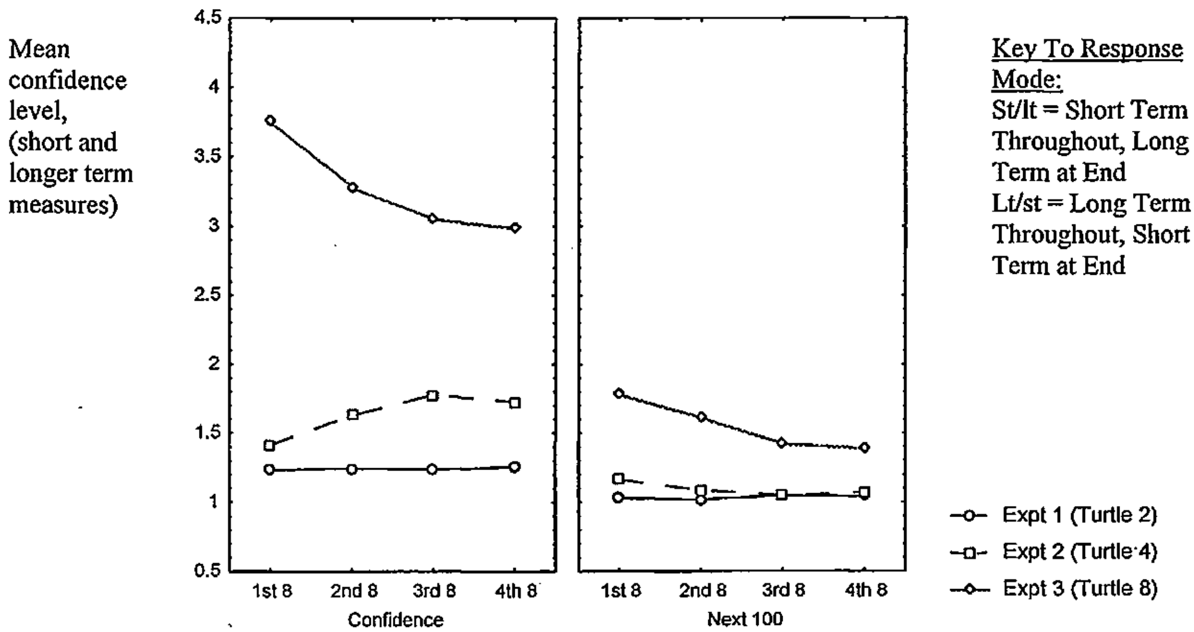


The three-way interaction between Experiment, Response Mode and Period was also significant, F(6,972)=3.24, p=0.004. Huynh Feldt correction was used to account for the lack of sphericity; and with conservative degrees of freedom (5,796) p=0.027. An examination of Figure 2.34 reveals that Participants were more exaggerated in their short term Confidence responses than they were in their Next 100 predictions when the probability of success decreased and the number of available outcomes increased, which also confirms the general trend observed between the individual analyses.

Confidence responses in Experiment 3 (Turtle 8) tended to decline, whilst in Experiment 2 (Turtle 4) they generally rose across the four periods, whereas with Experiment 1 (Turtle 2) the Confidence measures remained relatively flat. With respect to the Next 100 measure, Experiment 1 results were similar, Experiment 2 results were the other way around, almost displaying a decline, whilst in Experiment 3, although the decline across the four periods was still present, it was much less dramatic.

This interaction displays quite clearly that confidence responses across the three experiments did not equate with the actual probability of success in the task. Whereas the Next 100 measure was more directly related to the probability of success inherent with the task, people's confidence tended not to be affected to the same extent. Turtle 8 participants' higher responses can be explained by the fact that this analysis involves a ratio confidence measure, rather than participants' estimates of the actual probability of success. This in itself suggests that participants may well be fully aware of the probability of success, but still have exaggerated confidence.

Figure 2.34. Graph Illustrating the Three-way Interaction between Experiment, Response Mode and Period for the Step by Step Analysis in the Combined Analysis of Experiments 1, 2 and 3



In relation to the possible alternative explanation to the Langer and Roth results, the fact that across all Experiments, the SbS measures (particularly the Confidence measure) were not elevated for the Descending sequence near the end of the trials, suggests that the effect they observed was in fact due to a primacy effect of the early wins. The Hogarth and Einhorn model would also have predicted this, and therefore in this respect, the data from the three Experiments fits their model.

In summary, Sequence effects were observed with respect to the step by step measures, in that reliably, the most recent outcome information was paramount. As this was irrespective of whether the measure concerned was the Confidence or Next 100 it was clear that these two measure responded in the same way across all Experiments.

2.9.4. Battery Item Analysis

Again an identical analysis was conducted on the items in the question battery as for the individual analyses. What was of interest was again to see if the Experiment variable had a main effect on the measures in the analysis or interacted with the other independent variables.

Longer Term Items

On the five-way ANOVA [3(Experiment) x 2(Response Mode) x 3(Sequence) x 2(Sex) x 3(Measure)] on people's long term measures (own future success rate, under distraction, and someone else's Next 100), there were differences appearing between the Experiments. Table 2.13 below shows the ANOVA table that resulted from the analysis (also in Appendix 3o).

Table 2.13. ANOVA table for the Battery Item Analysis (Longer Term Items) in the Combined Analysis of Experiments 1, 2 and 3

1-EXPERIMENT, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX, 5-MEASURE

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	2	3.08342	324	.877635	3.51333	.030938
2	1	3.43408	324	.877635	3.91289	.048764
3	2	8.90363	324	.877635	10.14503	.000053
4	1	.27075	324	.877635	.30850	.578986
5	2	11.95179	648	.341761	34.97123	.000000
12	2	2.55203	324	.877635	2.90785	.056019
13	4	2.75482	324	.877635	3.13892	.014889
23	2	2.28496	324	.877635	2.60355	.075558
14	2	.92101	324	.877635	1.04943	.351325
24	1	.07268	324	.877635	.08282	.773697
34	2	3.74201	324	.877635	4.26375	.014867
15	4	3.54776	648	.341761	10.38084	.000000
25	2	2.45657	648	.341761	7.18800	.000817
35	4	.01329	648	.341761	.03888	.997120
45	2	.00575	648	.341761	.01684	.983304
123	4	.31527	324	.877635	.35923	.837539
124	2	.53695	324	.877635	.61181	.542991
134	4	5.14414	324	.877635	5.86137	.000145
234	2	.92963	324	.877635	1.05924	.347916
125	4	2.21463	648	.341761	6.48007	.000041
135	8	.12761	648	.341761	.37338	.934736
235	4	.20091	648	.341761	.58785	.671540
145	4	.34615	648	.341761	1.01285	.399948
245	2	.00665	648	.341761	.01946	.980733
345	4	.31410	648	.341761	.91907	.452280
1234	4	1.05116	324	.877635	1.19772	.311673
1235	8	.61880	648	.341761	1.81062	.072114
1245	4	.15222	648	.341761	.44540	.775792
1345	8	.18427	648	.341761	.53918	.827255
2345	4	.92918	648	.341761	2.71880	.028887
12345	8	.53047	648	.341761	1.55217	.135984

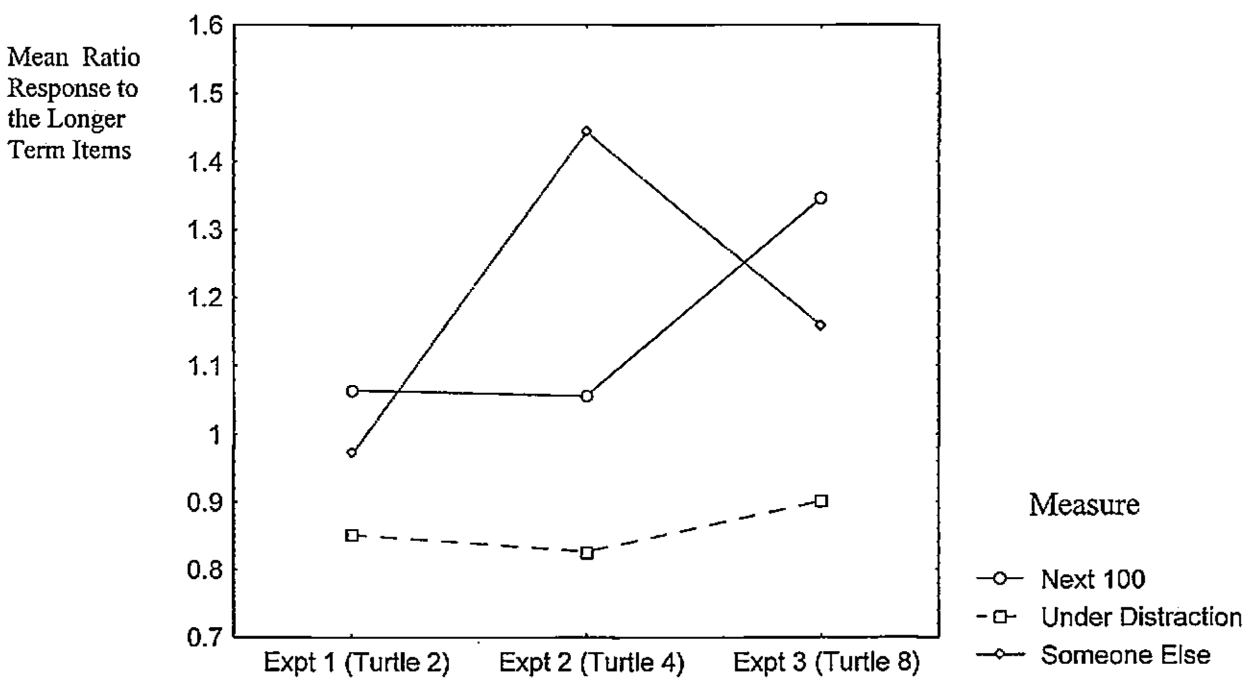
Collapsed across all other variables, the main effect of Experiment itself, $F(2,324)=3.51$, $p=0.031$, showed that participants in Experiment 1 underestimated their responses (mean of 0.96) and were significantly different to participants in Experiment 2 who overestimated theirs, mean of 1.11. Experiment 3 mean responses were again less objective, mean of 1.14.

A main effect of Sequence also resulted, $F(2,324)=10.15$, $p<0.001$. Collapsed across all other variables in the analysis, the participants in the Descending sequence (mean of 1.24) were significantly less objective and higher in their responses than participants in both the Ascending (mean of 1.04) and the Random (0.93) sequences.

A main effect of Response Mode resulted, F(1,324)=3.91, p=0.049. When Confidence was elicited throughout the sequences, collapsed across all three measures, people were more objective in their responses (mean of 1.01) than when the Next 100 measure was taken throughout (mean of 1.13).

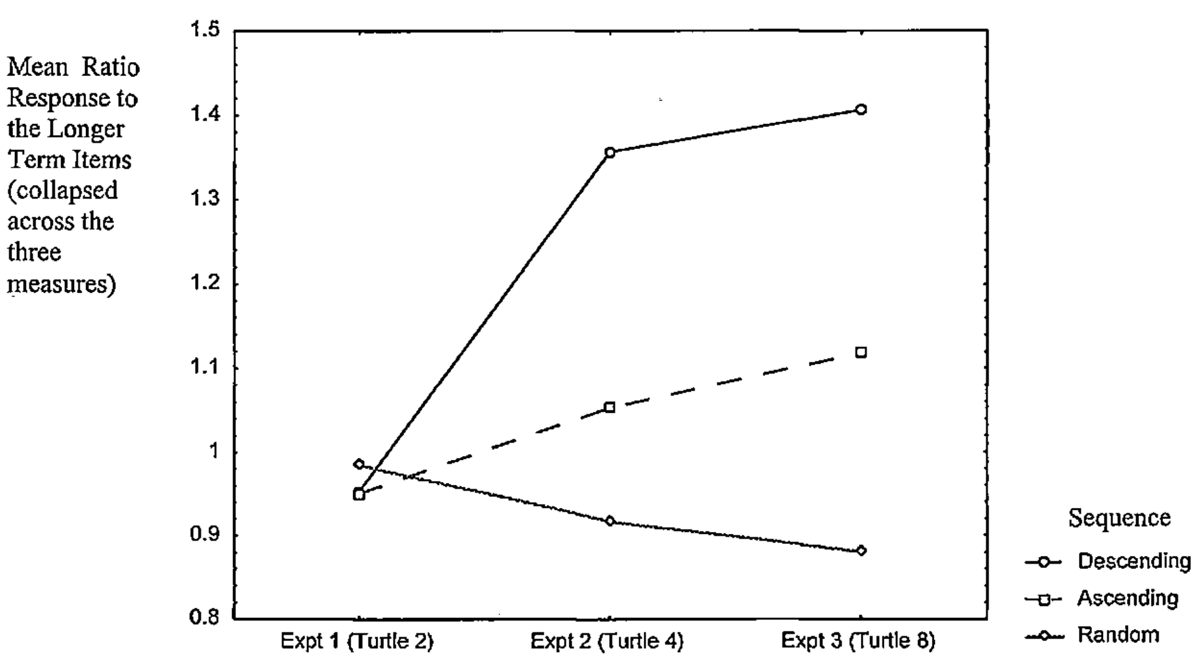
Consistent with results presented so far, a main effect of Measure resulted, F(2,648)=34.97, p<0.001. Collapsed across other variables in this analysis, participants thought that someone else (mean of 1.19) would do as well as themselves (mean of 1.16) at predicting the outcomes in these tasks. However, they did demonstrate their belief that they would perform significantly worse if they were distracted throughout the trials. This effect was not identical across the three Experiments, as the interaction between Experiment and Measure was significant, F(4,648)=10.38, p<0.001, Figure 2.35, suggesting that these measures did not behave in the same way across all three Experiments.

Figure 2.35. Graph Illustrating the Two-Way Interaction between Experiment and Measure for the "Longer Term Items" Analysis in the Combined Analysis of Experiments 1, 2 and 3



Although the Under Distraction measure was not affected by the Experiment, the other two measures were. An interesting observation here was with respect to participants' responses to the "Someone Else" measure in Experiment 2. With this probability task, they believed that someone else would perform significantly better than themselves obtaining a significantly higher win rate than both themselves and than the chance rate. It is possible that the reason for this difference for this measure in the Turtle 4 study lies in the fact that participants believe that they are not doing particularly well, and so believe that someone else will perform significantly better than themselves. With respect to Experiment 3, the reason why these participants believe they would perform better than someone else (although not significantly), may lie in the fact that there were minimal wins experienced in this Experiment, that the wins were occurring so infrequently that someone else would not be able to do any better.

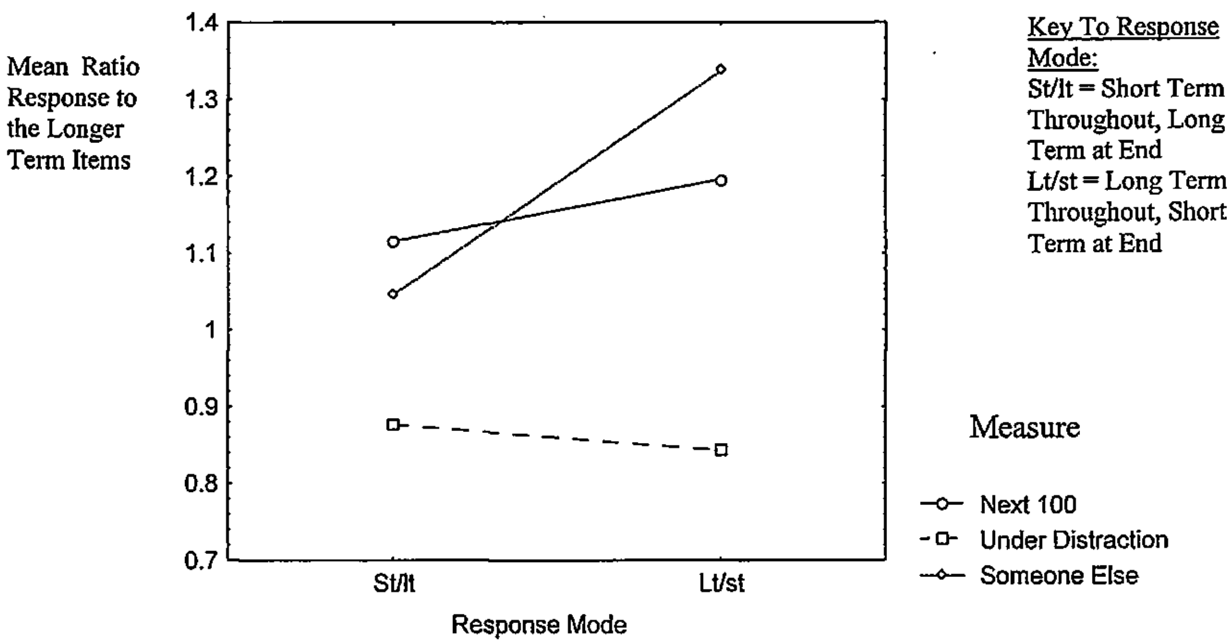
<u>Figure 2.36. Graph Illustrating the Two-way Interaction between Experiment and Sequence for the "Longer Term Items" Analysis in the Combined Analysis of Experiments 1, 2 and 3</u>



The main effect of Sequence reported above, was not identical across all Experiments as the interesting two way interaction between Experiment and Sequence demonstrates, $F(4,324)=3.14$, $p<0.015$, see Figure 2.36. From the Figure, it is clear that the largest differences arose with respect to the tasks which involved a lower probability of success, namely the Turtle 4 and Turtle 8 experiments.

A significant interaction between Response Mode and Measure also resulted, $F(2,648)=7.19$, $p<0.001$, Figure 2.37.

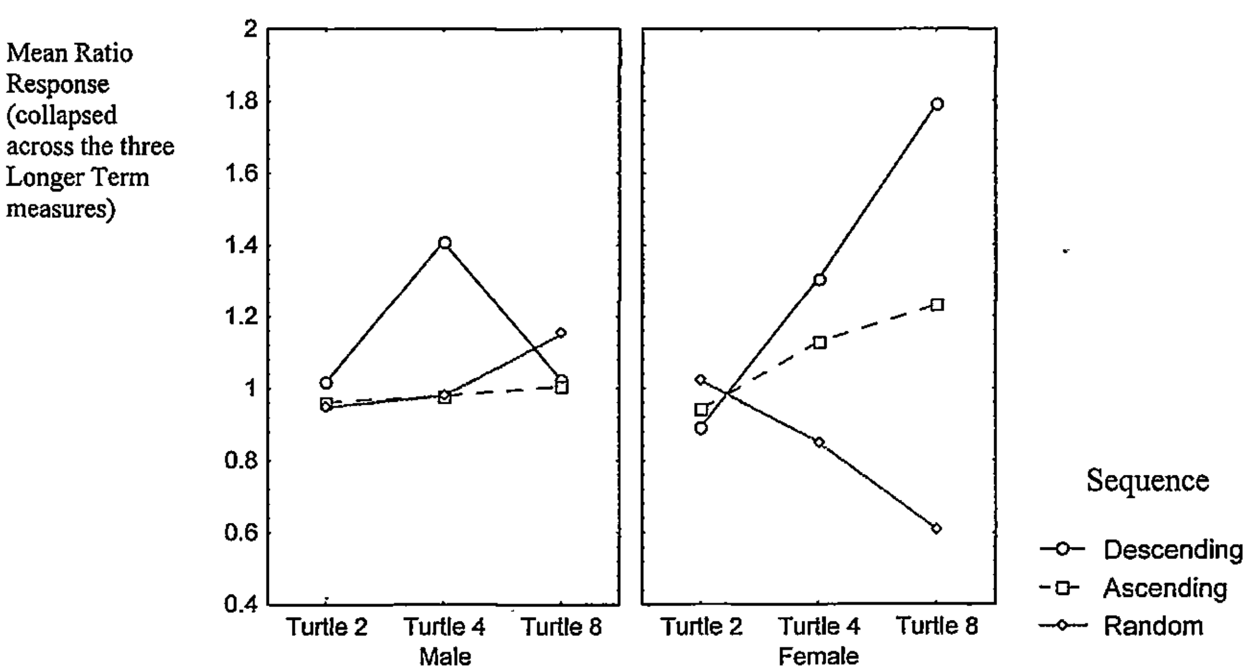
<u>Figure 2.37. Graph Illustrating the Two-way Interaction between Response Mode and Measure for the "Longer Term Items" Analysis in the Combined Analysis of Experiments 1, 2 and 3</u>



Of interest to note here is that the "Under Distraction" measure was not affected by whether the short or longer term measure had been elicited throughout the sequence. Eliciting the longer term SbS measure throughout had the effect of raising people's responses to the other two measures, and significantly with respect to the "Someone Else" measure.

A significant three way interaction between Experiment, Sequence and Sex, F(4,324)=5.86, p<0.001, Figure 2.38, also resulted.

Figure 2.38. Graph Illustrating the Three way Interaction between Experiment, Sequence and Sex for the "Longer Term Items" Analysis in the Combined Analysis of Experiments 1, 2 and 3



This three way interaction suggests that for the female participants, as the probability of success decreases the differences between the Sequences becomes progressively larger. In Experiment 3 (Turtle 8) the females in the Descending sequence were significantly higher than the other two sequences. This effect did not happen for the male participants where the only significant difference was that the Descending sequence for Experiment 4 resulted in higher longer term measures than the other sequences.

A significant three way interaction between Experiment, Response Mode and Measure resulted, $F(4,648)=6.48$, $p<0.001$, Figure 2.39.

Figure 2.39. Graph Illustrating the Three way Interaction between Experiment, Response Mode and Measure for the "Longer Term Items" Analysis in the Combined Analysis of Experiments 1, 2 and 3

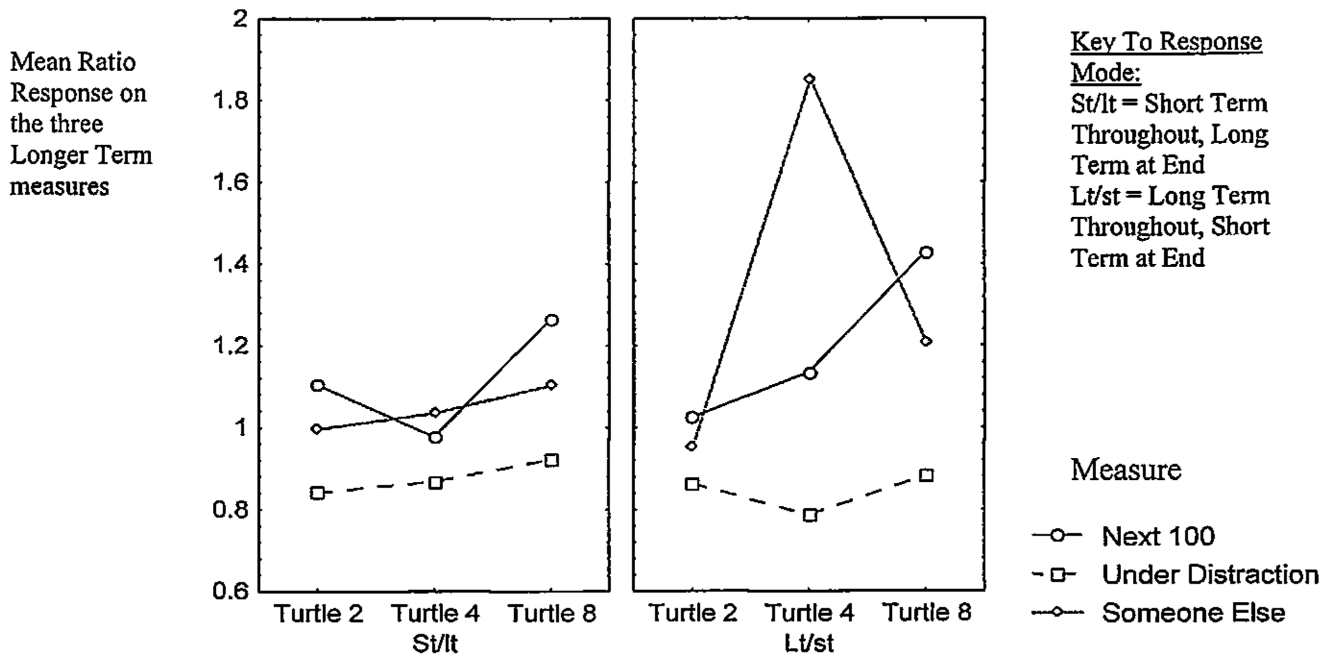
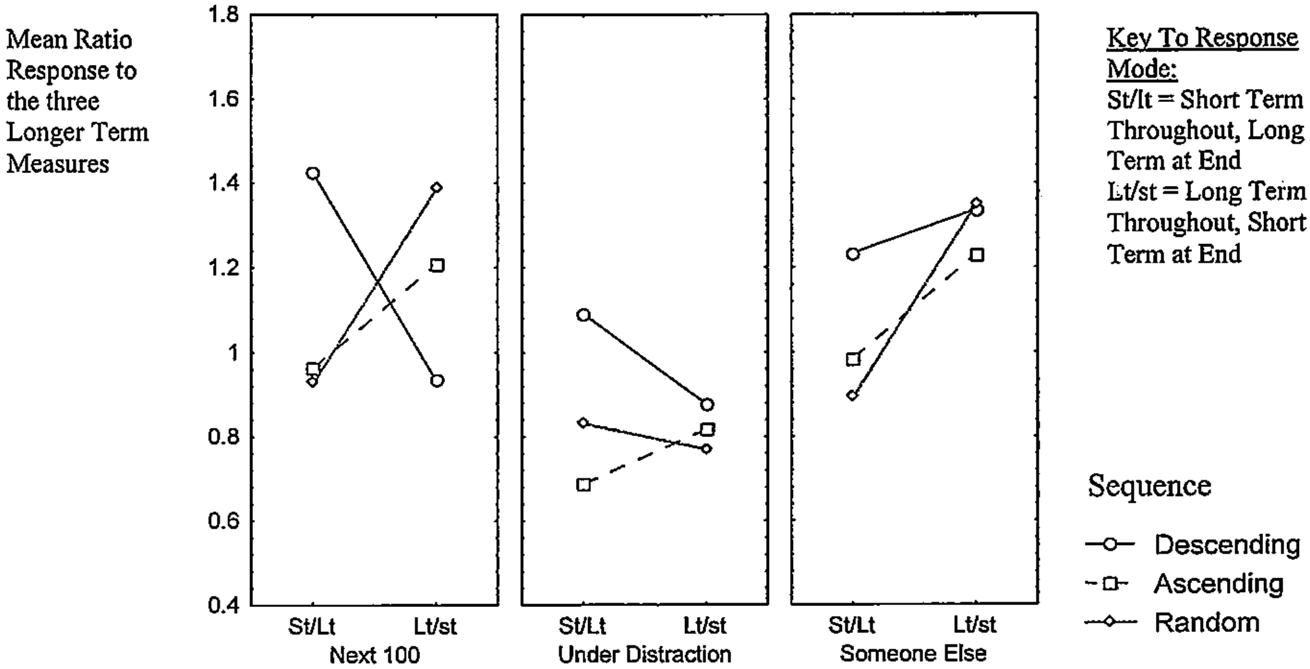


Figure 2.39 shows that the largest differences between the measures arose when the Next 100 measure had been elicited throughout. No differences between the measures occurred between the three Experiments when the short term Confidence measure was the SbS measure.

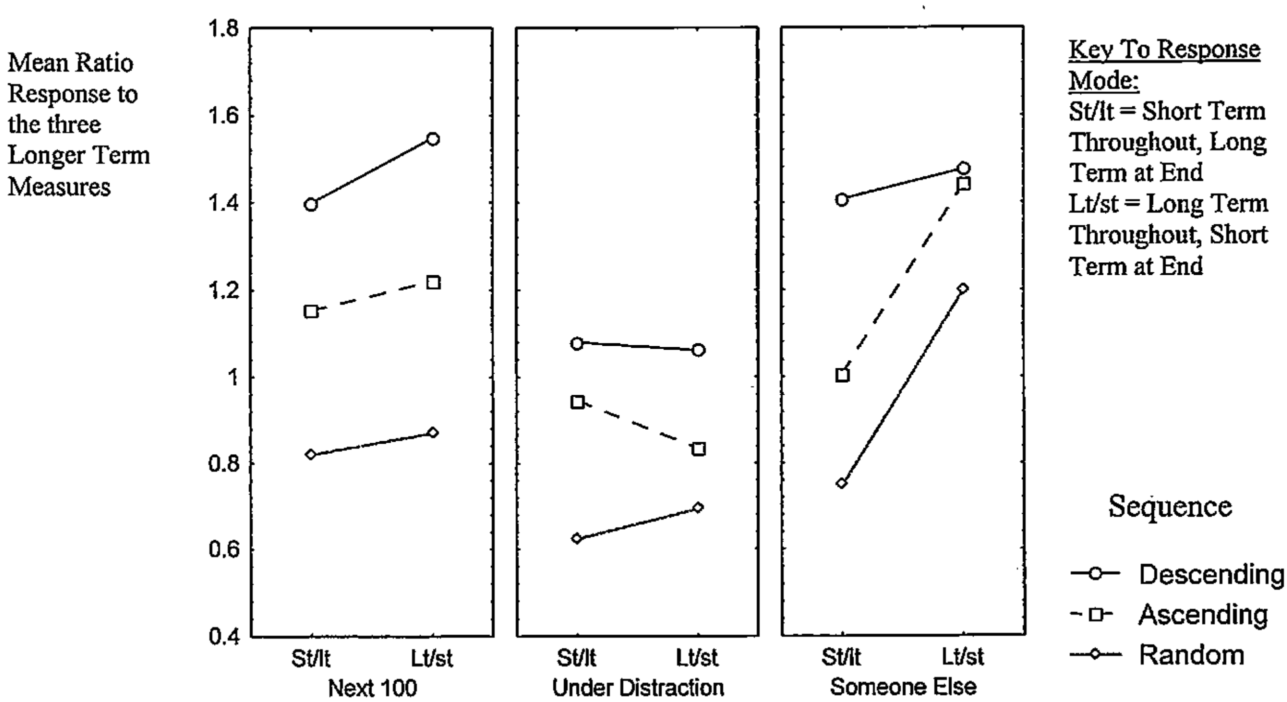
The four way interaction between Response Mode, Sequence, Sex and Measure was also significant, $F(4,648)=2.72$, $p=0.029$, Figure 2.40.

Figure 2.40. Graph Illustrating the Four way Interaction between Response Mode, Sequence, Sex and Measure for the "Longer Term Items" Analysis in the Combined Analysis of Experiments 1, 2 and 3

Male Participants



Female Participants



Although this four way interaction is hard to interpret, it does appear that female participants were more consistent in their responses across the variables and Experiments than their male counterparts. For all questions it appeared that irrespective of which measure was elicited as the SbS measure, the Descending sequence responses were higher than the Ascending, themselves higher than the Random sequence. For males there appeared to be great variability in responses as a function of the characteristics of the task.

Percentage of Trials

A four-way ANOVA [2(Experiment) x 2(Response Mode) x 3(Sequence) x 2(Sex)] was conducted on people's estimates of the percentage of trials that they thought they had won. This percentage was calculated by dividing the number of trials they thought they had won (Question 1) by the number of trials that they thought there had been (Question 2), expressed as a percentage and then as a ratio as in the above analysis. Table 2.14 below shows the ANOVA output that resulted, (also in Appendix 3o).

Table 2.14. ANOVA table for the Battery Item Analysis (Percentage of Trials) in the Combined Analysis of Experiments 1, 2 and 3

1- EXPERIMENT, 2-RESPONSEMODE, 3- SEQUENCE, 4-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	2	6.016687	324	.750418	8.01778	.000399
2	1	.003869	324	.750418	.00516	.942803
3	2	8.804175	324	.750418	11.73236	.000012
4	1	.694744	324	.750418	.92581	.336672
12	2	.280006	324	.750418	.37313	.688869
13	4	3.701037	324	.750418	4.93197	.000715
23	2	1.358610	324	.750418	1.81047	.165228
14	2	2.564544	324	.750418	3.41749	.033982
24	1	.220636	324	.750418	.29402	.588031
34	2	2.120845	324	.750418	2.82622	.060698
123	4	.411123	324	.750418	.54786	.700717
124	2	.463122	324	.750418	.61715	.540111
134	4	3.033301	324	.750418	4.04215	.003261
234	2	.158591	324	.750418	.21134	.809613
1234	4	.330567	324	.750418	.44051	.779303

A main effect of Experiment resulted, F(2,324)=8.02, p<0.001. LSD follow up analysis confirmed that collapsed across the other variables in the analysis, participants in Experiment 3 (mean of 1.49) thought they had won a significantly higher percentage of trials than participants in both Experiment 1 (mean of 1.08) and Experiment 2 (mean of 1.14).

A main effect of Sequence resulted, F(2,324)=11.73, p<0.001. LSD follow up confirmed that the Descending sequence (mean of 1.54) participants thought they had won a significantly higher percentage of trials than both the Ascending (mean of 1.03) and the Random (mean of 1.13) sequences.

The interaction between Experiment and Sequence was significant, F(4,324)=4.93, p<0.001, and is represented in Figure 2.41.

Figure 2.41. Graph Illustrating the Two-way Interaction between Experiment and Sequence for the "Percentage of Trials" Analysis in the Combined Analysis of Experiments 1, 2 and 3

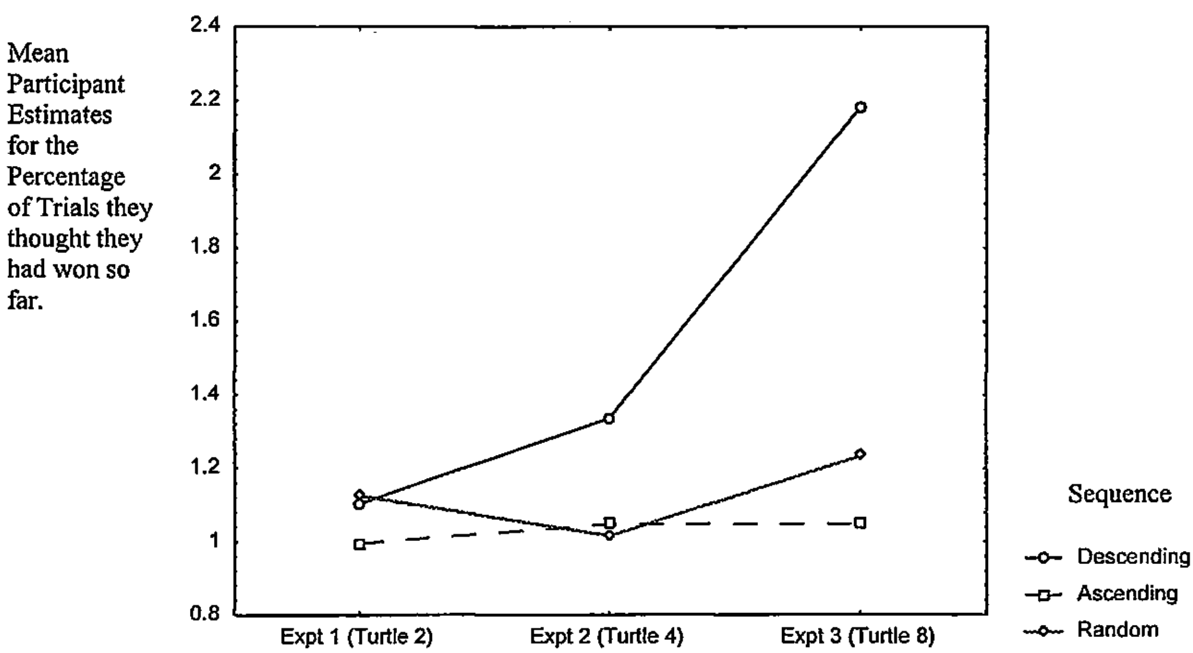
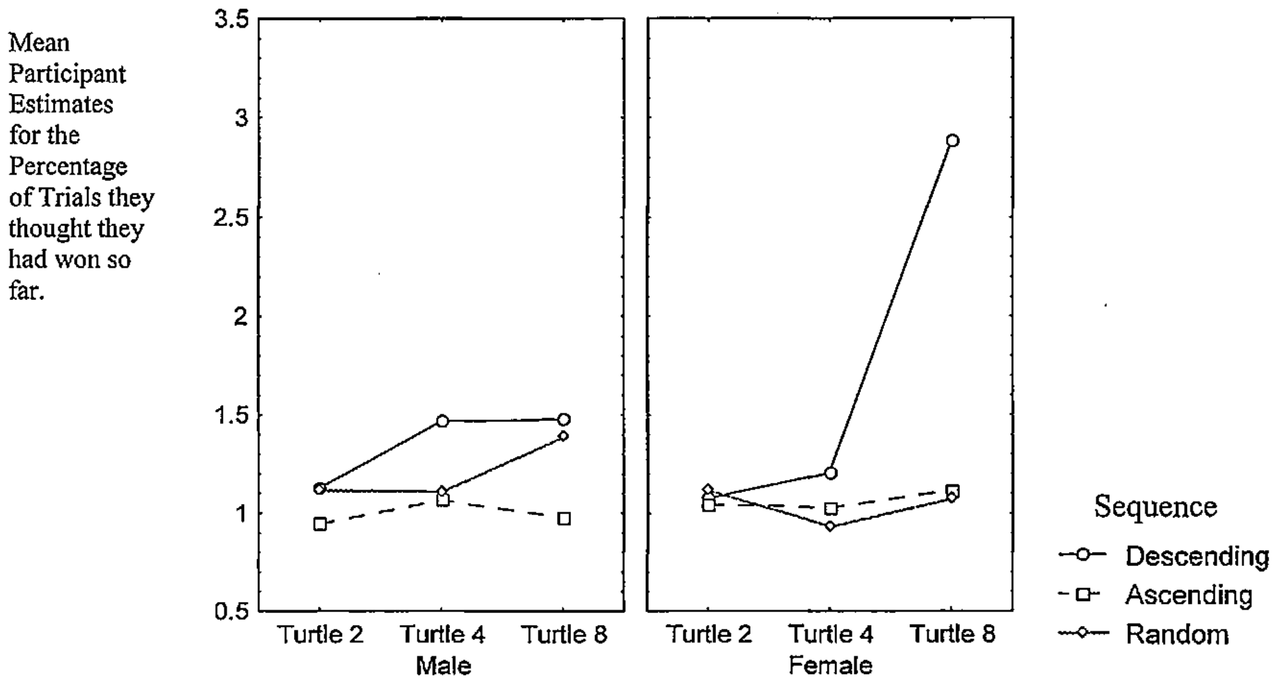


Figure 2.41 above clearly shows that Descending Sequence participants experiencing Turtle 8 (Experiment 3) significantly over-perceived the percentage of wins

that they thought they had experienced. The interaction suggests that as the probability of success in the trial decreases, the Descending sequence has a greater effect on this measure. LSD follow up analysis confirmed this, thus bigger effects appear with respect to the lowest probability task.

The interaction between Experiment and Sex was significant, $F(2,324)=3.42$, $p=0.034$. LSD follow up analysis revealed that the only significant difference was between Female's perceptions of the percentage of trials they thought they had won in Experiment 3, in that the mean for this group was significantly higher than all other groups. The three way interaction between Experiment, Sequence and Sex was also significant, $F(4,324)=4.04$, $p=0.003$, Figure 2.42.

Figure 2.42. Graph Illustrating the Three way Interaction between Experiment, Sequence and Sex for the "Percentage of Trials" Analysis in the Combined Analysis of Experiments 1, 2 and 3



This three way interaction shows that the main reason for the two way interaction between Experiment and Sex lies in the fact that the females in the Descending sequence in Experiment 3 believed they had won a significantly higher percentage of trials than females in the other sequences.

These results suggest that even though there was a tendency in the previous analyses for the Ascending sequence responses to be higher than the Random sequence responses, due to the use of an SbS response mode hence encouraging some recency effects, when it came to people's memory of past success, they were heavily influenced by the early information in the task.

How Good ?

A four-way ANOVA [2(Experiment) x 2(Response Mode) x 3(Sequence) x 2(Sex)] was conducted on perceptions of How Good participants thought they were was conducted. Table 2.15 below shows the ANOVA output that resulted (also in Appendix 3o).

Table 2.15. ANOVA table for the Battery Item Analysis (How Good ?) in the Combined Analysis of Experiments 1, 2 and 3

1- EXPERIMENT, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX

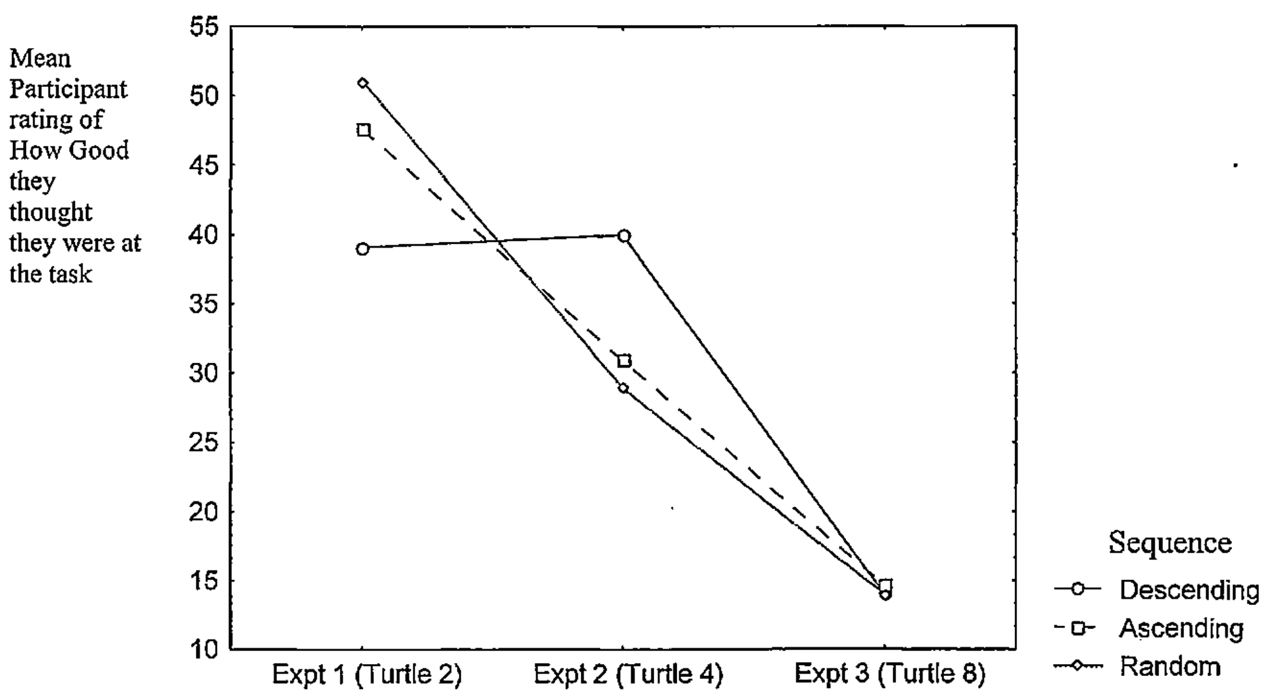
	df Effect	MS Effect	df Error	MS Error	F	p-level
1	2	30567.04	324	275.4463	110.9728	0.000000
2	1	60.84	324	275.4463	.2209	.638676
3	2	2.37	324	275.4463	.0086	.991435
4	1	368.04	324	275.4463	1.3362	.248561
12	2	153.50	324	275.4463	.5573	.573309
13	4	1446.75	324	275.4463	5.2524	.000413
23	2	320.09	324	275.4463	1.1621	.314140
14	2	639.67	324	275.4463	2.3223	.099678
24	1	.90	324	275.4463	.0033	.954452
34	2	279.75	324	275.4463	1.0156	.363323
123	4	664.31	324	275.4463	2.4117	.049025
124	2	759.86	324	275.4463	2.7586	.064867
134	4	976.42	324	275.4463	3.5448	.007553
234	2	614.06	324	275.4463	2.2293	.109249
1234	4	357.53	324	275.4463	1.2980	.270618

A main effect of Experiment resulted, F(2,324)=110.97, p<0.001. Participants in Experiment 1 thought they were significantly better (mean of 45.91) than participants in Experiment 2 (mean of 33.30) who themselves thought were better than those in Experiment 3 (mean of 14.21).

Because participants have won at a chance rate in each of the experiments, one would expect them to rate themselves as mid-way on the 0-100 How Good scale for each of the probabilities. However, it appeared that participants' responses were anchored closer to the probability inherent within the task.

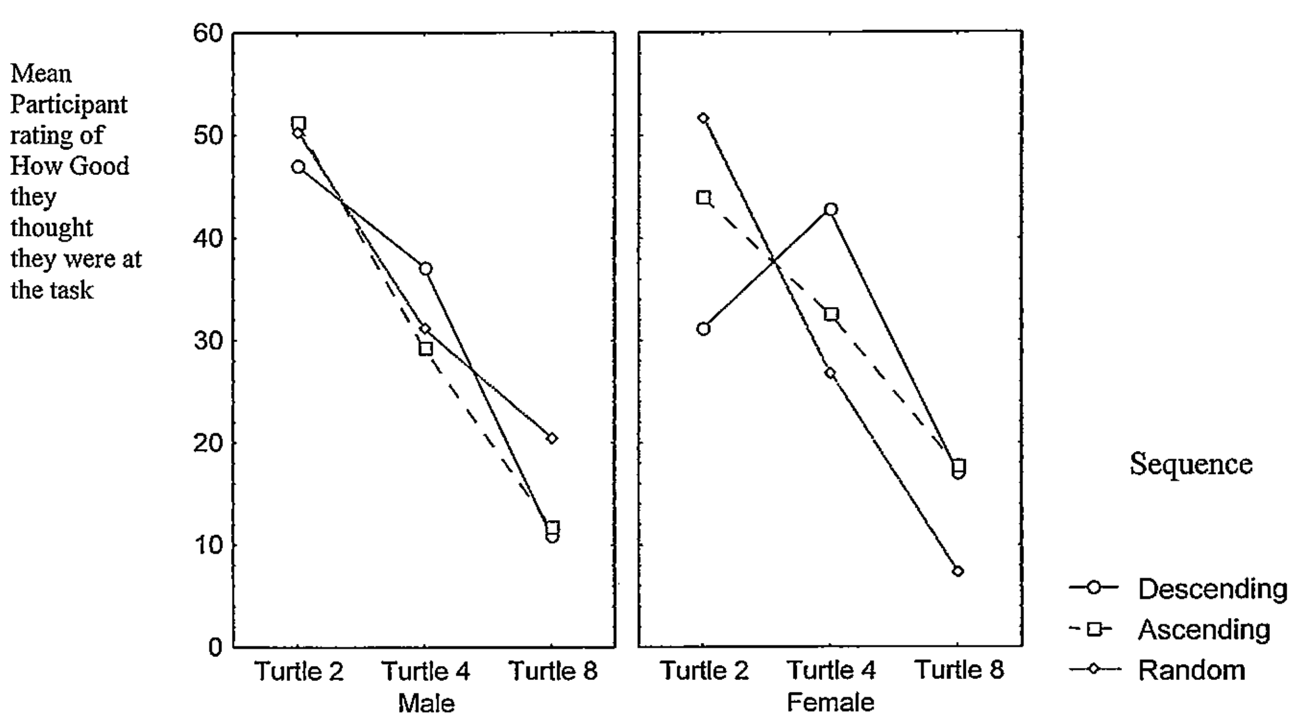
A significant interaction resulted between Experiment and Sequence, F(4,324)=5.25, p<0.001 which is represented in Figure 2.43. This confirms the individual analyses.

Figure 2.43. Graph Illustrating the Two-way Interaction between Experiment and Sequence for the "How Good" Analysis in the Combined Analysis of Experiments 1, 2 and 3



The interaction between Experiment, Sequence and Sex also resulted, F(4,324)=3.54, p=0.008. As Figure 2.44 below shows, the male participants responded in similar ways across the three Experiments, dropping their perceptions of how good they were at the task as the probability of success decreased (between-participants). However, although female participants in the Ascending and Random Sequences responded similarly to their male counterparts, there was a difference in the way that those in the Descending Sequence responded between the three Experiments. Female participants in Experiment 2 (Turtle 4) thought they were significantly better than those in both the other two sequences.

Figure 2.44. Graph Illustrating the Three-way Interaction between Experiment, Sequence and Sex for the "How Good" Analysis in the Combined Analysis of Experiments 1, 2 and 3



2.10. Conclusions

This section aims to focus the reader on the main findings from the analyses of the three Illusion of Control experiments, and to relate these to Langer and Roth's (1975) findings and the Hogarth and Einhorn (1992) belief revision model.

First of all the effect of the precise win sequence had very little effect on people's short and long term measures at the end of the task. In the individual analyses there were no main effects of Sequence resulting on these measures. The effect was significant only in the combined analysis. The effect size was very small and the fact that it came out in the combined analysis was probably due to the inflated number of participants in the analysis. Thus even if the effect is there it is unlikely to be useful in terms of offering an explanation of continued gambling. In terms of the Langer and Roth (1975) findings, they were not entirely replicated within the current experimental programme. The early win sequence did not result in significantly higher responses than the late win sequence, although the Descending sequence was higher than the Random sequence. The lack of difference between the Descending and the Ascending sequences could be explained in terms of the methodology used. Due to the use of step by step elicitation of responses all participants were encouraged to re-evaluate their confidence in the next trial or their longer term success rate predictions following each outcome throughout the sequences. Participants in the Ascending sequence were winning predominantly in the latter parts of the sequence. The fact that their responses were not significantly lower than those in the Descending sequences, suggests that these late wins had the effect of raising people's responses. Thus recency effects occurred in that participants were affected by recent outcomes. This methodology has therefore obliterated the standard order effect at the end of the task.

A general conclusion to be drawn from the results of the current experiments is in relation to participants' ability to adjust their short and long term confidence ratings on the basis of the objective probabilities of success. As the probability of success on any particular trial decreases from 0.5 (Experiment 1), to 0.25 (Experiment 2) to 0.125 (Experiment 3), people become less objective in their responses, as reflected in the main effect of Experiment. Their responses tended to be over-inflated, but became particularly over inflated when the number of possible outcomes inherent within the task increased (hence when the probability of success and the win rate decreased).

Confidence generally started off (and remained) higher than Next 100 predictions of success. What appeared to be happening was that confidence remained nearer to the 50% mark and did not appear to be as dependent upon the likelihood of success on the task, (i.e. the number of turtles in the race). This lead to severely over inflated responses when the probability of success decreased. On the other hand, Next 100 predictions were more dependent upon the objective rate of success, and as such, as the probability decreased so did people's longer term estimates of success.

When choosing between only two outcomes on a random task, participants appeared to be able to be appropriately confident, both in their Confidence in the next trial and their Next 100 responses. They became less objective in the task which was characterised by a 1 in 4 chance of success on any given trial, even in their baseline responses before any winning or losing had taken place. This was particularly the case with respect to short term confidence. The difference between the two measures became wider when the task involved eight possible outcomes on each race. Across all probability tasks, participants' confidence was higher than their Next 100 success rate predictions. The implications of this for the real gambling environment lie in the fact that when presented with a gambling opportunity, although people may realise that over time the chances that they will win more than to be expected are slim, they may bet more on individual events due to their over-confidence and lack of understanding of the independence of outcomes, and believe that they can in fact utilise recent outcome information to their benefit. This lack of understanding of the independence of events is investigated later in the thesis.

Although there are effects due to the change in the probability of the task, there are also effects in relation to the particular Response Mode employed, i.e. which measure (short or long term confidence) was elicited throughout the sequences. Focusing on the three way interaction between Experiment, Response Mode, and Measure, the main point to note is that only with the lowest probability task were there meaningful differences appearing between the two measures but only when the short term confidence measure had been elicited throughout. This interaction also displayed the observation that when people were encouraged to think longer term (about their longer term success rates) they were a lot more objective in their responses, and therefore were providing predictions much closer to the chance rate in each of the tasks.

The Step by Step analysis confirmed the suggestion that the methodology encouraged people to focus on recent information throughout the task. For each Experiment and for each sequence, the SbS measure tended to be significantly higher in periods involving a high local win rate than when the participant was experiencing a series of losses. For the Descending sequence, peoples SbS responses were initially elevated due to predominantly winning in the early stages. These responses steadily fell to values closely resembling their response they provided at the start of the task, before any trials had taken place (through the experience of progressively more losses). The reverse tended to be the case for the Ascending sequence, in which participants provided falling responses during the early stages, but then tended to rise throughout the later trials when they began to experience progressively more wins. There were some sex effects that resulted although the effect sizes were again small.

With respect to this Battery Item analysis, there was a large Sequence effect on peoples memory of past success. Those people who had won predominantly early on believed they had won a significantly higher percentage of the trials than both the late and the random win participants. This effect arose irrespective of the measure taken throughout the sequence. This does not constitute an Illusion of Control as defined by

Langer (1975, 1983) as the measure does not refer to perceived future success rates. However, it does present the paradox of why do the people who win early on over remember their past success but do not believe they will do equally well over future trials? It seems that people were dissociating between what they thought had happened and what they thought will happen. The order effect affected what they remember having happened, but had no effect on what people thought would happen in the future. Even getting people to think about the longer term throughout the task did still not alter this..

In relation to the Hogarth and Einhorn belief adjustment model (1992), the predictions made with respect to the SbS measures were upheld; using a SbS response mode appeared to induce a SbS process. People appeared to be focusing on recent outcome information when responding to the following trial. There was also some evidence in support of the models predicted effects of primacy. When the measures had not been elicited throughout, there was some evidence of the elevating effect of the early win sequence, particularly on individuals' memory of past success as noted above.

It must also be recognised that although the focus of the current work was on the Illusion of Control heuristic, there may well have also been many other heuristics and biases that may have been operating throughout the Turtle studies. The problems associated with this approach were discussed earlier in the introductory chapter.

There is of course an alternative explanation to the lack of clear order effects for the Illusion of Control. The Illusion of Control paradigm was presented here using a computer. Langer and Roth's (1975) study for example involved a more physical coin tossing experiment.

During the current methodology some participants, under the instruction of trying to influence the outcome of each race in their favour, reported that it would be impossible to influence the outcome of a computer, but indicated that a more physical task would be more predictable and controllable. The concept that the outcome could be controlled and predicted is equally fallacious with respect to both types of presentation.

It could be argued however that the presentation of the task to participants as a Psychokinesis task could in itself have instilled or encouraged the belief that participants could have some influence on the outcome. As reported, on the whole, participants were predicting much higher rates of success than the objective probability would warrant which would fit this argument. This could be explained by the fact that participants in all sequences, having received the same Psychokinesis instructions, came or were encouraged to believe that over another batch of trials they could improve their Psychokinetic ability due to "practice making perfect" where skills and abilities are relevant. However, this would not seem to be an appropriate enough explanation. This point is returned to in the general discussion section at the end of Chapter 3.

Although the difference in presentation of the otherwise identical paradigm is unlikely to be the reason for the lack of findings, there are therefore reasons why this needs investigation. Before concluding an evaluation of the Illusion of Control, the next chapter investigates whether a manual version of the 0.5 probability task produces similar results to those found with the turtle task.

3. Chapter 3: Manual versus Physical Presentation

3.1. Experiment 4

3.1.1. Introduction

One question that was raised within the discussion of the Turtle experiments was the generalisability of the results to all gambling tasks.

Within the gambling industry there are a variety of types of task that are on offer. One distinction that is apparent is the computer versus manual types. So far the experiments have utilised a computer task which may well be valid for comparison or discussion with similar type games within the industry such as video poker and fruit machines, and the developing Internet gambling market. However there are also many manual tasks that are available to the gambler, including activities such as roulette, poker and craps. It has been noted that when one is more involved with a task one is more confident (e.g. Langer and Roth, 1975) than when one is not. It could be argued that you would be more confident in an outcome when a physical action from the gambler is required, as it is easier to feel involved in something where you have to make both a decision and act on it. What needs to be evaluated therefore is whether or not the Illusion of Control effects are dependent upon the nature of the task; were the lack of effects observed in the previous experiments due to the use of the SbS measure, or was it due to the fact that the task was computer based? If the latter is true it suggests a further criterion for the Illusion of Control to develop. It also suggests that caution should be taken when generalising from the Langer and Roth study (and subsequent research), and that rather than generalising to gambling per se, the results may only offer accounts of gambling behaviour under specific gambling conditions, such as those which are characterised by physical rather than non-physical involvement of the gambler.

This raises therefore the question of both the validity of computer based laboratory tasks when investigating such phenomena such as the Illusion of Control and the more general question of ecological validity of experiments conducted in the laboratory. There have been reports that laboratory gambling research lacks this important external validity, primarily based upon not observing arousal increases in laboratory tasks, thereby labelling them as unexciting.

Anderson and Brown (1984) observed gamblers betting on blackjack in both a real and laboratory setting. The within-participant comparisons revealed that all gamblers in the real casino situation showed a higher heart rate increase (up to 58 beats per minute). When these gamblers were measured in the artificial laboratory setting, these significant heart rate increases were not observed, suggesting that laboratory research lacks ecological validity.

However, some concerns were raised as to the measurement of arousal in Chapter 1. Furthermore, laboratory studies have been shown to be arousing (Coventry and Norman 1998), when substantially increasing the level of involvement by asking participants to try to influence the outcome.

Additionally, Ladouceur, Gaboury, Bujold, Lachance and Tremblay (1991) compared both cognitive and behavioural components of video poker players during laboratory and the natural setting. There were no significant differences with respect to the level of motivation to play (measured by a five question instrument developed by Dumont and Ladouceur, 1990), with respect to the number of bets doubled throughout the play period, or with respect to the level of erroneous beliefs that were verbalised by participants. In the natural setting participants bet with their own money, whereas those in the laboratory were given an amount equal to their personal weekly bet. However, the laboratory participants were allowed to keep all winnings made from the session. What the authors observed was that the amount of money gambled in the laboratory was greater

than that gambled under the natural setting. These more recent pieces of evidence suggest that laboratory experiments do have ecological validity.

Another experiment was run in attempt to assess whether or not the lack of effects were due to the way in which the task was presented, investigating the degree of similarity that computer based tasks have with manual or physical versions. An identical paradigm was used to that of Experiment 1 although rather than the task being presented with the aid of a computer, coin tossing trials were utilised. Experiment 4 was also presented as a prediction task. The methodology was otherwise identical. Experiment 4 also therefore allowed for direct comparison of the results with those observed by Langer and Roth (1975).

One issue that was raised from discussion of the results from the Turtle experiments was that males and females were responding to wins and losses in an apparently dissimilar fashion. It was decided therefore to add on an additional sequence at the end of the paradigm. This sequence was a series of eight consecutive losses. It was hypothesised, due to female confidence having demonstrated a trend of greater fluctuation, that their confidence or SbS measures would fall throughout the period of extra losses.

3.1.2. Method

Participants

60 male and 60 female Undergraduate psychology students were recruited one by one, and equally distributed to the three Sequences, such that there were 20 males and 20 females in each Sequence. 10 males and 10 females in each Sequence responded either on a St/lt (Confidence throughout, Next 100 at end) or a Lt/st Next 100 throughout,

Confidence at end) Response Mode. Participants took part to gain a "Participation Point" which they needed as part of their undergraduate course credit requirement.

The 120 participants from the two-turtle Turtle Races in Experiment 1 were used as the comparison group.

Design and Materials

Three sequences were employed, which varied only in the positions of the wins and losses that would be experienced by each participant. They were identical to those used in Experiment 1, see Table 2.1. Participants either won predominantly early on in the task (Descending), predominantly late (Ascending) or in an apparently random fashion (Random). Within each sequence, participants were allocated either to the Ss/lt or the Lt/st response elicitation. Hence a factorial design of 2(Response Mode) x 3 (Sequence) x 2(Sex) was again employed.

The manual task chosen was that of a series of coin tossing trials. Two double-sided two pence coins (one which was double-sided heads and one which had tails on both sides) were obtained to provide a better way of controlling the outcome presented to the participants. A twelve inch screen was erected between the experimenter and participant to facilitate the changing of coins.

Procedure

Participants were seated opposite the experimenter one at a time. They were instructed that the study involved a coin prediction task, in which they were to predict the outcome of each flip of the coin. See Appendix 1 for the set of Instructions given to participants.

Following each prediction elicited, participants were asked to respond to one of two questions, (between-participants), depending upon which Response Mode they were under. As before, Participants under St/lt were asked how confident they were that their prediction for the next trial was correct prior to every trial (SbS), and asked how many trials they think they would win over the next 100 trials, at the end (EoS). The reverse was true for the other half of the participants, in the Lt/st response mode. Hence the frequency of measurement of the two measures short term Confidence and Next 100 predictions was manipulated by either eliciting them on a SbS or an EoS response mode.

To avoid stressing the association between the current task and the common use of the phrases "It's fifty-fifty" and "Flip a coin over it" an alternative scale to that of 0-100 was used. For those under the St/lt response mode, a visual short term confidence scale was placed in front of the participants, showing "Completely confident that you will lose" represented by "-5", through to "Completely confident that you will win" represented by "5"; with the centre point "0" marked "Uncertain". This scale was also shown to participants in the Lt/st at the end of all trials when they were exposed to this measure for the first time.

Participants were not told that the outcome of each flip of the coin was predetermined. Although the outcome of each trial was predetermined, the experiment was designed to give the appearance of a random task. A small screen was erected prior to the participant entering the room. The screen was erected so that the switching between the two double-sided coins could be done without the participant seeing the switch taking place. Participants were informed that their responses were being written down behind the screen. To dispel any concerns as to the use of the screen, participants were presented with the guise that the screen's presence prevented them from seeing previous participants' responses.

Following the briefing the participants first prediction was then recorded. When a win was due for any particular trial, the coin which corresponded with the participants'

prediction was used for that flip. If a loss was due, then the opposite coin was used. Participants in all Sequences won at a chance rate, hence they experienced a win on 16 of the 32 trials. Following their prediction, the SbS measure was then elicited and recorded before flipping the coin in full view of the participant.

Using this methodology the participant saw the flip of the (selected) coin from start to finish on every trial, unlike the participants in Langer and Roth's study in which they only saw the outcome on 50% of the trials. In addition to seeing the outcome, the participant was also instructed verbally whether they had won or had lost that particular trial.

Once all trials had taken place, the prediction and SbS measure for the 33rd trial was elicited. Here there was a pause in the trials when the appropriate EoS measure was elicited (short term Confidence or Next 100 predictions) followed by the question battery as used in the previous experiments; questions designed to measure other aspects related to the IoC, and participants' memory of past success.

Following the last question, participants were reminded of their latest predictions and SbS measure, and they then embarked upon an additional loss sequence. Participants were reminded of the latest prediction that they provided and of their response on the SbS measure, and the coin was flipped again. For these extra trials, all participants lost all eight trials, whilst eliciting the appropriate SbS measure.

3.1.3. Results and Discussion of Experiment 4

An identical analysis was conducted as before; the analysis of the data set was again broken up into four sections. Firstly an analysis of baseline values followed by an analysis to evaluate whether an Illusion of Control had been induced, and to see how the

short term Confidence and the Next 100 measures were affected by the two modes of responding, Step by Step or End of Sequence.

Thirdly, an analysis was conducted to see how the two measures fluctuated throughout the task following the progressive experience of each of the win Sequences. This analysis is labelled the Step by Step Analysis as it investigates changes in the SbS measures over four time periods.

The fourth stage of the analyses consists of an investigation into the effects of the variables on the measures that were not previously involved in the frequency of measurement manipulation, namely the question battery items.

The extent of the significant effect ("p" values) are reported, corrected to three decimal places. The alpha level of significance was set to $p<0.05$.

Within this data set the short term Confidence measure was made comparable to the Next 100 predictions by re-scaling the scale used, so that responses fell between 0-100, as utilised for the Next 100 measure. This was done by adding 5 to each Confidence score and then multiplying the result by 10.

3.1.3.1. Baseline Values

A three-way [2(Response Mode) x 3(Sequence) x 2(Sex)] analysis of variance (ANOVA) was conducted on baseline responses. See Appendix 4a for the ANOVA table. In this baseline analysis, Response Mode stipulated whether the measure was the Confidence or the Next 100 measure, and this variable had a main effect on responses; $F(1,108)=44.22$, $p<0.001$, such that Confidence was significantly higher than Next 100 predictions, (means of 62.67 and 47.70 respectively). No interactions or other main effects were significant. At the start of the sequence therefore, participants in the different sequences responded in a similar way to each other, although confidence responses in the next (the first) trial, were significantly higher than people's estimates of success over the Next 100 trials.

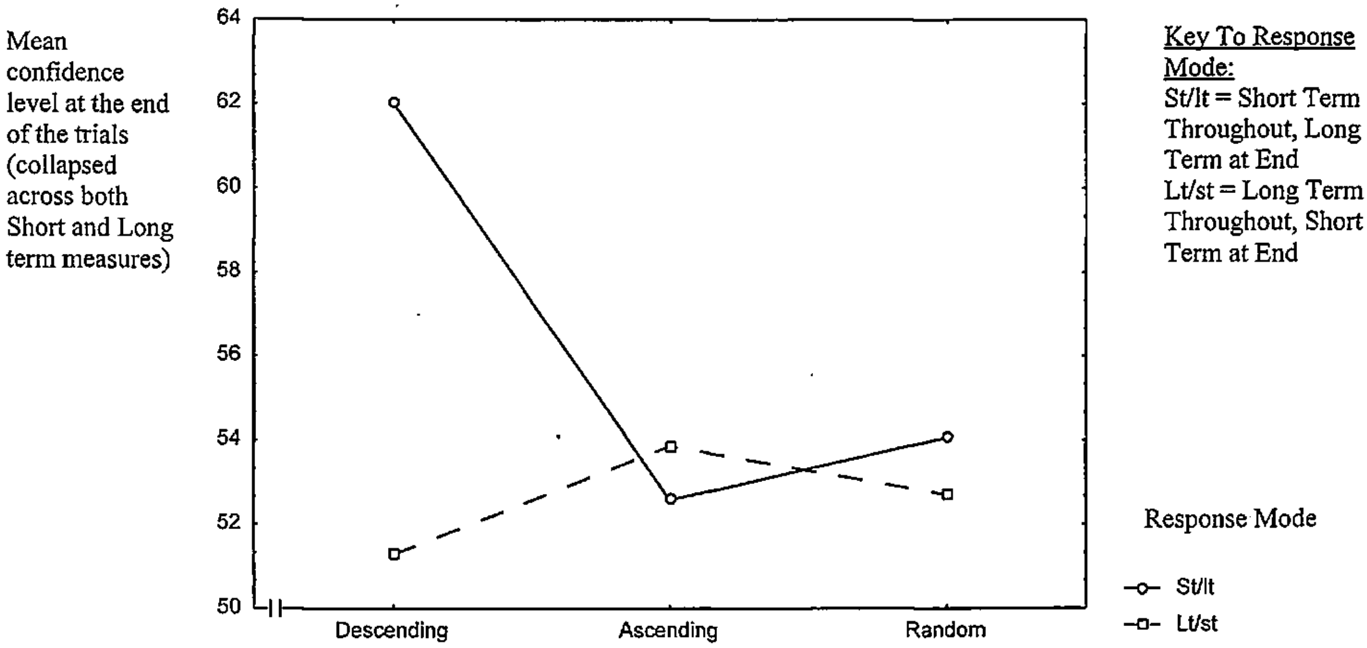
3.1.3.2. Illusion of Control: Confidence and Next 100 responses at the End of the Trials

The responses to the SbS measure after the final trial and the EoS measure were analysed using the four-way [2(Response Mode) x 3(Sequence) x 2(Sex) x 2(Measure)] design. See Appendix 4b for the ANOVA table.

A main effect of Measure resulted, $F(1,108)=97.57$, $p<0.001$. Again, Confidence (mean 62.58) was significantly higher than Next 100 predictions (mean 46.24).

The two way interaction between Response Mode and Sequence was also significant at the 5% level, $F(2,108)=3.45$, $p=0.035$. Figure 3.1 below shows that at the end of the trials there were no differences under one Response Mode (Lt/st) due to the Sequence experienced, but there were differences with respect to the other Response Mode (St/lt).

Figure 3.1. Graph Illustrating the Two-way Interaction between Response Mode and Sequence for the Illusion of Control Analysis in Experiment 4



When the longer term Next 100 measure was elicited throughout the task, there was no difference between the Sequences at the end of the task, collapsed across both measures. However, when the Next 100 measure was the EoS measure, and Confidence had been elicited throughout, a magnified Illusion of Control effect was observed; Participants who had won early on (Descending Sequence) were significantly more confident (both short and long term) than the participants in the other two Sequences.

So participants appeared to be particularly over confident both in the short term and the longer term, when they had experienced both early wins and the short term Confidence measure throughout. Getting people to consider their longer term estimates of success with every trial appeared to reduce the effect of winning early, to the point at which early win participants were no more confident on either measure than participants who experienced the other two sequences. These results suggest that a primacy effect had resulted at the end of the task, that people were not behaving according to Bayesian principles, but this was only the case when people's short term confidence was elicited throughout.

None of the other main effects or interactions were significant.

3.1.3.3. Step by Step Analysis

Again an identical analysis was conducted on the SbS measures throughout the trials as was conducted on the Turtle Two experiment data, to investigate how the measures fluctuated during the trials under the current task. A four-way ANOVA [2(Response Mode) x 3(Sequence) x 2(Sex) x 4(Period) was conducted. See Appendix 4c for the ANOVA table.

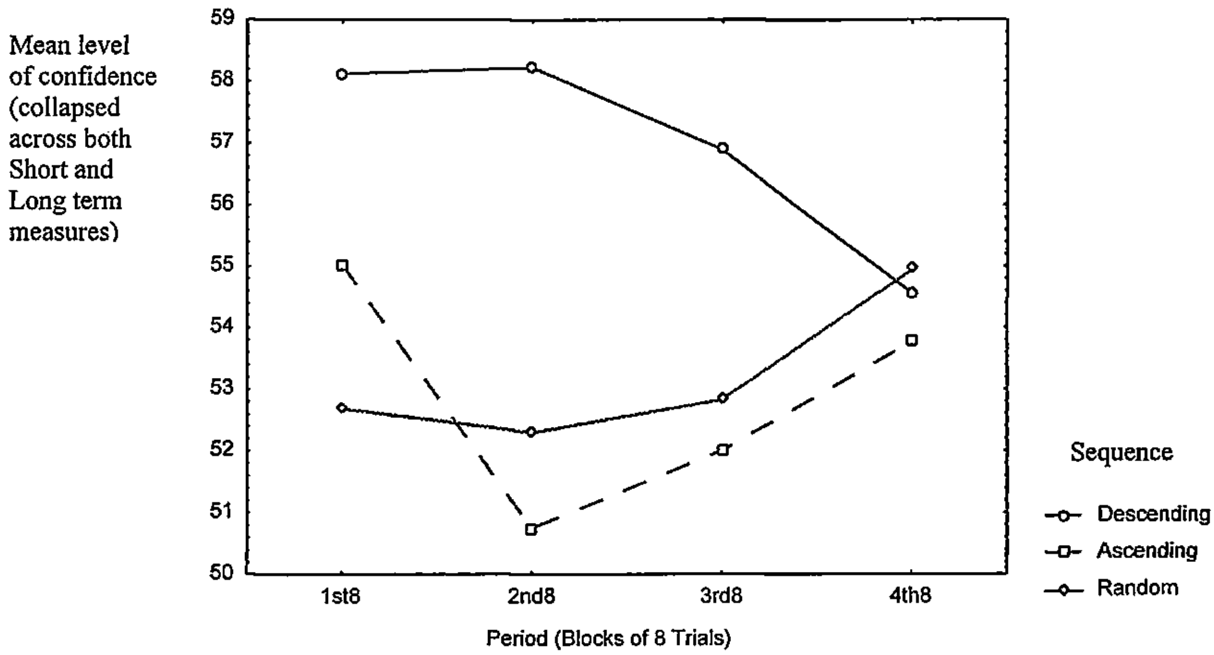
The Response Mode variable had a significant main effect on the measures (collapsed across both measures and all four Periods under analysis), $F(1,108)=88.07$, $p<0.001$. Response Mode stipulated which of the two measures was taken throughout. Again Confidence was significantly higher collapsed across all Periods and Sequences than Next 100 predictions (means of 63.08 and 45.63 respectively).

The interaction between Sequence and Period was the only other significant result obtained, $F(6,324)=3.33$, $p=0.003$. This was still significant with conservative degrees of freedom (2,108), $p=0.040$. This finding, in addition to the lack of a significant interaction between Sequence, Period and Response Mode [$F(6,324)=1.51$, $p=0.173$), suggests that the two measures were reacting in similar fashions throughout the trials, following the progressive experience of the Sequences, see Figure 3.2.

The pattern of responses throughout the trials was indeed very similar to that observed with the Turtle Two experiment. Descending Sequence participants were significantly higher in both Confidence and Next 100 predictions during the early stages of the trials. Throughout the trials their responses fell so that by the end of the trials they responded with significantly lower responses than those early stages. This can be explained by the win sequence itself, for as the number of trials increase the number of local wins that they experience falls. Ascending Sequence participants fell significantly in their responses to both measures throughout the early trials, but then rose gradually as they

began to win progressively more in later trials. The responses once all trials had been experienced were not significantly different to their starting values.

Figure 3.2. Graph Illustrating the Two-way Interaction between Sequence and Period for the Step by Step Analysis in Experiment 4



In addition, the Random Sequence, although no significant differences were observed between the periods under analysis, participants' responses to the measures demonstrated a tendency to increase in an upward fashion as the number of trials experienced increased. This latter point has been documented in previous papers, that confidence has a tendency to rise with experience (e.g. Coventry and Norman 1998), particularly if manipulated within-participants (Peterson and Pitz 1988).

3.1.3.4. Battery Items Analysis

An analysis was conducted on the question battery items relating to the perception of success in the longer-term under various imagined conditions, followed by an analysis on the memory questions, using Response Mode, Sequence, and Sex as the independent between-participant variables in the analysis. See Appendix 4d for the ANOVA tables for this section of the analysis.

Longer Term Items

Firstly an ANOVA was run on the longer-term items. A four-way ANOVA [2(Response Mode) x 3(Sequence) x 2(Sex) x 3(Measure)] was carried out, comparing the three levels of the within-participant repeated measure variable; participants' own predicted success rates, their success rates if distracted, and their perceptions of how many trials another person would win; responses to the same questions that were used in the previous experiments.

A main effect of Sequence, $F(2,108)=5.00$, $p=0.008$, resulted. LSD follow up revealed that Descending sequence participants gave significantly higher responses than participants in both the Ascending and Random sequences, means of 48.51, 41.71 and 42.37 respectively.

Males (mean 46.17) also gave significantly higher responses than females (mean 42.22); main effect of Sex $F(1,108)=4.17$, $p=0.044$.

A main effect of Measure $F(2,216)=14.23$, $p<0.001$ also resulted. Peoples' own predictions of success were significantly higher when not distracted (mean of 46.24) than when they imagined themselves to be distracted, (mean of 41.09). Collapsed across all other variables, participants felt that someone else would perform similarly to themselves, mean of 45.25.

The interaction between Response Mode and Sequence also reached significance, F(2,108)=4.07, p=0.020, see Figure 3.3.

Figure 3.3. Graph Illustrating the Two-way Interaction between Response Mode and Sequence for the "Longer Term Items" Analysis in Experiment 4

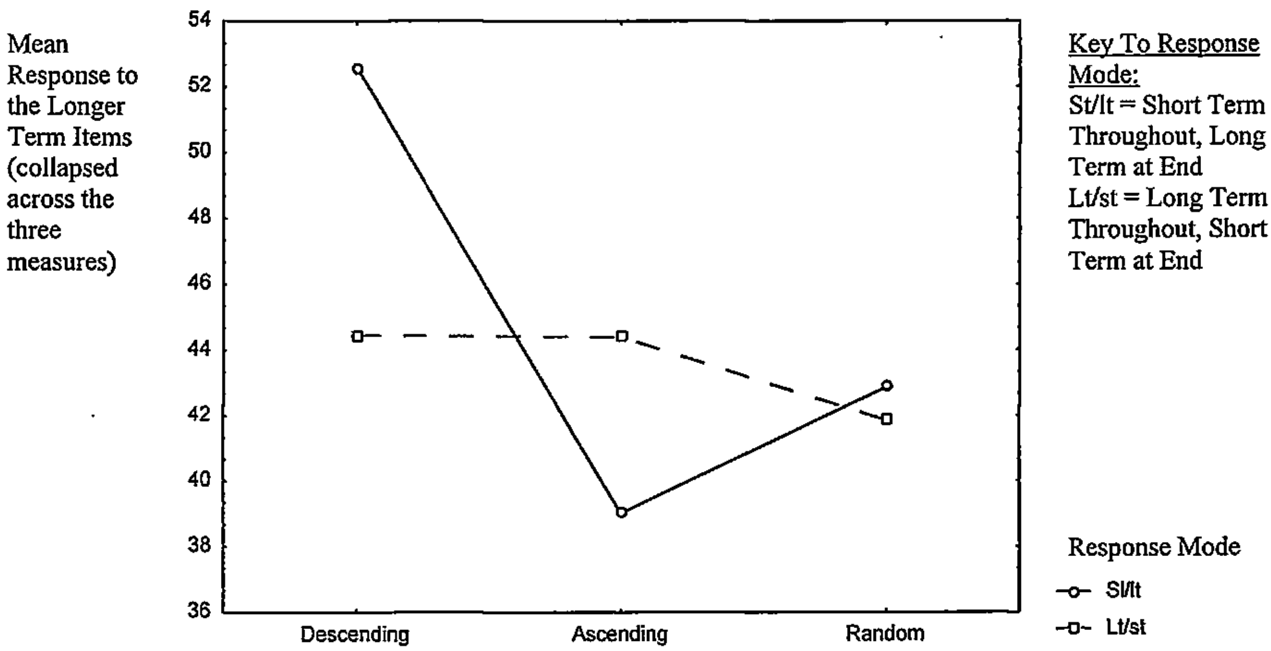
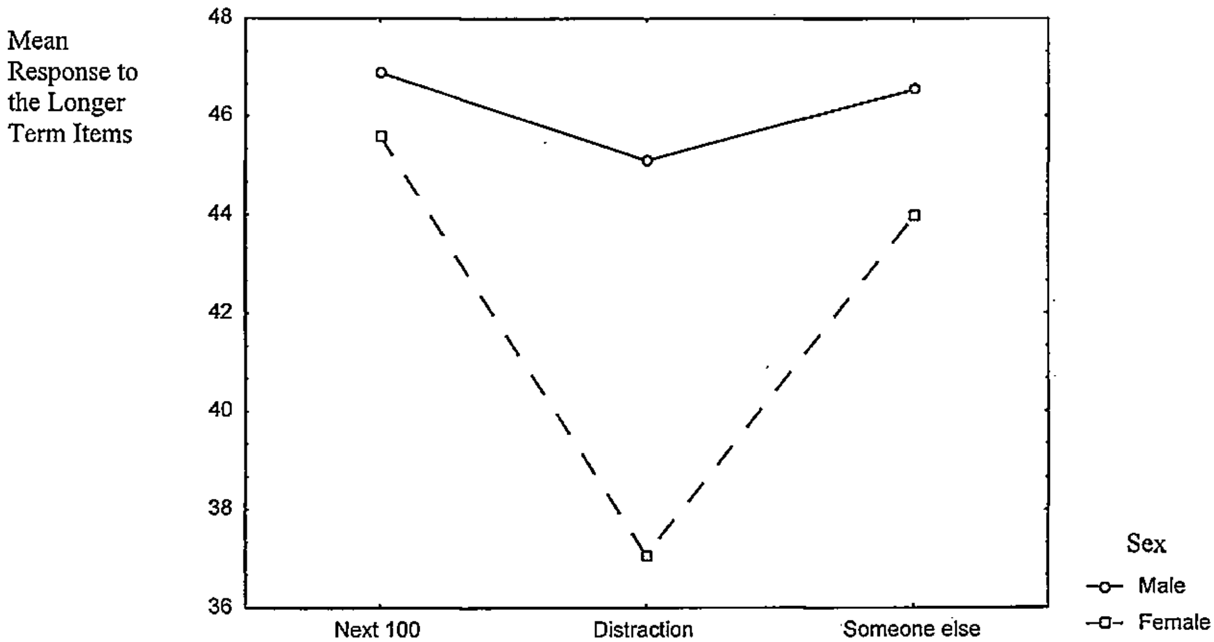


Figure 3.3 shows a similar pattern of results as was observed with the earlier analysis. As the interaction between these two variables and the Measure variable was not significant, the three measures were affected in similar ways by the frequency manipulation. Follow up analysis using the LSD method revealed that only responses from participants in the Descending sequence were significantly higher than all other comparison groups, and only for those participants under the St/lt response mode.

The interaction between Sex and Measure F(2,216)=6.09, p=0.003 was significant, see Figure 3.4 below.

Figure 3.4. Graph Illustrating the Two-way Interaction between Sex and Measure for the Step by Step Analysis in Experiment 4



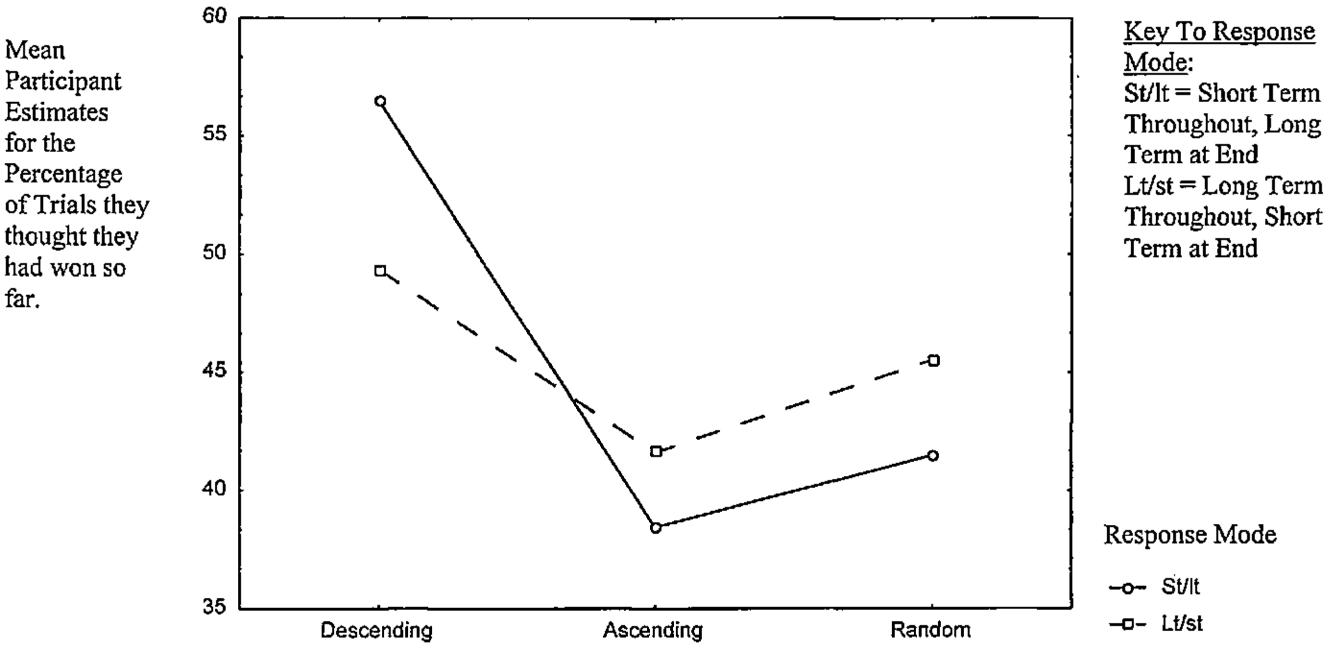
Follow up analysis revealed that the male participants did not differ in their responses to the three measures, whereas the females thought they would perform significantly worse if distracted.

Percentage of Trials

Secondly an analysis was conducted on people's estimates of the percentage of trials that they thought they had won. This percentage was calculated by dividing the number of trials they thought they had won (Question 1) by the number of trials that they thought there had been (Question 2), expressed as a percentage.

A main effect of Sequence resulted, $F(2,108)=15.66$, $p<0.001$. Descending sequence participants thought they had won a significantly higher percentage of trials (mean 52.92) than both the Ascending (mean 40.03) and Random sequences (43.51). A significant interaction between Response Mode and Sequence was also found, F(2,108)=3.38, p=0.038, and is presented in Figure 3.5.

Figure 3.5. Graph Illustrating the Two-way Interaction between Response Mode and Sequence for the "Percentage of Trials" Analysis in Experiment 4



From the figure it is apparent that when the Next 100 measure was elicited throughout, the Descending sequence responses were significantly higher than the Ascending sequence (but not Random), but when Confidence was the SbS measure Descending sequence responses were significantly higher than both the other two sequences. For the Ascending sequence, responses were significantly higher when the Next 100 measure was elicited throughout than when the Confidence measure was. The reverse was true for the Descending sequence, where participants thought they had won a significantly higher percentage than participants in the same sequence but who responded with the Next 100 throughout. However, the Descending sequence participants under both Response Modes responded significantly higher than those experiencing the Ascending sequence. LSD follow up analysis confirmed this.

How Good ?

Thirdly, a three-way ANOVA [2(Response Mode) x 3(Sequence) x 2(Sex)] was conducted on perceptions of How Good participants thought they were was then carried out.

A main effect of Sequence resulted, $F(1,108)=8.09$, $p<0.001$, in the predicted direction. Descending Sequence participants thought that they were significantly better at the task than either of the two other sequences. See Table 3.1 for the means.

An interesting point with the lack of a significant main effect of (or interaction with) Response Mode, is that this suggests that there is no overlap of the SbS measures on this How Good measure. It therefore appears that whichever Step by Step measure is used throughout the task, there is no effect on this End of Sequence measure. Participants' perceptions of How Good they were, were significantly correlated (Pearson Product-Moment Correlation, $r=0.42$, $N=120$, $p<0.05$) with their predictions for their success rates over the next 100 trials, which would be expected.

Table 3.1. Means for Participants' perceptions of How Good they were at the task

	How Good?
Descending	61.00
Ascending	50.00
Random	50.25

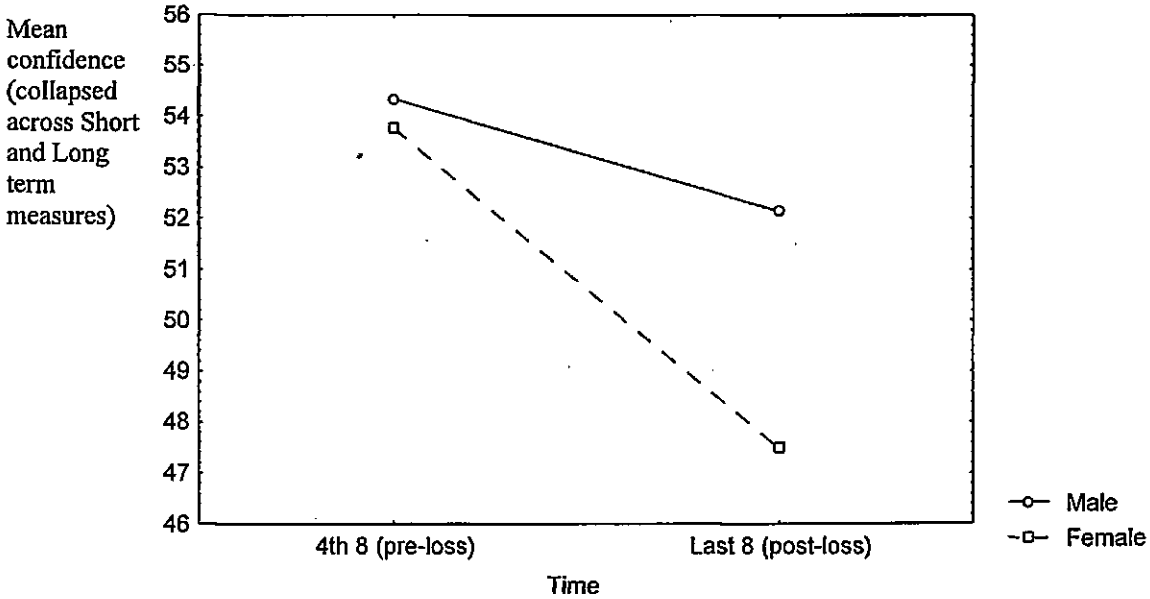
3.1.3.5. Extra Loss Sequence

The same SbS measures were elicited throughout the additional loss sequence experienced by all participants (8 consecutive losses). The average response over the last eight trials was calculated and compared with the average response over the last eight trials of the main sequence, and a 2(Response Mode) x 3(Sequence) x 2(Sex) x 2(Time) ANOVA was conducted. See Appendix 4e for the ANOVA table for this analysis.

A main effect of Response Mode reappeared, $F(1,108)=64.76$, $p<0.001$, such that again Confidence responses were significantly higher than Next 100 predictions, means of 60.17 and 43.69 respectively. The extra series of losses also had a main effect on responses, significantly reducing people's responses from a mean of 54.05 at the end of the main sequence, to a mean of 49.81 after the sequence of losses; $F(1,108)=23.42$, $p<0.001$.

As predicted from the previous observation that males and females did not tend to react in the same way to the experience of wins and losses, the interaction between Sex and Time (pre or post loss sequence) was also significant, $F(1,108)=5.46$, $p=0.021$. As Figure 3.6 below shows, the females' average responses dropped significantly from 53.76 to 47.48, whereas males remained relatively stable (54.34 to 52.14). This confirms that females were affected more overall than their male counterparts by a series of consecutive losses. The observation that male participants on the whole did not fall in confidence (across both short term and longer term confidence) could offer a part explanation for why the majority of problem gamblers are male. Whereas females appeared to be under the belief that if they have just experienced a loss another loss is equally likely (perhaps perceived it to be more likely), this was not the case for the males.

Figure 3.6. Graph Illustrating the Two way Interaction between Time (pre/post loss sequence) and Sex in Experiment 4



3.2. General Discussion and Comparison of Experiment 4 and Experiment 1

3.2.1. Introduction

The two types of task that were used, as already discussed, resembled each other in every way apart from the method of presentation of the Illusion of Control paradigm. The three distinctive and important differences between the two Experiments were that firstly Experiment 1 was presented to participants with the use of a computer, whilst Experiment 4 was presented with the use of real coin tossing (physical). Secondly, Experiment 1 was presented to participants as a Psychokinesis task, whilst Experiment 4 was presented as a Coin Prediction task. Thirdly, Experiment 1 used Turtles as icons whilst Experiment 4 used coins. Comparisons can however be made between the two types of task as essentially every other detail regarding the paradigm was identical, although discussion of the potential effects of these differences will be presented in the general discussion section towards the end of this chapter.

Due to the observations that the more involved people are in a task and the more familiar the task is, the greater the illusion of control induced, (e.g. Langer and Roth 1975) one might expect that participants may rate themselves as better at the computer based paradigm. With this presentation, it is the participant who makes the physical actions throughout the trials. Here, the participant had control over many facets of the experiment, including the speed at which they progressed through the trials, and physically choosing their outcome. This may have lead them to feel more involved and more in control of the task. This might have resulted in these participants having had higher perceptions of how good they were at the task as compared to the manual task in which the Experimenter conducted the physical movements for each trial. Due to computer games being played predominantly by males, one may additionally expect that males would rate themselves as better than females.

Alternatively, participants may have felt that the outcomes on the computer task were more likely to be predetermined and therefore more fixable than fixing the outcome from flipping a coin.

Preferences for gambling activities are observably differentiated between the sexes. Particular games are often predominantly played by one sex. Bingo for example is played predominantly by females, whereas casino games and horse racing are predominantly played by males. A comparison between the two tasks may highlight some differences with respect to the two presentation types.

As the main influence on confidence and Next 100 measures throughout the trials has appeared so far to be whether a win or loss was experienced in the previous trial, the step by step measures would be expected to fluctuate in similar ways across the two tasks.

With respect to the baseline confidence measures, the manual presentation of the task resulted in higher responses than for the computer presentation. However, for both experiments there were no interactions with any other variables. By the end of the trials in both experiments the short term measure was significantly higher than the Next 100 measure.

In terms of whether the Illusion of Control was induced by the end of the trials, there was no apparent clear effect resulting. There were signs however which replicated the Langer and Roth findings of exaggerated long term success predictions, but only under the specific condition of the measure having only been elicited at the end of the task (as an EoS measure).

With respect to the Step by Step measures taken throughout the task, the participants responded in very similar ways between the two experiments. It appeared that the individuals were basing their responses on a trial by trial basis, focusing on the outcome of the recent local trials for the basis of their Confidence or updated Next 100 perceptions.

For the items that were not included in the manipulation of the frequency of measurement, participants across the two studies responded in similar ways on the basis of the sequence which they had experienced. On peoples memory of past success, those in the early win sequence believed they had won a significantly higher percentage of trials than participants in the other conditions. These individuals also tended to believe they were significantly better at the task, which would be expected considering they thought they had had a higher success rate. It appeared therefore, that these other EoS measures were not affected by which of the two SbS measures had previously been elicited.

With these EoS measures there were a few differences arising between males and females for those experiencing the computer presentation. It appeared that for the How Good measure the sequence only had a significant differential effect for the two sexes with respect to the Descending early win sequence. Males in this sequence thought that they were significantly better at the task than their female counterparts. This difference was also true of the participants' memory of past success where males and females responded similarly following the experience of the Ascending and Random sequences, but differently (males significantly higher) under the Descending sequence. Both of these findings suggest that the early information is important, and specifically the early wins which occur during this latter sequence.

The following section serves to evaluate whether the lack of strong Illusion of Control effects observed with the Turtle experiments (1, 2 and 3) was due to the fact that the task was too different from the Langer and Roth (1975) study to expect similar results, or whether the use of the current methodology (utilising Step by Step measures) was the main reason. This section therefore addresses, in a combined analysis, the issue of ecological validity of computer based laboratory gambling tasks.

The data was coded such that an additional variable was included in the analysis, which stipulated the Type of task; whether the data was obtained under the manual and physical coin flipping task, or from the Turtle Races with two turtles in each race.

Hence a factorial design for the following analysis of 2(Type) x 2(Response Mode) x 3 (Sequence) x 2(Sex) was employed. The between-participant variable characteristics were: Type, physical or computer task; Response Mode, defining which measure was elicited throughout and which measure was elicited once only at the end of the sequence; Sequence, defining whether the participant experienced the Descending, Ascending or Random sequence; and Sex. The alpha level of significance was again set at $p<0.05$.

As with the previous combined analysis, the focus here was on the main effects of the variable Type, and the interactions that this had with the other independent variables.

3.2.2. Illusion of Control: Confidence and Next 100 responses at the End of the Trials

The responses to the SbS measure after the final trial and the EoS measure were analysed using a five-way [2(Type) x 2(Response Mode) x 3(Sequence) x 2(Sex) x 2(Measure)] design. Table 3.2 below shows the ANOVA table for this section (also presented in Appendix 4f).

Table 3.2. ANOVA Table for the Illusion of Control Analysis in the Combined Analysis of Experiments 4 and 1

1-TYPE, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX, 5-MEASURE

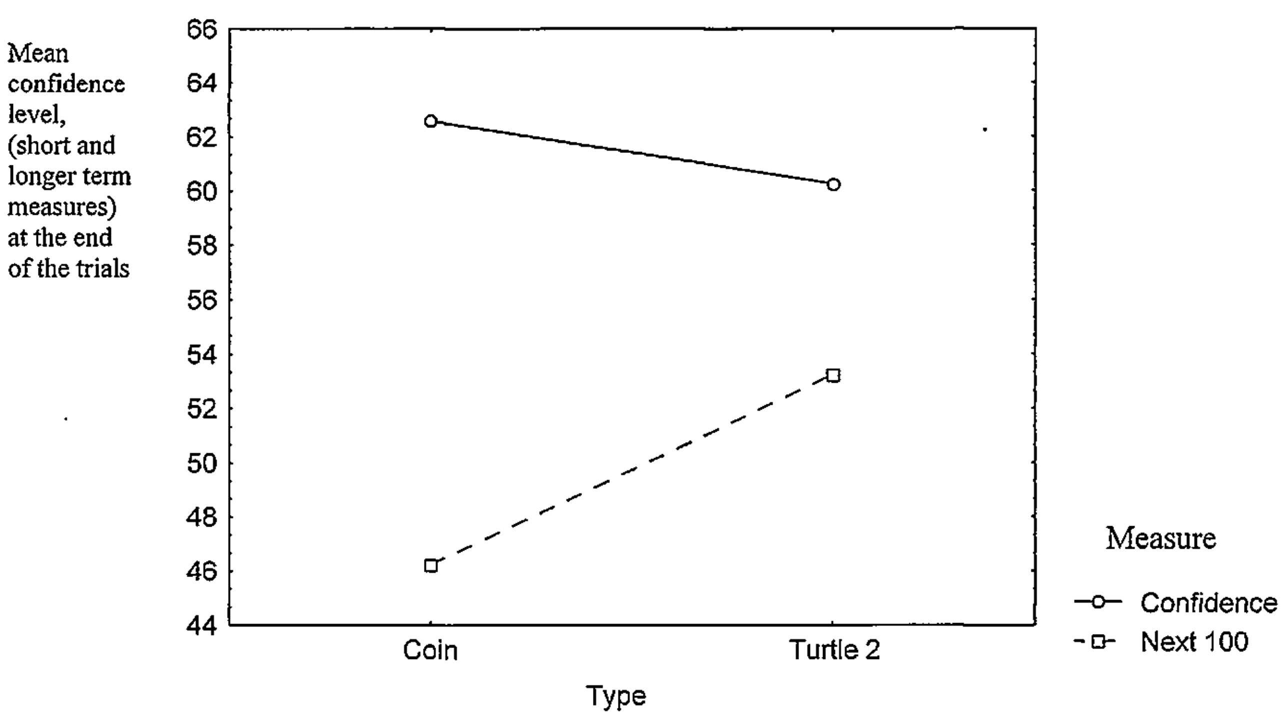
	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	653.33	216	384.3792	1.69971	.193714
2	1	1512.30	216	384.3792	3.93440	.048575
3	2	201.61	216	384.3792	.52452	.592591
4	1	5.21	216	384.3792	.01355	.907440
5	1	16380.03	216	221.2245	74.04257	.000000
12	1	.41	216	384.3792	.00106	.974029
13	2	129.25	216	384.3792	.33626	.714809
23	2	1405.39	216	384.3792	3.65627	.027440
14	1	43.20	216	384.3792	.11239	.737766
24	1	30.00	216	384.3792	.07805	.780228
34	2	650.40	216	384.3792	1.69208	.186567
15	1	2604.01	216	221.2245	11.77088	.000721
25	1	221.41	216	221.2245	1.00083	.318229
35	2	.46	216	221.2245	.00210	.997902
45	1	22.53	216	221.2245	.10186	.749920
123	2	7.79	216	384.3792	.02027	.979940
124	1	755.01	216	384.3792	1.96423	.162497
134	2	43.28	216	384.3792	.11260	.893560
234	2	303.01	216	384.3792	.78830	.455920
125	1	418.13	216	221.2245	1.89009	.170617
135	2	851.08	216	221.2245	3.84712	.022818
235	2	112.98	216	221.2245	.51069	.600804
145	1	25.21	216	221.2245	.11395	.736020
245	1	49.41	216	221.2245	.22334	.636984
345	2	188.13	216	221.2245	.85039	.428674
1234	2	157.58	216	384.3792	.40995	.664197
1235	2	106.76	216	221.2245	.48261	.617836
1245	1	34.13	216	221.2245	.15429	.694854
1345	2	761.41	216	221.2245	3.44182	.033772
2345	2	16.21	216	221.2245	.07329	.929350
12345	2	28.78	216	221.2245	.13008	.878093

The main effect of Response Mode F(1,216)=3.93, p=0.049 and the interaction between Response Mode and Sequence F(2,216)=3.66, p=0.027 were as before. The main effect of Type did not appear, F(1,216)=1.70, p=0.194.

A main effect of Measure appeared, F(1,216)=74.04, p<0.001, at the end of the trials, mean Confidence was 61.42 whereas Next 100 predictions had a mean of 49.74.

An interaction between Type and Measure was also significant, F(1,216)=11.77. p<0.001. From viewing the Figure 3.7 below, it can be seen that for the Confidence measure, collapsed across both Response Modes, there was little difference between the participants' responses in the two types of task.

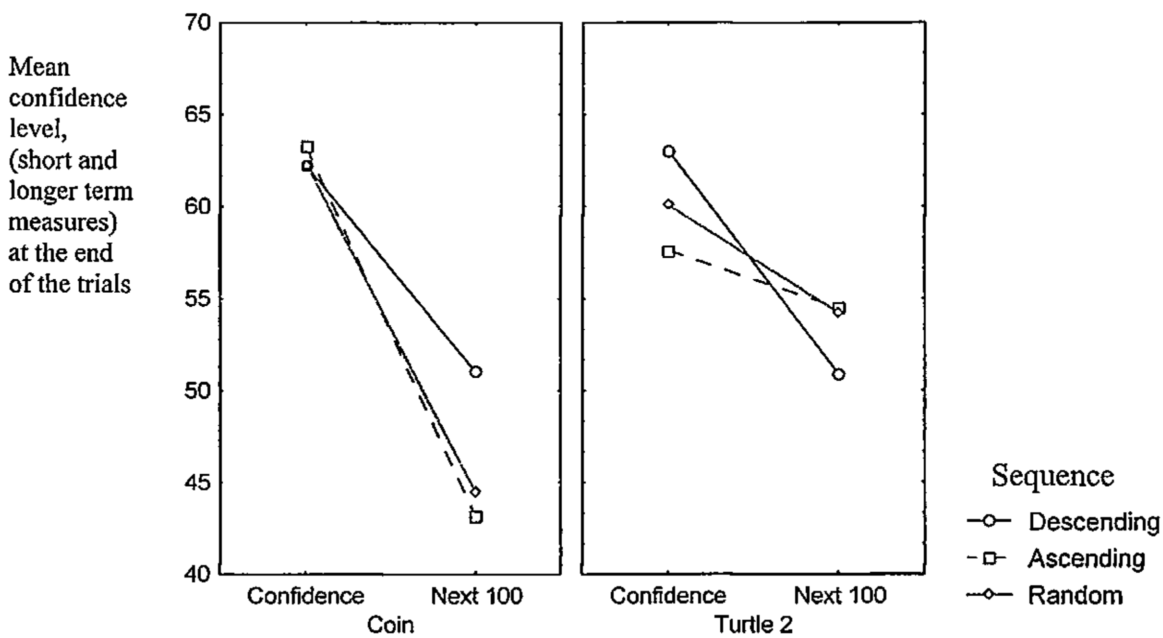
Figure 3.7. Graph Illustrating the Two-way interaction between Type and Measure for the Illusion of Control Analysis in the Combined Analysis of Experiments 1 and 4



However, Confidence was significantly higher than Next 100 predictions in both types of task. In addition to this, participants in the computer task predicted significantly higher Next 100 success rates than those doing the coin prediction task. Follow up using the LSD method confirmed this. This suggests that there is some differential effect of the

task on the one measure, namely the Next 100 predictions, but not the other. More information can be obtained however from looking at the significant three way interaction between Type, Sequence and Measure, F(2,216)=3.85, p=0.023. Figure 3.8 represents this interaction graphically.

Figure 3.8. Graph Illustrating the Three-way interaction between Type, Sequence and Measure for the Illusion of Control Analysis in the Combined Analysis of Experiments 1 and 4



For the Confidence measure there were no effects of Sequence in either the coin or the Turtle trials. For the Next 100 measure there was no effect of Sequence in the Turtle trials but the standard order effect was observed for the coin trials, in which the early wins lead to significantly higher longer term estimates of success.

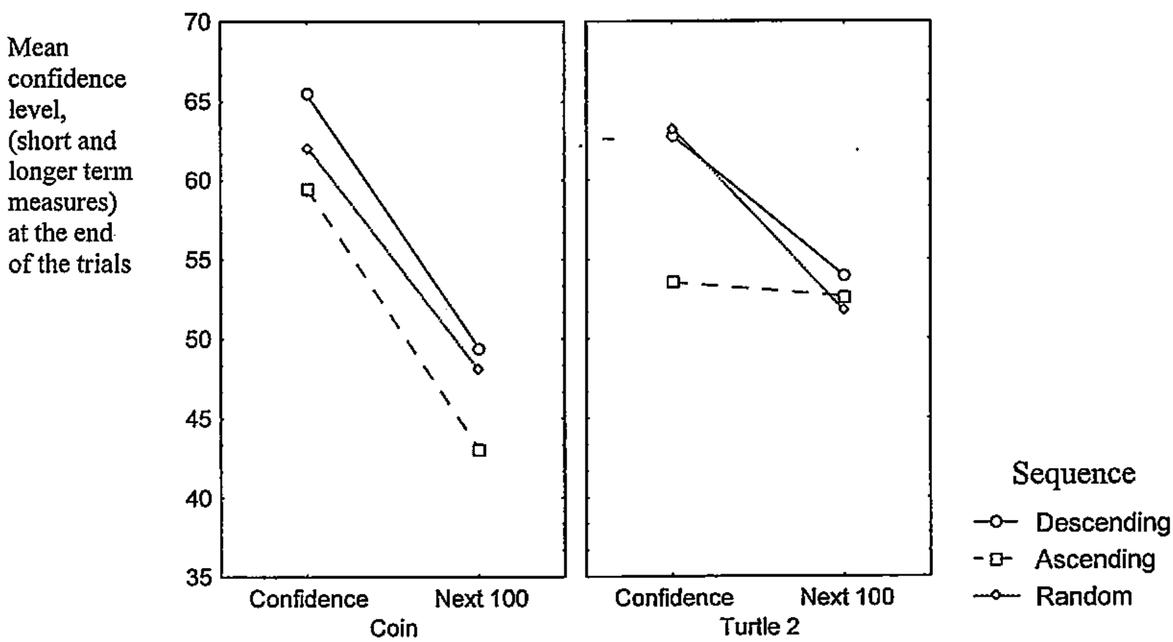
However, this effect occurred when collapsing across the Response Mode, and so no information is provided in relation to how the two measures react to the different tasks when elicited by either a SbS or an EoS Response Mode. The lack of significant interactions between the Response Mode variable and Type, or Measure, suggests that the two measures were affected in similar fashions by the Sequences in both studies under both response elicitation modes.

A four way interaction between Type, Sequence, Sex and Measure resulted, $F(2,216)=3.44$, $p=0.034$. See Figure 3.9 below.

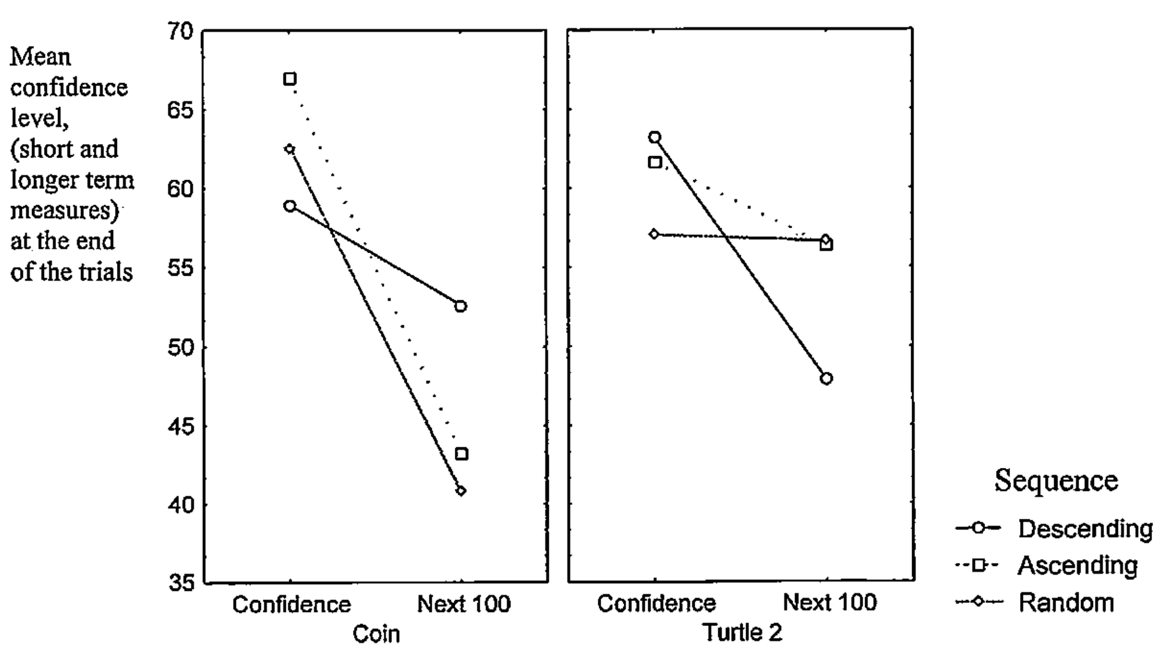
This suggests that males and females react somewhat differently to the two types of task in relation to their responses on the two measures. One point to note about this interaction is that with the coin trials, the Sequences appear to have similar effects on the two measures in male participants, but not females, albeit that Confidence is significantly higher than Next 100 predictions. Perhaps the main point to note is that again the assumption that males and females respond in the same way when making decisions on uncertain events, is not upheld. It appears that there are differences in terms of how they are affected by the task characteristics.

Figure 3.9. Graph Illustrating the Four way interaction between Type, Sequence, Sex and Measure for the Illusion of Control Analysis in the Combined Analysis of Experiments 1 and 4

Male Participants



Female Participants



3.2.3. Step by Step Analysis

This analysis of variance was to investigate whether there were any differences in the Step by Step measure taken throughout the task between the two tasks. The measures taken on a trial by trial basis were averaged into four blocks of eight trials and an identical Period analysis was conducted on the combined data set for the coin flipping and the Turtle races, as to that conducted previously; a five-way ANOVA [2(Type) x 2(Response Mode) x 3(Sequence) x 2(Sex) x 4(Period). Table 3.3 below shows that results of this ANOVA, (also in Appendix 4g).

Table 3.3. ANOVA Table for the Step by Step Analysis in the Combined Analysis of Experiments 4 and 1

1-TYPE, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX, 5-PERIOD

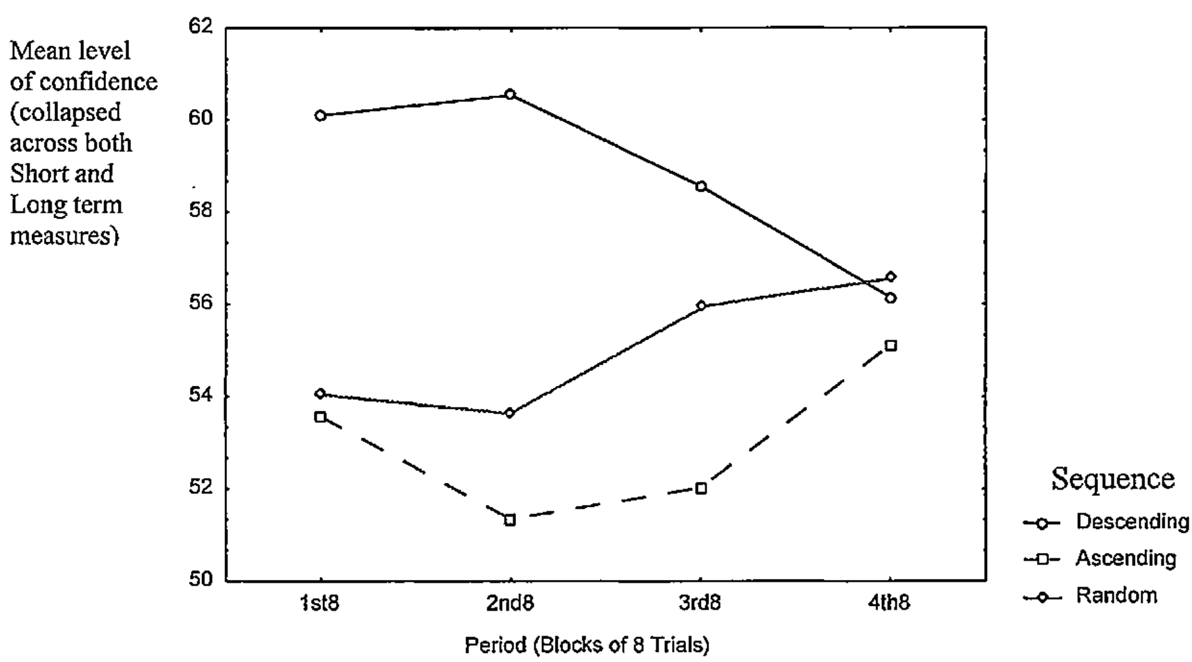
	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	1591.35	216	800.2333	1.98861	.159925
2	1	46530.39	216	800.2333	58.14603	.000000
3	2	2796.93	216	800.2333	3.49514	.032072
4	1	319.70	216	800.2333	.39951	.528009
5	3	31.65	648	69.1027	.45800	.711731
12	1	2981.27	216	800.2333	3.72550	.054897
13	2	324.92	216	800.2333	.40603	.666800
23	2	109.26	216	800.2333	.13653	.872455
14	1	225.48	216	800.2333	.28176	.596093
24	1	73.84	216	800.2333	.09228	.761595
34	2	114.67	216	800.2333	.14330	.866577
15	3	46.79	648	69.1027	.67704	.566305
25	3	18.25	648	69.1027	.26416	.851233
35	6	335.13	648	69.1027	4.84977	.000074
45	3	126.29	648	69.1027	1.82754	.140822
123	2	256.01	216	800.2333	.31992	.726553
124	1	338.44	216	800.2333	.42292	.516173
134	2	1084.04	216	800.2333	1.35466	.260219
234	2	575.05	216	800.2333	.71861	.488593
125	3	13.97	648	69.1027	.20211	.894943
135	6	66.42	648	69.1027	.96111	.450739
235	6	132.76	648	69.1027	1.92121	.075128
145	3	34.38	648	69.1027	.49753	.684115
245	3	45.31	648	69.1027	.65569	.579578
345	6	35.40	648	69.1027	.51232	.799233
1234	2	.85	216	800.2333	.00106	.998941
1235	6	101.03	648	69.1027	1.46207	.188713
1245	3	54.46	648	69.1027	.78803	.500821
1345	6	92.28	648	69.1027	1.33537	.239014
2345	6	35.58	648	69.1027	.51485	.797312
12345	6	148.05	648	69.1027	2.14253	.046863

A main effect of Response Mode resulted, $F(1,216)=58.15$, $p<0.001$. This just confirms again that Confidence was significantly higher overall (mean 62.60) than Next 100 success rate predictions, mean of 48.68. A main effect of Type did not result, $F(1,216)=1.99$, $p=0.160$.

A significant main effect resulted of Sequence, $F(2,216)=3.50$, $p=0.032$. Follow up analysis with the LSD method confirmed that the difference lay between the Descending sequence mean (58.84) and Ascending sequence mean, (53.01). The Random sequence did not differ from either of the other two sequences, mean of 55.07.

More interesting though, there was an interaction between Sequence and Period which was highly significant, $F(6,648)=4.85$, $p<0.001$, see Figure 3.10 for the plot of means.

Figure 3.10. Graph Illustrating the Two-way Interaction between Sequence and Period for the Step by Step Analysis in the Combined Analysis of Experiments 1 and 4



The figure clearly demonstrates that the SbS measures reacted as they did in each of the previous Turtle experiments, with the Descending sequence resulting in high responses in the early stages, falling as participants experience progressively more losses, whilst in the Ascending sequence, participants decrease in their confidence responses in the early stages, but increase as the number of trials and the number of wins increases. The lack of a three way interaction with these variables and the Type variable, $F(6,648)=0.96$, $p=0.451$, suggests that throughout the trials the SbS measures react similarly under both types of task. This further suggests that the decision making that has been taking place and the expression of confidence throughout the process appears to be very similar for both the physical and the computer based task.

3.2.4. Battery Items Analysis

An ANOVA was conducted on the question battery items relating to the perception of success in the longer-term under various imagined conditions, followed by an analysis on the memory questions, using Response Mode, Sequence, and Sex as the independent variables in the analysis. See Appendix 4h for the ANOVA tables in this analysis.

Longer Term Items

Firstly analysis was run on the longer-term items, comparing participants' own predicted success rates, their success rates if distracted, and their perceptions of how many trials another person would win. Table 3.4 below shows the output that resulted from this analysis.

Table 3.4. ANOVA table for the Battery Item Analysis (Longer Term Items) in the Combined Analysis of Experiments 1 and 4

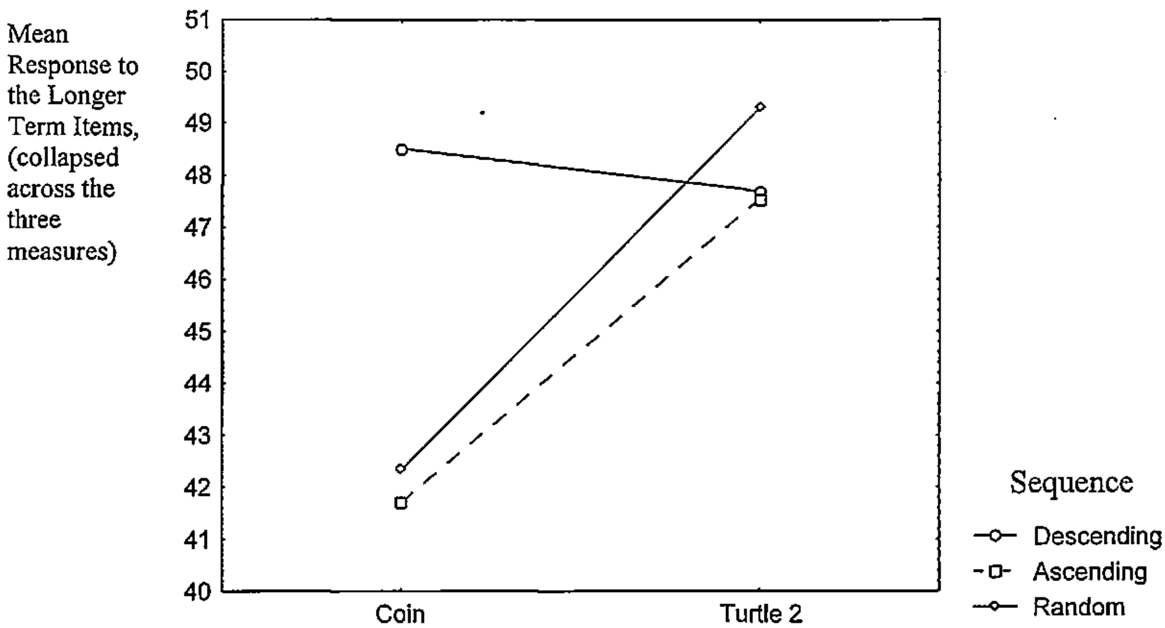
1-TYPE, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX, 5-MEASURE

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	2868.012	216	345.5927	8.29882	.004367
2	1	391.612	216	345.5927	1.13316	.288290
3	2	745.893	216	345.5927	2.15830	.118006
4	1	1203.835	216	345.5927	3.48339	.063343
5	2	3845.968	432	118.5464	32.44271	.000000
12	1	8.668	216	345.5927	.02508	.874312
13	2	1059.387	216	345.5927	3.06542	.048668
23	2	1607.113	216	345.5927	4.65031	.010536
14	1	337.568	216	345.5927	.97678	.324101
24	1	49.612	216	345.5927	.14356	.705142
34	2	40.401	216	345.5927	.11690	.889726
15	2	462.038	432	118.5464	3.89752	.021010
25	2	31.929	432	118.5464	.26934	.764013
35	4	55.974	432	118.5464	.47217	.756179
45	2	379.935	432	118.5464	3.20494	.041527
123	2	192.735	216	345.5927	.55769	.573350
124	1	15.901	216	345.5927	.04601	.830356
134	2	1046.551	216	345.5927	3.02828	.050459
234	2	123.754	216	345.5927	.35809	.699423
125	2	206.110	432	118.5464	1.73864	.176987
135	4	116.181	432	118.5464	.98005	.418111
235	4	99.748	432	118.5464	.84142	.499419
145	2	99.360	432	118.5464	.83815	.433212
245	2	101.129	432	118.5464	.85308	.426819
345	4	94.670	432	118.5464	.79859	.526553
1234	2	250.343	216	345.5927	.72439	.485795
1235	4	57.008	432	118.5464	.48089	.749786
1245	2	370.476	432	118.5464	3.12516	.044925
1345	4	27.824	432	118.5464	.23471	.918754
2345	4	41.302	432	118.5464	.34840	.845135
12345	4	68.137	432	118.5464	.57477	.681082

A main effect of Type resulted, F(1,216)=8.30, p=0.044. The Next 100 predictions were significantly higher after the Turtle computer task (mean 48.19) than they were after the coin flipping experiment (mean 44.19).

An interaction between Type and Sequence resulted, F(2,216)=3.07, p=0.049, Figure 3.11. With the coin trials the standard order effect resulted in that collapsed across the three measures, the Descending sequence resulted in significantly higher responses than the other two sequences. However, this did not result for those experiencing the Turtle task.

Figure 3.11. Graph Illustrating the Two-way Interaction between Type and Sequence for the "Longer Term Items" Analysis in the Combined Analysis of Experiments 1 and 4

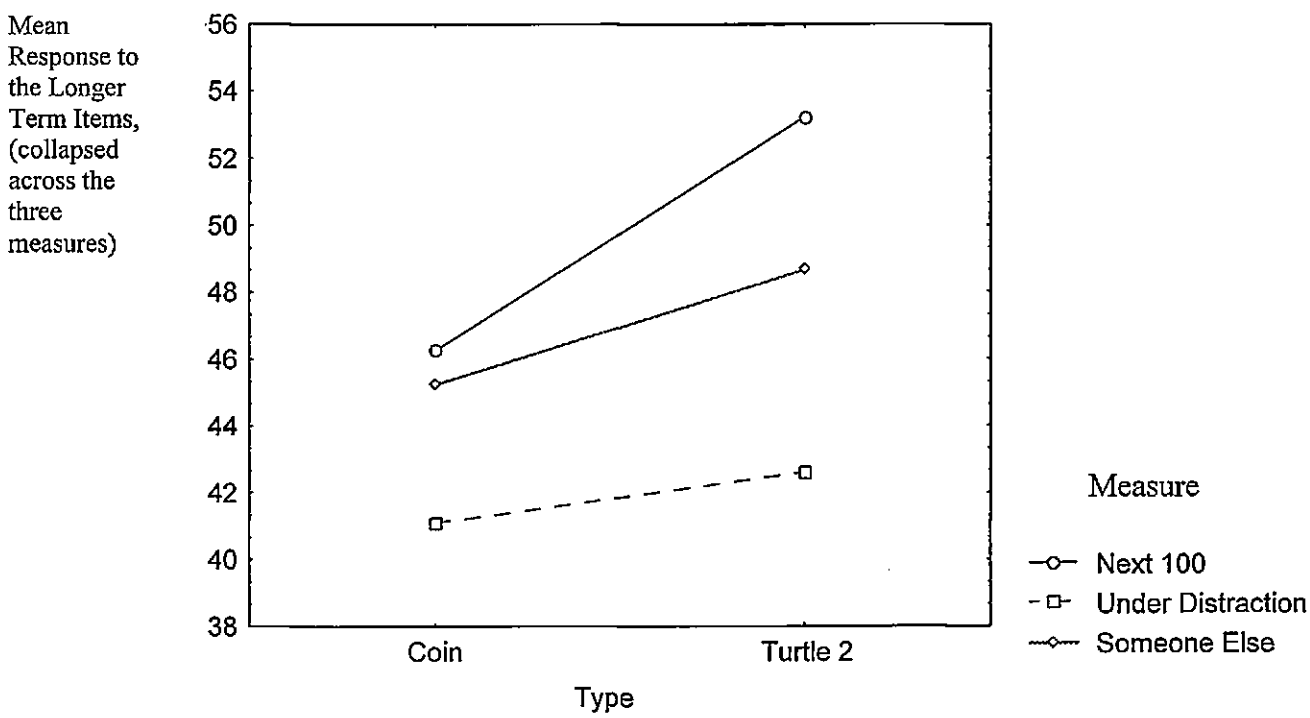


An interaction between Response Mode and Sequence also resulted, $F(2,216)=4.65$; $p=0.011$, as before.

A significant main effect of Measure ($F(2,432)=32.44$, $p<0.001$) in that, collapsed across all other variables, participants thought that they would perform significantly better than other people, and than if they were distracted, means of 49.74, 46.98 and 41.85 respectively.

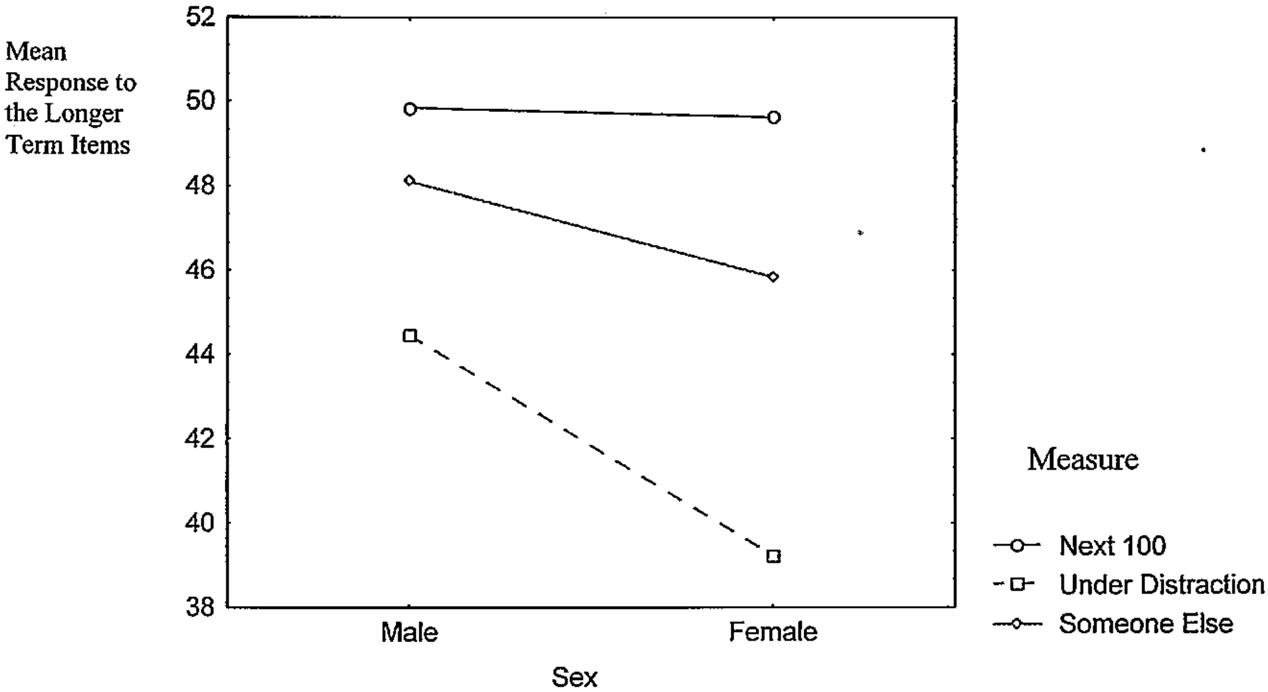
This main effect demonstrates that participants thought that the task required their concentration to maintain a higher level of success. The interaction between Type and Measure, $F(2,432)=3.90$, $p=0.021$, illustrates the fact that the responses to these two measures for both task do differ, however, as the plot of their means clearly shows, (Figure 3.12) they are affected in a very similar way. The most important difference appears to be that the differences between the measures is most marked when having taken part in the computerised two Turtle task. Hence although the interaction was significant the two tasks had similar effects on these particular measures.

Figure 3.12. Graph Illustrating the Two way Interaction between Type and Measure for the "Longer Term Items" Analysis in the Combined Analysis of Experiments 1 and 4



Additionally, a two way interaction resulted between Sex and Measure, $F(2,432)=3.20$, $p=0.042$, Figure 3.13.

Figure 3.13. Graph Illustrating the Two-way Interaction between Sex and Measure for the "Longer Term Items" Analysis in the Combined Analysis of Experiments 1 and 4



Whereas males thought they would perform similarly to anybody else, females thought that somebody else would perform significantly worse than themselves. Both sexes thought that if they were distracted they would perform significantly worse at the task. This distraction measure also differentiated between the two sexes in that females participants thought that the extent to which being distracted would worsen their performance was much greater than for males.

Percentage of Trials

A four-way ANOVA [2(Type) x 2(Response Mode) x 3(Sequence) x 2(Sex)] was conducted on people's estimates of the percentage of trials that they thought they had won. This percentage was calculated by dividing the number of trials they thought they had won (Question 1) by the number of trials that they thought there had been (Question 2), expressed as a percentage. Table 3.5 below shows a summary of the results that were obtained.

Table 3.5. ANOVA table for the Battery Item Analysis (Percentage of Trials) in the Combined Analysis of Experiments 1 and 4

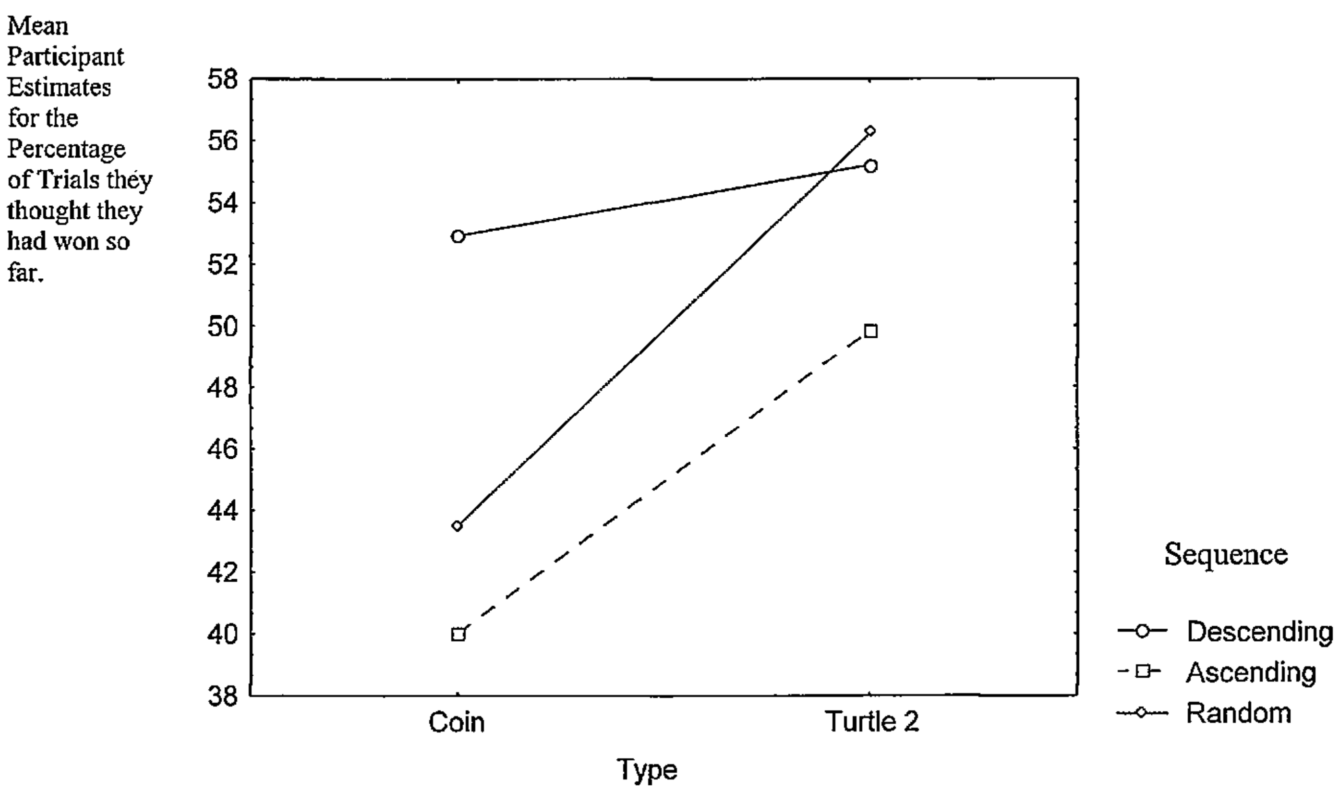
1-TYPE, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	4132.625	216	201.7259	20.48634	.000010
2	1	115.870	216	201.7259	.57440	.449344
3	2	1673.624	216	201.7259	8.29653	.000338
4	1	.284	216	201.7259	.00141	.970114
12	1	111.588	216	201.7259	.55316	.457836
13	2	587.171	216	201.7259	2.91074	.056574
23	2	407.940	216	201.7259	2.02225	.134856
14	1	27.234	216	201.7259	.13501	.713656
24	1	145.980	216	201.7259	.72366	.395889
34	2	12.050	216	201.7259	.05974	.942029
123	2	177.454	216	201.7259	.87968	.416398
124	1	25.190	216	201.7259	.12487	.724155
134	2	205.198	216	201.7259	1.01721	.363328
234	2	218.363	216	201.7259	1.08247	.340587
1234	2	421.761	216	201.7259	2.09076	.126087

Both a main effect of Type, $F(1,216)=20.49$, $p<0.001$, and main effect of Sequence, $F(2,216)=8.30$, $p<0.001$ resulted. Participants experiencing the Turtle paradigm thought they had a significantly higher percentage of wins (mean 53.78%) than the coin prediction participants, (mean of 45.49%). Follow up analysis also revealed that Descending sequence participants thought that they had won a significantly higher percentage of trials than those in the Ascending sequence, means of 54.07% and 44.93% respectively.

The interaction between Type and Sequence was of marginal significance, F(2,216)=2.91, p=0.057, see Figure 3.14. The Descending sequence responses were markedly higher than both the other sequences but only for the manual coin task.

Figure 3.14. Graph Illustrating the Marginal Two-way Interaction between Type and Sequence for the "Percentage of Trials" Analysis in the Combined Analysis of Experiments 1 and 4



How Good ?

Thirdly, a four-way ANOVA [2(Type) x 2(Response Mode) x 3(Sequence) x 2(Sex)] was conducted on perceptions of How Good participants thought they were was then carried out. Table 3.6 below provides a summary of the ANOVA results.

Table 3.6. ANOVA table for the Battery Item Analysis (How Good ?) in the Combined Analysis of Experiments 1 and 4

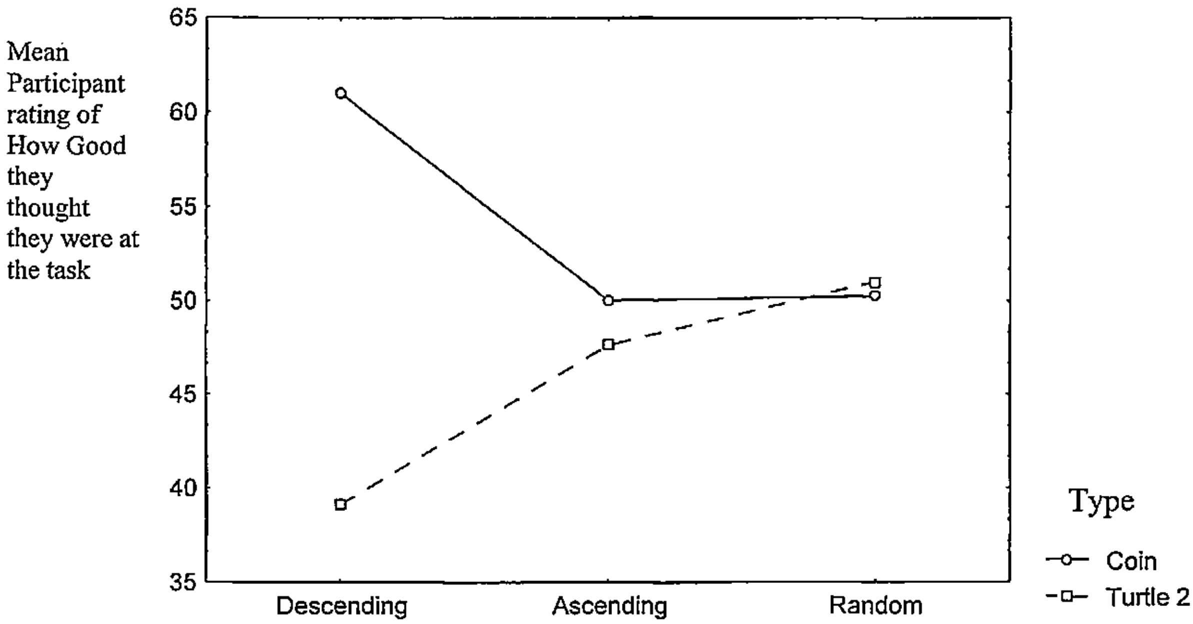
1-TYPE, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	3689.504	216	237.9958	15.50239	.000111
2	1	165.004	216	237.9958	.69331	.405962
3	2	68.629	216	237.9958	.28836	.749778
4	1	1842.604	216	237.9958	7.74217	.005872
12	1	1.504	216	237.9958	.00632	.936709
13	2	3013.379	216	237.9958	12.66148	.000006
23	2	22.804	216	237.9958	.09582	.908668
14	1	175.104	216	237.9958	.73574	.391978
24	1	1012.704	216	237.9958	4.25513	.040328
34	2	545.404	216	237.9958	2.29165	.103552
123	2	207.554	216	237.9958	.87209	.419543
124	1	155.204	216	237.9958	.65213	.420241
134	2	588.654	216	237.9958	2.47338	.086684
234	2	366.979	216	237.9958	1.54196	.216308
1234	2	278.229	216	237.9958	1.16905	.312619

A main effect of Type, $F(1,216)=15.50$, $p<0.001$ resulted, as did an effect of Sex, $F(1,216)=7.74$, $p=0.006$. Turtle race players thought they were significantly worse at the paradigm than their counterparts experiencing the coin prediction task, means of 45.91 and 53.75 respectively. Males thought they were significantly better than females, means of 52.60 and 47.06 respectively. The fact that Turtle race players thought they were significantly worse than the coin prediction participants is in contrast to the previous analysis in which it was observed that they thought they had won a significantly higher percentage of the trials.

A significant interaction between Type and Sequence resulted, $F(2,216)=4.26$, $p=0.040$. This is represented graphically in Figure 3.15.

Figure 3.15. Graph Illustrating the Two-way Interaction between Type and Sequence for the "How Good" Analysis in the Combined Analysis of Experiments 1 and 4



From the figure it is clear that the biggest difference between the two types of presentation occurred for the How Good measure for participants in the Descending sequence, whereas the participants in the other two sequences reacted similarly to both Types.

The interaction between Response Mode and Sex just reached significance, F1,216)=4.26, p=0.040. However, this interaction was not significant in either of the individual analysis of the coin trials or Experiment 1, and so will not be reported further.

3.3. General Conclusions and Discussion of the Illusion of Control

There were some differences arising from the different type of presentation of the task. Although the effect sizes were small they are worthy of mention.

Short term Confidence responses at the end of the task did not differ between the two modes of presentation. However, the Next 100 measure was affected by the presentation of the task. Participants in the Turtle experiment thought they would win a significantly higher number of trials than their counterparts experiencing the coin flipping trials.

Under specific circumstances the order effect was observed with the manual coin flipping task. The early wins did induce significantly higher longer term estimates of success than the other two sequences at the end of the task (but only when the Next 100 measure had not been elicited throughout the task). Additionally, the difference between the two tasks at the end of the task in the short term Confidence measure was much more marked than the difference in the longer term Next 100 estimates. The Next 100 responses also tended to be significantly higher for the Turtle task than they were for the coin task.

With respect to the Battery Items, there were two notable differences. Firstly with respect to the *Longer Term* items although in the same direction, the difference between participants own predictions for success over the Next 100, their predicted performance if distracted and their predictions for someone else's performance, was greater for participants in the Turtle experiment. The other difference to note was the observation that although participants in the Turtle experiment did not have exaggerated perceptions of their previous win history as a function of the sequence which they experienced, the effect of sequence for those participants in the coin tossing trials approached significance. For these participants the early wins lead to participants remembering more wins than both participants in both the other two sequences. However, participants in both types of task thought that they would perform significantly worse if they were distracted, indicating that for both presentations, participants thought that concentration was important for achieving wins.

These differences arising between the two tasks are important in that it appears that with the manual coin flipping version of the task, the particular sequences experienced could be of importance in terms of participants' future success rate predictions and memory of past success. Langer and Roth's (1975) results were therefore replicated to some extent. Additionally, the results for the coin flipping trials do provide evidence for the predictions made by the Hogarth and Einhorn model, in which primacy effects are likely when measures are elicited at the end of the sequences only. Furthermore, this primacy effect disappears when the measure has been taken throughout the sequence. However, this only applied to the longer term Next 100 measure and not to the short term Confidence measure for which there was no effect of primacy at the end of the task.

These results may therefore provide some evidence for the strong cognitive hypothesis in terms of differential levels of play, but only for manual type tasks. However, it must also be noted that the effect on future success rate predictions only occurred under specific circumstances. Additionally, all these effects sizes were small.

As the three main tasks used a computer based activity, and no real money or risk was involved one may argue that the task would not have been exciting and arousing enough for participants to continue to play, and for valid comparisons to be made with real world gambling tasks. In theory it would have been desirable to obtain a measure of heart rate (as a measure of arousal) throughout the studies reported so far. However, this would have lead to further difficulties arising from an attempt to handle too many variables at the same time. Additionally, the methodology utilised for the three Turtle studies has already been reported to have been arousing.

The Coventry and Norman (1998) study reported that the task was arousing. Heart rate measurements taken throughout the task were all significantly higher than baselines taken before the start of the experimental trials. Hence, although no arousal measurements were taken throughout the current experiments, the task used has been shown to be arousing. The fact that 60 people (half of all participants) continued to play once the Experimenter had left the room in Experiment 3, lends support to the notion that the task was at least somewhat exciting. Furthermore, anecdotal evidence comes from the 360 participants across the three Experiments, the vast majority of whom became visibly actively involved in the task, often displaying elation when winning and frustration when losing.

The other difference in presentation between the two tasks noteworthy of discussion is that issue of the instructions that participants received. With the Turtle trials participants were asked to try to influence the outcome of each race by using Psychokinesis whilst with the coin flipping trials participants were simply instructed to try to predict the outcome correctly. It could be argued that this difference in presentation could also offer an account of the differences between the results reported above. The argument raised earlier (in the discussion of the use of the Psychokinesis cover) that this methodology may have induced people to believe that Psychokinetic powers could in fact be utilised and that this offered a reason for why people in the Turtle studies predicted higher rates of future success, does not stand up. Looking at the results of the coin tossing trials, where participants were not encouraged to influence the outcome, it is clear that people experiencing this presentation (that of prediction) were also predicting higher rates of success than the objective probability would warrant. A more plausible reason for the exaggerated predictions of future success, as this was the case for both types of presentation, is the pure experience of the tasks themselves.

When one considers the third difference in presentation, that of the Turtle Vs Coin distinction, another possible reason for the differences arises in relation to the prior beliefs held by participants about the nature of the two tasks. On the basis of familiarity the two tasks differ quite extensively; the flipping coins is much more of an everyday occurrence than exposure to the concept of Psychokinesis. Although the majority of people had heard of Psychokinesis and knew what it was when it had been explained to them, there was absolutely no need to present further information about the coin flipping. The prior knowledge about the two tasks that people held could potentially partly explain the differences observed. People may have believed before any experience of the task that they could perhaps have some Psychokinetic ability, or could at least develop it. Likewise, participants may have had the firm belief that predicting the outcome of a coin toss would become easier once more practice was obtained. These, and other beliefs about the nature of the two tasks, could also have been different in terms of their stability throughout the task. Further investigation could make an attempt to assess the nature of people's beliefs both before and after experience of the task. However, too much investigation into the prior beliefs could confound the effect that the experience of the task has on the individuals concerned. Additionally, responses to assessing beliefs after the experience of the task may also be confounded due to the experience of the task itself.

Although these differences between the tasks were apparent, they were minor differences in relation to the overwhelming similarities. This is particularly clear when one looks at the results of the analysis of the step by step measures. Here there were no differences at all arising between the two types of presentation, suggesting very similar findings in respect of recent information being paramount for both types of task.

The results arising from the Extra Loss sequence demonstrated strong support for the notion that one can not assume that males and females respond to these types of tasks in identical ways. This section demonstrated that the two sexes respond differently to a series of losses. Whereas males tended on the whole not to be particularly affected by this (in terms of the SbS measures), females' responses throughout the trials dropped significantly. The results to the Battery Items also further indicated that investigations should take account and control for sex effects.

One problem with the Hogarth and Einhorn model that is relevant to the current work is that it is possible that some people have actually adopted a step by step process when making judgements even when the questions were asked only at the end of the trials. The use of the counterbalanced design that was employed here may have increased the likelihood of this occurring as participants were always making one or the other judgements (the Confidence or the Next 100 measures) on a step by step basis.

For the step by step measures it was clear that people were using a step by step process as their responses were highly dependent upon the most recent outcomes. Hence, by the end of the sequences when all participants had won an identical number of trials, there was no clear recency (or primacy) effect due to the precise win sequence experienced. An argument could be developed in terms of the above concern with the Hogarth and Einhorn model. This argument would suggest that the reason for not inducing a primacy effect with respect to the End of Sequence measure at the end of the task, could be due to the fact that people were affected by having experienced a step by step response mode within the same study. This argument if valid, would have to account for the results under both presentations of the task, as this would be task independent. Looking at the results across the two types of presentation, it becomes clear that this is not a suitable explanation for the lack of a primacy effect with the End of Sequence measure for the Turtle studies. This is because when the participants experienced the more physical coin tossing trials the primacy effect did occur under specific circumstances. This would suggest that although the counterbalancing could have been a reason for the lack of the predicted effects, the most plausible explanations are the ones provided earlier.

A note regarding the "Continue to Play" measure is that it was only used in Experiment 3. In this experiment, participants only won four out of the 32 trials, and as discussed earlier, this low absolute number of wins may not have been enough for the previous win order to have the predicted effect. This measure may have highlighted differences between the different probabilities of success. It would be of interest to utilise this measure in future studies involving a similar paradigm across a range of differing probabilities of success. This is particularly the case when one considers that for the manual presentation (coin flipping) under some circumstances the order effect appeared, hence early wins in a manual task may induce people to play for longer. This would need investigation.

Even though the sampling process and the random allocation of all participants to each of the three win sequences would have minimised the possible effects of other individual differences playing a role, it would have been desirable to have monitored and controlled for them as they could still have played a part. Possible individual differences that could have been behind people's responses include their degree of optimism or pessimism for example, or indeed the extent to which they are impulsive.

One general concern regarding the Illusion of Control research and its generalisability to all gambling forms, which applies equally to the current work as it does to some of the research in the gambling literature, is that within each of these Experiments the probability of success was set and controlled throughout the duration of the task. Many gambling activities are structured in such a way that there can be within-activity probability changes dependent upon the decision of where to place the bet taken by the gambler. This point is particularly visible when one considers the game of roulette for example. One possible technique for investigating differences between tasks in which the probability of success is constant and tasks with within-activity probability changes, would be to design and run a series of computer based experiments. Computer versions of activities such as roulette could be designed in a similar fashion to the Turtle tasks, which would allow the participant to vary the probability of success on any particular trial whilst still having their wins and their loss positions predetermined by the Experimenter.

A further point about the probabilities of success related to the tasks used in the current work, is that the Experiments only investigated participants' responses to tasks in which their win rate matched on to the probability of success. For example, the participants in Experiment 1 experienced a task with a 50% chance of success on every trial. Overall they also won 50% of the trials. There may be interesting differences to be discovered in relation to tasks in which the participants win proportionately more or less than the objective probability would warrant. For example, a series of studies could be run whereby although the probability of success remains constant throughout the task at 0.5, the effects of participants winning 25% or 75% of the time could be investigated.

This series of studies has started to bridge the gap between standard Illusion of Control studies and real gambling, using a paradigm more similar to the real gambling task. In doing this, the effects that have been previously observed have not been cleanly replicated, although interesting patterns have emerged. The conclusion that one could draw here is that the previous tasks have not mimicked the real gambling scenario in an appropriate fashion; ignoring what effect wins and losses can have on confidence in local outcomes and on longer term estimates of success. This suggests that the Illusion of Control is not as applicable to the gambling scenario as was previously thought.

Gambling tasks, as already argued, can be seen as decision making tasks in which both modes of processing (SbS and EoS) are applicable. People have to decide how confident they are in their chosen outcome for the next event when both choosing between alternatives and placing a bet itself, and take a decision at some point as to when they will return to the gambling environment, which is likely to be affected by their longer-term estimates of success. If they believe that they will do significantly better than the objective probability would warrant on a future trip to the local casino, then subjectively there is no reason to delay the event, and delay the receipt of the associated rewards.

Although the strong cognitive perspective has received some support in that it is clear that recent outcome information is important with respect to participants' confidence and longer term estimates (and can therefore offer an account of gambling in general) the "strong cognitive hypothesis" has not received the supporting evidence it would need in order to explain differential levels of play. The order of events in the task only had a significant effect on participants' longer term estimates of success under very specific circumstances. The effects on individual confidence and future success rate predictions of the particular positions of wins and losses within the sequence did not appear to offer an explanation on its own for continued gambling behaviour, evidenced by the lack of a consistent strong sequence effect at the end of the trials. Furthermore, given the opportunity to continue the task (Experiment 3) people did not differ in terms of the length of continued play as a function of their previous win history on the task. However, there was a significant correlation between the confidence at the end of the task and the number of trials that participants played once the Experimenter had left the room. This is important in that implies that although previous win sequence has little effect, there is still a direct association between confidence and actual behaviour. This could also benefit from further investigation.

In conclusion then, there was evidence in support of the strong cognitive hypothesis in explaining gambling generally, but there was little evidence in support of its ability to explain differential levels of play. The following chapters investigate the weak and integrative hypotheses outlined in the introductory chapter.

4. Chapter 4: Erroneous Perceptions, Dissociation, the REI and Loss of Control

4.1. Introduction

It appears that the early wins and the Illusion of Control perspective cannot explain excessive play on their own. The results from the Illusion of Control studies did not support the "strong cognitive hypothesis" in relation to differential levels of play. In this chapter the two other hypotheses outlined at the start of the thesis are investigated. These are the "weak cognitive hypothesis" and the "integrative hypothesis".

The "weak cognitive" hypothesis stipulates that there is an individual differences element necessary to supplement the "strong cognitive hypothesis". The "integrative hypothesis" stipulates that although the decision making process is important, it is only important in relation to and interaction with other concepts. This chapter investigates the potential role of individual differences in processing styles used in relation to the "weak cognitive hypothesis" whilst it also investigates the "integrative hypothesis" in relation to the extent to which people become dissociated whilst gambling.

As we've seen in the previous studies, people are not objective or realistic in their judgements regarding how successful they are likely to be on future trials. This lack of objectivity demonstrated within the sequential analysis for the previous experiments appeared to reflect an apparent lack of knowledge of the independence of outcomes. The belief that the subsequent outcomes are related to, and somewhat determined by, previous outcomes is erroneous. On the roulette wheel for example, the ball that is spun has no memory of where it landed on the trial (or trials) before, and therefore its new resting position is open to the full range of possible numbered slots on every spin. People tend to base their beliefs about chance tasks on the law of small numbers, which suggests that a small sample drawn from the population of possible sequences would always be representative of the population as a whole. Tossing a coin and having it land on Heads five times in a row, is deemed inappropriately unlikely, even though out of a thousand tosses, five Heads in a row is as equally likely to arise as any other sequence.

The gambling environment and activities offer scope for these kinds of erroneous or fallacious beliefs to arise. For example, there are often boards near the roulette tables, publicising the most recent outcomes, implying that they can be used to increase one's chances of a correct prediction. Alternatively punters are offered cards and a pen to write down the previous outcomes. In terms of probability of success, objectively they serve no purpose.

This chapter investigates the role of erroneous perceptions in gambling per se, and the extent of their role in the explanation of persistent gambling. In particular, the relationship between the individual difference measure of the REI (Epstein 1990) and the degree of erroneous perceptions is examined to test the weak cognitive hypothesis. The relationship between erroneous perceptions, loss of control and the concept of dissociation is the other main focus, as a test of the integrative hypothesis.

Before outlining how these hypotheses were tested, a review of each of the concepts of erroneous perceptions, dissociation and the REI is presented in sequence.

4.2. Erroneous Perceptions and Gambling

Erroneous beliefs are beliefs that are false in the sense that they do not respect the principles of chance, and they span a range of types of errors. For illustrative purposes examples of some of these follow in Table 4.1.

Table 4.1. Examples of Erroneous Perceptions.

1. Making cause and effect links

Ex.: "I am going to double with a high card because last time was a low card"
"Usually, the first round is a winning one"
"I'll bet more because I lost the last three times".

2. Referring to skills

Ex:. "I have to get my hand in".
"I am going to concentrate more, I need to think".

3. Blaming or congratulating oneself

Ex.: " I didn't play well this time".
"I am not proud of myself".

4. Using mystic or superstitious terms

Ex.: "Intuition is guiding me".
"If you think too much, it will ruin your chance of winning".
"I feel that I'm going to win this time".

5. Referring to the concept of luck

Ex.: "I'm keeping the "2" because it's a number that brings me luck".
"I'm betting 5 credits because it is my lucky number".

6. Making predictions

Ex.: "It's going to be a Queen".
"This time, it will be a straight".

7. Confirming a hypothesis

Ex.: "I knew it was going to be a straight, I said so".
"The guy sitting next to me said that it was due to pay up".

8. Amazement in front of a result

Ex.: "How come I didn't win?"

Evidence for the existence of erroneous beliefs in the gambling setting is widespread. A large amount of work has been conducted by Ladouceur and his colleagues in Canada, providing evidence for both the existence of erroneous cognitions, and the success of cognitive therapies that address those distortions.

The method typically used for extracting and assessing these erroneous beliefs has been a form of protocol analysis, that of the "think aloud" method. This method involves instructing participants to verbalise every thought that passes through their minds whilst playing, without censoring them even if they initially appear irrelevant. Participants are also instructed not to attempt to justify their thoughts and to keep talking as continually as possible (Ladouceur, Gaboury, Dumont and Rochette, 1988). Verbalisations are subsequently coded as irrational if their content contains any reference to factors that have no objective effect on the outcome, for example, personification of the machine or other means of explaining away losses.

Gaboury and Ladouceur (1989) showed that 70% of gambler's verbalisations were erroneous during gambling. This result has been replicated under different conditions: frequent or infrequent wins, limited or unlimited stakes, regular or occasional gamblers and in a variety of games such as blackjack, video poker, roulette or slot machines (Gaboury, Ladouceur, Beauvais, Marchand and Martineau, 1988; Ladouceur and Gaboury, 1988; Ladouceur, Sylvain, Duval, Gaboury and Dumont, 1989; Sylvain and Ladouceur, 1992).

Ladouceur and Dube (1997) investigated the effects of monetary incentive on the cognitive activity of individuals and on the betting strategies that were used whilst playing roulette. Their results showed that the percentage of erroneous perceptions clearly outnumbered the number of accurate perceptions about the task. Furthermore, it appeared that the risk taking behaviour and the percentage of erroneous to non-erroneous perceptions were not influenced by monetary incentives.

In another paper by Ladouceur and Dube (1997), the authors got participants to recognise and to generate random sequences. Again, whilst doing the task, participants verbalised more erroneous than accurate statements. However, in addition to this, the authors further analysed the verbalisations which revealed that the basic cognitive error related to the participants' lack of knowledge with respect to the independence of events. These results are commonplace; see Ladouceur, Paquet and Dube (1996), Ladouceur, Ferland, Boudreault, Morin, Quesnel, Vachon, Giroux and Jacques (1996) and Ladouceur, Dube, Giroux, Legendre, and Gaudet (1995) for examples.

Although there is good evidence that most gamblers produce erroneous verbalisations during gambling, this in itself does not explain loss of control. However, some evidence for there being a relationship between erroneous perceptions and the loss of control comes from research into the cognitive therapy that has been developed, again primarily by Ladouceur in Quebec, Canada. Ladouceur and colleagues have reported significant success in reducing the level of gambling by pathological gamblers in their treatment centres. The interesting point about the therapy is that the main goal of it was to address the erroneous perceptions that appeared to underlie the clients' gambling behaviour. The cognitive therapy targeted the misconception of the notion of the randomness of outcomes in the gambling forms in which they took part.

Ladouceur et al (1999) report five pathological gamblers at the start of therapy, no longer meeting the DSM-IV criteria to be classed as pathological, at the end of the treatment. This was maintained at a 6 months follow up, along with a clinically significant decrease in the urge to gamble and an increase in their perception of self control.

Sylvain, Ladouceur and Boisvert (1997) also reported success with a similar focus on the cognitive correction of erroneous perceptions. Their success was maintained at both the 6 and the 12 month follow ups. Their therapy sessions did however also include problem solving and social skills training, alongside relapse prevention techniques, so the extent to which the therapy was successful due to the correction of fallacious beliefs is clouded by the more holistic approach of the therapy.

Savoie and Ladouceur (1995) demonstrated that providing people with accurate information on the negative probability of gains, induced revision of the participants beliefs about the task which subsequently lead to them modifying (reducing) their betting habits.

Additionally when Ladouceur and colleagues have utilised other therapy strategies which have not included a focus on the cognitive element they have not had success in reducing gambling habits, e.g. Gaboury and Ladouceur (1993).

Although these findings do indicate that the focus on the erroneous beliefs within the therapy package can reduce the extent of the gamblers gambling behaviour, and specifically to below DSMIV criteria, it can not be argued with any great certainty that it was the cognitive elements that were responsible for the excessive gambling in the first place. However in conjunction with the above evidence, these therapy results do provide some weight to the notion that the cognitive distortions may have some relevance.

The mere existence of erroneous perceptions does not explain why some people continue to gamble and others manage to stop, or continue but at non-problem levels. Any significant role of erroneous perceptions on excessive levels of gambling would be strengthened by the existence of a relationship between the level of fallacious beliefs held and the frequency at which the gambler gambles. It would then have to be evaluated whether or not the individual is more likely to hold a high level of fallacious beliefs and therefore gambles more, or that the gambler develops more fallacious beliefs from increased exposure to the gambling environment.

The literature to date on the relationship between frequency of gambling and the level of erroneous perceptions, across a variety of forms, appears at first sight rather positive. Many researchers have demonstrated a clear positive correlation between the two, e.g. Ladouceur and Walker (1996). However, Coventry and Norman (1998) suggest that the criteria for labelling a verbalisation as erroneous should be made more stringent, and as will be explained there are inherent problems with the "think aloud" method used to access these verbalisations.

Savoie and Ladouceur (1995) reported firstly that all lotto players entertained erroneous perceptions, but secondly and more interestingly, that regular players were found to hold an elevated degree of fallacious beliefs as compared to casual players. Griffiths (1994) observed 60 participants in a British amusement arcade and recorded their verbalisations. Regular gamblers produced a significantly greater number of irrational beliefs than low frequency gamblers. Coulombe, Ladouceur, Desharnais, and Jobin (1992) found similar results in that they observed that on average their 12 regular video poker players expressed more erroneous perceptions than their 12 occasional players. In addition these authors reported significant correlations between the number of erroneous perceptions (verbalisations) and arousal as measured by heart rates, reporting that the more excited the gambler was measured to be, the greater the number of erroneous verbalisations were expressed. However, there are three pertinent problems associated with this study which apply to the methodologies used generally. Firstly, as discussed in the introductory chapter, there are problems associated with heart rate and its measurement of arousal. Secondly, as discussed shortly, the categorisation of whether or not a verbalisation is erroneous has arguably been misguided. When the necessary adjustments to the methodology have been made, this relationship does not appear (e.g. Coventry and Norman 1998) Thirdly, the think aloud method itself has been criticised due to its ad-hoc rationalisation nature (Nisbet and Wilson, 1977). This form of protocol analysis is only reliable when the verbalisations occur during the task. As Coventry and Norman (1998) argue, most of the verbalisations that are categorised as irrational in gambling are produced after decisions are made and the outcomes are known. In addition, it is likely that regular players require less mental resources to play the games involved and so have more resources available to allocate to talking during the task. In contrast, lower frequency players, by definition, may have less experience with the tasks and therefore have less mental resources available to "think aloud". This being the case, it is likely that regular players provide a higher number of erroneous verbalisations, simply due to the fact that they could be talking more. What is of more interest therefore would be the percentage of erroneous to non-erroneous beliefs and descriptions verbalised by participants during play.

Investigating this, Coventry and Norman (1998) found no differences between the levels of irrational verbalisations produced by high and low frequency gamblers, defined as such by whether or not they chased their losses. The categorisation method used for

defining whether a verbalisation was irrational or not was also much more stringent than that used by Griffiths (1994) and by Ladouceur and his colleagues. These authors argued that a verbalisation such as "this machine does not like me" is not an irrational statement about the task, or which reflects the participants' belief about the nature of the task. They argued that this kind of verbalisation is much the same as when a tennis player for example blames his or her racket following a bad shot. Very rarely do the tennis players actually believe that their tennis racket was the reason for the bad shot, but rather their expression is instead an attempt to apportion blame away from themselves in a convenient way at the time. This the authors argue is what the gambler who personifies the machine for example is doing, and this would have been previously termed as irrational. The more appropriate categorisation strategy, adopted by Coventry and Norman (1998) was to define any verbalisation as irrational if it demonstrated a lack of understanding of probability theory, such as "I have not won for a while, so I must be about to win". With this more appropriate categorisation strategy, high and low frequency players were not differentiated by the percentage of their verbalisations which were erroneous.

This method of protocol analysis is therefore not devoid of problems. The criticism of the heuristic and biases approach of attempting to match a particular behaviour to a particular heuristic can also be made with respect to the verbalisation assessment method. In a sense, gamblers may just be trying to explain away the result of their behaviour on a post-hoc basis, rather than expressing an actual belief about the task. Hence although the verbalisations may themselves be erroneous, they may not map directly on to the actual beliefs about the task, and are therefore less likely to map directly on to behaviour expressed within the task.

Due to the criticisms of the method of measuring the erroneous perceptions, and to the fact that they do not differentiate between high and low frequency players, the present study aims to ask direct questions as to individuals' beliefs about the task. This method is not subject to the problems outlined above and addresses the actual beliefs held, rather than getting people to verbalise what comes to mind during a gambling episode. Wagenaar (1988) made use of this methodology and observed that the habitual gamblers in his sample maintained a high degree of erroneous perceptions, specifically about the game of Blackjack.

In relation to the erroneous perception perspective as measured by verbalisations, caution should therefore be applied if they are to be studied on their own when explaining continued play. If the levels of erroneous perceptions held do not differ between people who gamble regularly and those who do not, how may they play a role in gambling? It may be that the level of fallacious beliefs held has a relationship with other individual differences or concepts. Two plausible concepts include the processing form utilised (e.g. rational or experiential, Epstein, Pacini, Denes-Raj and Heier, 1996) and what has been defined as Dissociation.

4.3. Rational Vs. Experiential Processing

Viewing gambling as a decision making activity involving the accumulation of information throughout the experience of the activity at hand, Epstein (1990) and his co-authors' work on processing styles could be of particular relevance to the current work. One of the research areas within this field is the relationship between rational vs. experiential thinking and susceptibility to biases in reasoning and decision making (Handley et al 2000). These two types of processing have clear and obvious links to the two notions of rationality (Evans, 1993, 1996) discussed in Chapter 1, and the view that gambling is dominated by implicit processes (Coventry, in press). The experiential process has clear links in this perspective with Rationality$_1$ where people act in a way to realise the achievement of their goals, where their goals may lie in maximising their involvement in the activity. The use of the rational process would signal Rationality$_2$ whereby people reason in a way which conforms to an appropriate normative system such as formal logic.

According to the cognitive-experiential self-theory (CEST, Epstein 1990), people use both a rational and an experiential processing system when integrating information. Tversky and Kahneman (1983) would have labelled these two systems as heuristic versus analytic, and would have argued that these systems operate independently of each other. CEST theory however argues that these two systems interact with each other and that behaviour will be determined jointly by the two systems, (Handley et al, 2000). The proponents of this theory developed the Rational-Experiential Inventory that measures, with four sub-scales, the extent to which individuals rely on and enjoy using the two modes of processing. "According to CEST, the rational system operates primarily at the conscious level and is intentional, analytic, primarily verbal, and relatively affect free. The experiential system is assumed to be automatic, preconscious, holistic, associationistic, primarily non-verbal and intimately associated with affect." (Epstein et al, 1996, p.391). Hence it is clear that these dimensions bear some relation to the concepts of rationality$_1$ and rationality$_2$, and that the experiential system may map onto implicit processing. The REI measures both people's engagement and their ability in the use of both of the modes of processing. A brief presentation of the four scales that make up the REI follows to make the potential relevance of the inventory clearer.

Rational Ability (RA) refers to confidence in one's ability to think logically and analytically; for example, "*I have no problem in thinking things through carefully*". Rational Engagement (RE) refers to reliance on and enjoyment of thinking in an analytical and logical manner; for example, "*I enjoy thinking in abstract terms*". Experiential Ability (EA) refers to confidence in one's intuitive impressions and feelings; for example, "*When it comes to trusting people, I can usually rely on my gut feelings.*" Experiential Engagement (EE) refers to reliance on and enjoyment of feelings and intuitions in making decisions; for example, "*I like to rely on my intuitive impressions.*"

Pacini and Epstein (1999) carried out two studies with this 40-item shortened version of the original REI. In the first study they tested the validity of the new REI whilst in the second study they examined behavioural compromises between rational and experiential processing in the Ratio-Bias paradigm as a function of individual differences in thinking style using the REI. The total score reliabilities for each of the scales was substantial; for the Rationality scale α=0.90 and for the Experientiality scale α=0.87 (the latter being more reliable than in the original scale). The correlation between these two scales was insignificant (r= -0.04) supporting the assumption of the existence of two independent information processing modes. Factor analysis was also used to confirm the distribution of the items in two independent main scales. The first factor accounted for 19.4% of the variance which contained all of the rationality items, whilst the second factor accounted for 14.6%, which contained all of the experientiality items. The REI scales and subscales also showed discriminant validity as indicated by the different relations with a variety of personality variables that were measured. In their second study they observed that when optimality is at issue (when the probability between the two trays of white and reds jelly beans differed between the two trays presented in the Ratio-Bias paradigm) participants' responses to an increase in incentive (from $0.10 to $2 for a win) depended on individual differences in both rational and experiential thinking styles. They concluded that the rationality of the individual (as measured by the rationality scale) was the determining factor in the degree to which participants responded in a non-optimal fashion. In addition to these studies demonstrating reliability and validity of the REI, behavioural effects of the individual's score on the REI scale and subscales were also observed. See Handley et al (2000) for an in-depth analysis of the REI subscales and successful validation on use with a UK subject population.

As was seen in Chapter 2, the Illusion of Control did not appear as robust as was previously believed, only occurring under specific circumstances. One possibility is that the way people process the information they are presented with affects their beliefs about the gambling forms, and this in turn may affect the way and the frequency at which they take part in these activities. Hence the processing style used could partly determine gambling behaviour.

With this in mind, one needs to investigate whether people who prefer certain processing styles in preference to others are more prone to take part in gambling and risk taking activities. For instance, is it the case that people who feel confident in their ability to think logically and analytically (scoring high on the RA), and express an enjoyment in performing tasks where logic and analytical skills play a part (high on RE), are less likely to gamble? With gambling tasks there are very few opportunities indeed for the need for a logical process when making decisions about the possible outcomes, as no matter how good the individual is, their ability in logic will have nothing to bear on whether they are successful or not at arriving at the "correct" response. The logical and analytical skills would only come in to play and be of use, ironically, at the consideration of a gambling episode stage, when they may prevent the individual from entering into such chance determined tasks, if monetary gain is the main motivation.

Conversely, someone who scores highly on the EE scale, could be expected to be more likely to enjoy tasks such as those determined by chance; those tasks when any concrete information about past events is irrelevant for prediction, where they enjoy relying on and testing hunches they have built based on past experience.

In the following study therefore, the REI was administered alongside the rest of the questionnaire, to investigate participants' responses to each of the four sub-scales and how they related to their gambling behaviour, and their beliefs about the gambling they partake in.

4.4. Dissociation and Gambling

The integrative model of gambling to be pursued assumes that cognitive variables on their own cannot explain why some people are able to control their gambling behaviour whilst others continue to gamble to excessive and undesirable levels. One plausible construct which may be worthy of investigation is that of dissociation. Although there has yet be to demonstrated any clear link between fallacious beliefs, loss of control and the concept of dissociation, there is a clear rationale as to why such a link should be investigated.

Casinos and other gambling environments design their establishments in such a way as to manipulate people's beliefs about the likelihood of success and the regularity of wins so that players spend more time at the machines. Research into the 'near miss' has shown how near-wins can encourage continued play, and they can encourage fallacious beliefs, (e.g. Griffiths 1991). In addition to the layout of the establishment, operators have become increasingly keen on developing a more 'complete experience', encouraging the development of other forms of entertainment. All these act to place the gambler in an all-together different (and pleasant) environment, as soon as the gambler enters the establishment. This change in environment may in itself explain part of the reason for entering the gambling institution, in addition to the motivation to win money.

Griffiths (1995) attempted to identify which mood states were critical to gambling. His results indicated that high frequency fruit machine gamblers experienced more depressive moods before playing than low frequency players, and that the high frequency players experienced significantly more excitement during gambling than the low frequency comparison group. Griffiths also reported (1993) from a postal survey that during play, participants experienced increased excitement and a reduction in their depressive moods. These participants also reported escapism as their core motivation for gambling. Although these papers shed some plausible light on the issue of mood state and gambling (and therefore escapism), caution must be taken when generalising from these results. Both of these studies involved self-report measures in the form of responses to questionnaires, thus the methodology is open to criticism with this kind of material. It is very likely that the gamblers involved in the studies responded to the items in such a way as to rationalise and justify their behaviour, hence the likelihood that they report better moods whilst (and from) gambling is increased.

Dickerson, Cunningham, England, and Hinchy (1991) reported that for high frequency gamblers their prior mood significantly accounted for their persistence while losing and for their cognitions regarding the wins that they had received. These offer support both to the notion that mood states may well be important and to the notion that the gambling environment can alter mood and dissociate the gambler from their prior environment. Dickerson et al also suggested that there might be a positive link between mood state and the level of erroneous perceptions held by the gamblers.

Dissociation has been documented across a range of phenomena such as alcohol use and binge eating, (Baumeister, 1991) but has only received minimal empirical attention within gambling settings. Dissociative states involve both an attentional and an emotional component where people in such states exhibit a narrowing of attention with a particular focus on the immediate experience at hand, and a related positive mood state which allows them to block out other life events of an unpleasant nature. Although the term dissociation is often related to a specific class of psychiatric disorders, dissociative experiences of a non-pathological nature are common in the general population as well, possibly up to 90% of the population; Kihlstrom, Glisky and Anguilo (1994), Putman et al (1996).

Dissociation is a complex psychophysiological process that produces alterations in sense of self, accessibility of memory and knowledge and integration of behaviour (Putman 1991b), and refers to an alteration of consciousness that affects attention, memory and identity, (Kihlstrom, Glisky and Anguilo, 1994). The DSM-III-R (1987) also classified dissociation as such. The Dissociative Experiences Scale (DES, Bernstein and Putman

1986) is a self-report measure of the frequency of dissociative experiences. It was conceptualised as a trait measure (as opposed to a state measure) and it enquires about the frequency of dissociative experiences in the daily lives of those who complete the measure.

Kuley and Jacobs (1988) investigated the relationship between dissociative experiences and sensation seeking among social and problem gamblers. Their problem gambling group (high frequency gamblers) reported a significantly greater number of dissociative experiences than those in the social gambler group (low frequency gamblers).

The frequency at which someone decides to gamble may lie in their need for escape from everyday thinking or living, therefore one needs to investigate the level of dissociation experienced as a function of frequency of play. One motivation reported for gambling has been, as discussed (in Chapter 1), as a form of escape from every day problems. The DSM criteria for pathological gambling includes this item as a recognised "symptom". Do people who gamble more frequently than others experience a greater level of dissociation? If this is the case, it could suggest that as one gambles more and more, one needs to gamble progressively more to experience the same degree of dissociation. This habituation type explanation could explain why some people gamble excessively and beyond their resources, as the ability to escape becomes less and less obtainable without increasing the frequency and perhaps variability of play.

Hence loss of control, fallacious beliefs (erroneous perceptions) and dissociation may all be related to each other and to one's frequency of play. This relationship has yet to be investigated and two studies were conducted and are reported below. Study 1 was conducted using an undergraduate psychology population in order to investigate the existence of the relationships discussed above. The observed relationships were then followed up with a larger general population sample in Study 2.

4.5. Study 1

4.5.1. Method

Participants

Participants were recruited from the Psychology Undergraduate pool at the University of Plymouth. In all, 98 (80 women and 18 men) Participants took part for credit towards their degree scheme.

Materials

Participants were to respond to both a gambling activities questionnaire and to the Rational-Experiential Inventory (REI), (Pacini and Epstein, 1999). The 40 item version of the REI was used to determine information processing styles used. This shorter version is made up of four subscales with 10 items on each; Rational Ability (RA), Rational Engagement (RE), Experiential Ability (EA), and Experiential Engagement (EE). Participants were to respond to each item on the 5-point scale by circling one response ranging from 'definitely not true of myself' to 'definitely true of myself'. See the Appendix 5a to view the 40 item version.

The gambling activities questionnaire consisted of 33 items, and included items extracted from, the DSMIII-R criteria for Pathological Gambling (1980), and the Gambling Attitudes and Beliefs Survey (Breen and Zuckerman, 1999). Table 4.2 displays these items. In addition to these items, there were also a number of questions regarding gambling frequency, time and amount spent, and gambling forms participated in. The full questionnaire can be seen in Appendix 5b.

Table 4.2. Questionnaire Items for Loss of Control, Dissociation and Fallacious Beliefs

Loss of Control Items

8. Do you see your gambling activities as ever having lead to a problem?
9. Have you sought or thought of seeking help for your gambling behaviour?
10. Was there any time when the amount you were gambling made you nervous?
11. After winning, do you feel you ought to gamble more to increase your winnings?
12. Do you gamble until all your spare cash has gone?
13. After losing, do you spend more money to try to make up for your losses?
14. Do you ever get into debt as a result of your gambling?
15. Have you borrowed money to gamble or pay gambling debts?
16. Do you find you gamble for longer than you intended?
17. Do you need to gamble with more and more money to achieve the desired excitement?
18. Do you ever have unsuccessful attempts to control, cut back, or stop gambling?
19. When you gamble, do you go back another day to win back the money you lost?
20. Do you ever gamble more money than you intended to?
21. Have you felt guilty about the way you gamble or about what happens when you gamble?
22. Have you hidden betting slips, lottery tickets, gambling money, or other signs of gambling form your spouse, children, or other important people in you life?

Dissociation Items

23. Gambling makes me feel really alive.
24. Sometimes I forget about the time when I am gambling.
25. If I were feeling down, gambling would probably pick me up.
26. I like gambling because it helps me to forget my everyday problems.

Fallacious Beliefs Items

27. If I have not won any bets for a while, I am probably due for a big win.
28. I know when I'm on a streak.
29. It is important to feel confident when I'm gambling.
30. No matter what the game is, there are betting strategies that can help you to win.
31. I have carried a lucky charm when I gambled.
32. I must be familiar with a gambling game if I am going to win.
33. To be successful at gambling, I must be able to identify streaks.

Procedure

Participants signed up for a time slot of their choice. They then turned up for the session held within the Psychology Department, resulting in groups of between 4 and 20 participants filling in the questionnaire.

4.5.2. Results and Discussion for Study 1

Although 98 participants took part, 12 participants failed to fill in the questionnaire completely or correctly. Hence for the analysis, data from the 86 remaining participants were analysed. Before an analysis of the main variables is presented, some descriptive statistics are presented regarding the participants' gambling activities. This results section is structured such that following these descriptive statistics, the relationship between the REI sub-scales and the other variables is then presented, followed by an analysis of the inter-correlations between the other variables.

The nature of gambling on lotteries (such as the UK National Lottery) is different from most other forms of gambling, having a number of highly distinctive features (Fitzgerald, 1997; Wagenaar, 1988). Firstly, they are relatively cheap to play; in the UK a single game costs just £1.00. Secondly, they offer enormous jackpot prizes; the typical Saturday draw on the UK lottery is around £8-£10 million, although these can be much higher if nobody wins a particular week and the prize fund is rolled over to the following week's draw. Thirdly, they offer a very low probability of winning this jackpot; again to take the UK lottery as an example, the odds of winning the jackpot are a little under 14 million to 1. However, smaller prizes with higher odds are available for matching some of the six numbers. Fourth, lotteries are relatively infrequent, in the UK there are only two draws per week, and hence the associated availability of this form of gambling is restricted. A fifth distinctive characteristic is that the outcome information is not immediate. The least amount of time possible between the choosing of the numbers to the actual draw is 30 minutes, as no new lottery tickets are sold in the last 30 minutes before the draw takes place. The maximum time on the other hand between choosing your numbers and finding out whether they have been drawn is four weeks (selecting your numbers and choosing to keep these for four weeks). Furthermore, lotteries are sometimes perceived either as not

true gambling forms, or alternatively as socially acceptable forms of gambling (Hill and Williamson, 1998).

Due to the nature of gambling on the National Lottery being distinctively different from other forms available, the participants who reported taking part only in the National Lottery (taking part in no other form of gambling) were separated out from the analysis, and a separate (but identical) analysis was conducted. Hence within each of the analysis sections which follow, the analysis is presented for National Lottery Only players, and then separately for people who gamble on other forms as well (in addition to, or instead of, the National Lottery).

4.5.2.1. Breakdown of Frequency and Forms Participated In

Table 4.3 shows the frequency of gambling forms taken part in by the sample. Although every form listed in the available options on the questionnaire had people responding to them, the vast majority of people reported taking part in the National Lottery (86%). 31 participants reported playing on both the National Lottery and Scratch Cards (11 participants reported playing only on the National Lottery), leaving 51 participants involving themselves in other forms as well. In all, over three quarters gambled on the National Lottery, whilst 46.5% of them gambled on Scratch Cards and 40.7% on Gaming Machines.

The vast majority of people reported playing only up to and including three forms, with an approximately equal spread across the frequency of participants playing one, two or three games. These figures can be seen in Table 4.4, which also displays the frequency at which the National Lottery or Scratch cards appeared in relation to the number of forms played in.

Table 4.3. Number and Percentage of Participants reporting playing on the various forms. N=86

Form	Number	Percentage
Horse Racing (Off Course)	9	10.5
National Lottery	74	86.0
Bingo	12	14.0
Horse/Dog Racing (On Course)	19	22.1
Scratch Cards	40	46.5
Pools	2	2.3
Gaming Machines	35	40.7
Casinos	7	8.2
Sports Betting	11	12.8
Other	3	3.5

Table 4.4. Study 1. Frequency of Number of Forms taken part in, and the degree of National Lottery and Scratch Card players.

Number of Forms	Frequency	No. of People playing National Lottery and Scratch Cards	Cumulative Frequency
1	24 (27.9%)	18 (75%)	18 (23.4%)
2	25 (29.1%)	22 (88%)	40 (51.9%)
3	23 (26.7%)	23 (100%)	63 (81.8%)
4	6 (7.0%)	6 (100%)	69 (89.6%)
5	4 (4.7%)	4 (100%)	73 (94.8%)
6	3 (3.5%)	3 (100%)	76 (98.7%)
7	1 (1.2%)	1 (100%)	77 (100%)
Missing Data	12	-	-

Table 4.5 provides information as to the frequency of the participants' gambling behaviour, their typical length of gambling episode, and their typical expenditure at a session.

Table 4.5. Frequency Statistics for Frequency, Length and Expenditure

	Frequency
Frequency of Gambling Episodes	
Less often than once every six months	4
Less than once a month, but more than once every six months	5
Less than once a week, but more than once a month	18
Less than every day, but more than once a week	31
Every day	28
Length of Gambling Episode	
No Response	12
0-10 mins	69
11-30 mins	9
30-60 mins	3
1-2 hours	3
more than 2 hours	2
Expenditure per Session	
No Response	12
£1-£5	72
£6-£10	8
£11-£25	1
£26-£50	0
£51-£100	0
over £100	0

4.5.2.2. Erroneous Perceptions, Dissociation and Loss of Control Scores

A score for each participant for Loss of Control items was achieved by summing the number of items within that category that had been responded to with a 'Yes' response. The Dissociation and Fallacious Beliefs categories were responded to on a four point Likert type scale from Strongly Disagree (score of 1) to Strongly Agree (score of 4), and were each summed within each category. Hence the higher the total, the more fallacies held, or the greater the dissociation experienced.

Table 4.6 below shows a breakdown of the loss of control, dissociation and fallacious beliefs held by participants reporting taking part in the various gambling forms.

Table 4.6. Breakdown of Loss of Control, Dissociation and Fallacious Beliefs by participants' Main Form of Gambling

	Loss of Control	Dissociation	Erroneous Beliefs	N
Horse Racing (Off Course)	1.0	6.0	7.0	1
National Lottery	0.7	6.4	12.3	34
Bingo	0.0	6.0	8.0	1
Horse/Dog Racing (On Course)	0.5	6.8	13.2	6
Scratch Cards	1.6	5.9	12.0	7
Gaming Machines	3.5	7.3	14.3	12
Casinos	1.0	5.0	15.0	1
Sports Betting	4.0	12.0	16.0	1

Although for this population there were no particular forms of gambling that were associated with a very high loss of control, the highest loss of control experienced appeared to be with gaming and fruit machines (mean of 3.5), and on sports betting (mean of 4.0). The level of dissociation reported by participants did not particularly distinguish between the gambling forms, neither were there any great differences between the levels of erroneous perceptions held. However it must be noted that the number of participants taking part in the above forms (as their main form) varies across forms drastically in this current sample.

4.5.2.3. National Lottery Only Players

This section is split up into two parts. Firstly the analysis on the REI sub-scales in relation to the other measured variables is presented. This is followed by an analysis of the inter-correlations between the other variables. For this group the number of participants was very low (N=11), so the reliability of the results for this group could be questioned.

The relationship between the REI sub-scales and the other variables (National Lottery Only players)

A score was obtained for each of the four sub-scales within the REI by summing the scores for the 10 items within each sub-scale. For each sub-scale a Likert type response scale was presented, whereby participants could respond by circling one of five options. These ranged from Definitely False (given a score of 1) to Definitely True (given a score of 5) with Undecided or Equally True and False acting as the centre point (given a score of 3).

Pearson Product-Moment Correlation coefficients were calculated to investigate the relationship between the scores on the four sub-scales on the REI, and the following variables: Number of Forms (NoF), Frequency over the last 12 months, Typical Length of gambling episode (Length), Typical amount spent per episode (Amount), Loss of Control (LoC), Dissociation, and the Extent of Fallacious beliefs held (Fallacies). The alpha level of significance was set at $p<0.05$. None of the REI dimensions correlated significantly with any of the gambling activity questions. See Table 4.7 for the correlation matrix.

The Inter-correlations between the other variables measured. (National Lottery Only players)

For this population, N=11, the Length of the typical gambling episode correlated significantly with Loss of Control, ($r=0.99$) as did typical Amount spent, ($r=0.99$). See Table 4.7 for the correlation matrix. Length and Amount correlated perfectly, $r=1.00$. Loss of Control correlated with Fallacies ($r=0.64$) but did not correlate significantly with Dissociation. Dissociation and Fallacies did not correlate either for this

Table 4.7. Correlation Matrix for Student Sample, National Lottery Only Players; (* = p<.05, ** = p<.01).

	No. of Forms	Frequency	Length	Amount	Loss of Control	Dissociation	Fallacies	RA	RE	EA	EE	R	E
No. of Forms	1.00	--	--	--	--	--	--	--	--	--	--	--	--
Frequency	--	1.00	.04	.04	.19	.13	-.14	-.02	-.02	.31	.02	-.03	.14
Length	--		1.00	1.00	.99**	.26	.58	-.03	.43	-.07	-.32	.29*	-.24
Amount	--			1.00	.99**	.26	.58	-.03	.43	-.07	-.32	.29	-.24
Loss of Control	--				1.00	.24	.64*	-.20	.51	-.16	-.44	.21	-.38
Dissociation	--					1.00	.53	.00	-.28	.13	.06	-.19	.10
Fallacies	--						1.00	-.39	.04	-.42	-.17	-.24	-.30
RA	--							1.00	.10	.42	.13	.70**	.28
RE	--								1.00	.38	.16	.78**	.28
EA	--									1.00	.56*	.53*	.84**
EE	--										1.00	.19	.92**
R	--											1.00	.38
E	--												1.00

group. Again however, the numbers in this group were indeed very low, and the results should be interpreted with caution.

4.5.2.4. Players of all types of Gambling (Excluding National Lottery Only Players)

The relationship between the REI sub-scales and the other variables (Gamblers on All Forms)

For this group, N=68. Rational Engagement (RE) correlated negatively with the Number of Forms (r=-0.28) but positively with Length (r=0.27). See Table 4.8 for the correlation matrix. This suggests that, in line with expectations, that the more one enjoys taking part in analytical type tasks the lower the number of forms that they take part in. However, the positive correlation with Length indicates that for this sample, the more one enjoys such tasks, the longer one stays involved with the current task. This is contrary to both expectation and to the negative correlation reported above with the number of forms.

The Inter-correlations between the other variables measured (Gamblers on All Forms)

For this group, N=68, Dissociation correlated significantly with Loss of Control (r=0.35) and Fallacies (r=0.65). See Table 4.8 for the correlation matrix. Loss of Control did correlate in the expected direction (r=0.24) although not significantly, with Fallacies. Amount spent on a typical episode correlated significantly with typical Length of the episode, (r=0.51).

Table 4.8. Correlation Matrix for Student Sample, All Forms; (* = p<.05, ** = p<.01).

	No. of Forms	Frequency	Length	Amount	Loss of Control	Dissociation	Fallacies	RA	RE	EA	EE	R	E
No. of Forms	1.00	.13	-.04	.20	.16	-.14	.07	.00	-.28*	.15	.16	-.19	.16
Frequency		1.00	-.18	-.05	.06	.00	-.12	.03	-.23	.08	.12	-.13	.10
Length			1.00	.51**	-.09	.08	.14	.07	.27*	-.03	-.06	.22	-.05
Amount				1.00	-.03	-.13	-.05	-.08	.20	.01	.02	.08	.01
Loss of Control					1.00	.35**	.24	-.05	-.16	.12	-.02	-.13	.05
Dissociation						1.00	.65**	-.04	-.14	.00	.07	-.12	.04
Fallacies							1.00	.15	-.08	-.06	-.18	.03	-.13
RA								1.00	.37**	-.15	-.22	.80**	-.19
RE									1.00	.03	-.03	.86**	-.00
EA										1.00	.78**	-.07	.94**
EE											1.00	-.14	.95**
R												1.00	-.11
E													1.00

4.5.3. Discussion

For these groups, some relationship seemed to appear between the level of fallacious beliefs, the loss of control and the extent of the dissociation experience. The participant numbers for the National Lottery Only players were small, thereby reducing the potential validity of the results. However, looking at the participants who took part in other forms, the level of dissociation experienced correlated with both loss of control and fallacies in the expected direction. The higher the degree of fallacious beliefs held, the greater the dissociation experience, and the greater the loss of control reported. However, the loss of control did not correlate independently with the erroneous perceptions variable for this group. Although it was not significant, this relationship was in the same direction (the greater the number of fallacies that one holds, the greater the loss of control experienced) as the significant relationship for the National Lottery Only players.

As one would expect, for both groups the amount spent on a typical gambling episode correlated positively with the length of that gambling episode, supporting the notion that accessibility to a gamble can itself encourage the amount of gambling.

These results however are correlational and as such do not provide evidence of causal links between variables. A discussion of the potential models to be considered to account for these links will be postponed until towards the end of this chapter.

The only sign from the current data that the REI scale may be of relevance to gambling was the negative correlation between Rational Engagement and the Number of Forms for those participants who reported playing more than just the National Lottery. This result indicates that the more one enjoys taking part in activities which involve some form of rational decision making, the less the number of forms that one involves themselves in, or indeed the less likely they are to take part in gambling activities. What was contrary to this was the observation that Rational Engagement also correlated, and positively, with the typical Length of the gambling episode. This suggests that the more

one enjoys rational decision making tasks, the longer one plays them when they occur. This positive correlation would not have been expected.

There are several relationships that would have been expected to reach significance which did not. For instance, one would have also expected both the Rational sub-scales (Rational Ability and Rational Engagement) to correlate negatively with Frequency, Length, and Amount. One would also have expected the two Experiential sub-scales to correlate in the opposite direction with the same variables. None of these variables correlated with either of the two Experiential sub-scales.

The National Lottery Only players all spent between £1 and £5 per episode, and all reported their typical episode lasting between 0 and 10 minutes. Both these categories scored a value of 1 when coding the responses which explains the perfect correlation between Amount spent and Length observed with the National Lottery Only players. For participants who gambled on a variety of forms, the Amount spent on a typical gambling episode correlated with the Length of time that the participant reports being involved with the task on that occasion; the longer you are involved, the more money is spent, as would be expected.

Loss of Control correlated significantly with both Amount spent on a typical episode and Length of episode, but only with respect to National Lottery Only players. This relationship would also have been expected for people who play a variety of forms.

In summary, this study shed some light on the possible relationships between a range of variables, particularly with respect to the level of Dissociation, the extent of the fallacious beliefs held, and the Loss of Control experienced. The results do not however offer support for the notion that the ways in which people enjoy and perceive their ability to use an Experiential (heuristic) or Rational (analytic) mode of processing (as measured by the REI), bear any relevance to the participation in gambling activities. One reason for the lack of relationships found may have been due to sampling.

The majority of the student sample were low frequency players. Investigating these relationships between variables may be more fruitful with a sample drawn from the general population with an increased number of higher frequency gamblers.

The following study was therefore run with a general population sample to further investigate the relationships between the variables considered in Study 1 and at the same time to establish whether the findings from the student population are generalisable.

4.6. Study 2

4.6.1. Method

Participants

Names and addresses of 556 adults were drawn randomly from the Electoral Register for the Plymouth area. The resulting sample consisted of those who returned the completed questionnaire in the stamped addressed envelope, which was provided to encourage return. The 27% return rate consisted of 148 Participants, (65 women, 69 men and 14 who did not indicate their gender).

Materials

Identical materials were used to those used in Study 1.

Procedure

The questionnaire (including both the REI and the gambling sections, as in Study 1) was sent out to prospective participants with a covering letter explaining that the study was researching the styles of processing that people in the general population use alongside a questionnaire about gambling preferences and activities, emphasising individual confidentiality. Participants were asked to complete the whole questionnaire and return it in the stamped addressed envelope provided.

4.6.2. Results and Discussion for Study 2

23 of the 148 returned questionnaires had no or little usable data, hence the remaining 125 were used in an analysis identical to that performed with Study 1. This results section follows an identical structure to that used to present the results from the student sample study (Study 1). Again participants taking part in the National Lottery only were analysed separately.

4.6.2.1. Breakdown of Frequency and Forms Participated In

Refer to Table 4.9 for the frequency of the forms taken part in. Again the National Lottery and Scratch Cards appeared to be the most dominant gambling forms, with 114 (91.2%) purchasing National Lottery tickets.

Table 4.9. Number and Percentage of Participants reporting playing on the various forms. N=125.

Form	Number	Percentage
Horse Racing (Off Course)	15	12.0
National Lottery	114	91.2
Bingo	18	14.4
Horse/Dog Racing (On Course)	17	13.6
Scratch Cards	41	32.8
Pools	23	18.4
Gaming Machines	22	17.6
Casinos	6	4.8
Sports Betting	6	4.8
Other	6	4.8

Table 4.10 shows that 84% of people reported playing only up to and including three forms, although a majority of these reported only taking part in one, and on 82.8% of the time, this happened to be the National Lottery.

Table 4.10. Main Population. Frequency of Number of Forms taken part in, and the degree of National Lottery and Scratch Card players.

Number of Forms	Frequency	No. of People playing National Lottery and/or Scratch Cards	Cumulative Frequency
1	58 (46.4%)	48 (82.8%)	48 (41.7%)
2	28 (22.4%)	28 (100%)	76 (66.1%)
3	19 (15.2%)	19 (100%)	95(82.6%)
4	9 (7.2%)	9 (100%)	104 (90.4%)
5	7 (5.6%)	7 (100%)	111 (96.5%)
6	1 (0.8%)	1 (100%)	112 (98.3%)
7	3 (2.4%)	3 (100%)	115 (100%)
Missing Data	23	-	-

Table 4.11 provides information as to the frequency of the participants' gambling behaviour, their typical length of gambling episode, and their typical expenditure at a session.

Table 4.11. Frequency Statistics for Frequency, Length and Expenditure.

	Frequency
Frequency of Gambling Episodes	
Less often than once every six months	27
Less than once a month, but more than once every six months	14
Less than once a week, but more than once a month	12
Less than every day, but more than once a week	41
Every day	54
Length of Gambling Episode	
No Response	29
0-10 mins	102
11-30 mins	7
30-60 mins	4
1-2 hours	4
more than 2 hours	2
Expenditure per Session	
No Response	23
£1-£5	107
£6-£10	10
£11-£25	4
£26-£50	2
£51-£100	1
over £100	1

Again the National Lottery was engaged in by the vast majority of participants (91.2%). The data also represented a high incidence of Scratch card play among the participants, (32.8%). Only a limited number of people gambled in Casinos (4.8%). Whereas with the student sample only 2.3% of participants played on the Pools, 15.5% of this sample played. Gambling on sports was the only other main difference between the two samples, with 12.8% of the student sample, but only 4.8% of the general population.

4.6.2.2. Erroneous Perceptions, Dissociation and Loss of Control Scores

Table 4.12. Breakdown of Loss of Control, Dissociation and Fallacious Beliefs by Form

	Loss of Control	Dissociation	Erroneous Beliefs	N
Horse Racing (Off Course)	6.5	9.0	17.5	2
National Lottery	0.4	5.6	11.0	96
Bingo	1.5	8.5	14.0	2
Horse/Dog Racing (On Course)	0.5	8.0	15.0	2
Scratch Cards	0.5	6.5	12.0	2
Pools	0.0	4.5	12.5	2
Gaming Machines	2.3	7.3	12.6	8
Sports Betting	2.0	11.0	17.0	1

Table 4.12 above shows a breakdown of the loss of control, the dissociation and the erroneous beliefs scores broken down by participants' main gambling forms. For example, as one might expect, loss of control was less of an issue for people playing predominantly on the National Lottery, Scratch cards and Pools. The point that on course betting also did not result in a high loss of control score (mean 0.5) would suggest something about the availability of the betting forms. When betting on course there are only a limited number of races planned to run at the particular meeting for that particular day, and hence access is somewhat limited, as the focus of the day is the racing occurring on course. However, in comparison, those predominantly taking part in off-course betting have easier access to the whole spectrum of racing available. This could account for why the loss of control reported by these participants was particularly high in comparison to the other forms, (mean of 6.5).

A score was obtained for each of the variables in an identical fashion to that utilised for Study 1 reported earlier. Again, Pearson Product-Moment correlation coefficients were calculated to investigate the nature and strength of the relationship between all the variables.

4.6.2.3. National Lottery Only Players

The relationship between the REI sub-scales and the other variables (National Lottery Only players)

Rational Engagement correlated with Frequency (r=0.30), and with Length (r=0.39). and Experiential Engagement correlated negatively with Frequency (r=-0.40), and with Length (r=-0.47). Experiential Ability also correlated negatively with Length (r=-0.35). See Table 4.13 for the correlation matrix. The correlations for this group were in direct contrast to expectations. This may in itself provide further evidence that gamblers playing on the National Lottery Only ought to be analysed separately to those taking part in other less socially acceptable forms.

The Inter-correlations between the other variables measured (National Lottery Only players)

Fallacies correlated significantly with Loss of Control (r=0.56) and Dissociation (r=0.68), but Loss of Control did not correlate significantly with Dissociation. Frequency correlated with Length (r=0.85), Loss of Control (r=0.65), Amount did not correlate with any variables. Length correlated with Loss of Control (r=0.52). See Table 4.13 for the correlation matrix.

Table 4.13. Correlation Matrix for Main Population, National Lottery Only Players; (* = p<.05, ** = p<.01).

	No. of Forms	Frequency	Length	Amount	Loss of Control	Dissociation	Fallacies	RA	RE	EA	EE	R	E
No. of Forms	1.00	--	--	--	--	--	--	--	--	--	--	--	--
Frequency	--	1.00	.85**	-.03	.65**	-.14	.26	-.06	.30*	-.28	-.40**	.13	-.36*
Length	--		1.00	-.04	.52**	-.18	.15	.06	.39**	-.35*	-.47**	.24	-.44**
Amount	--			1.00	-.03	.18	.24	-.09	-.08	-.21	-.14	-.09	-.19
Loss of Control	--				1.00	.05	.56**	.04	.21	-.23	-.25	.13	-.25
Dissociation	--					1.00	.68**	.16	.01	-.04	-.02	.09	-.03
Fallacies	--						1.00	.14	.12	-.10	-.03	.14	-.07
RA	--							1.00	.75**	-.21	-.30*	.93**	-.27
RE	--								1.00	-.18	-.32*	.93**	-.26
EA	--									1.00	.75**	-.21	.94**
EE	--										1.00	-.33*	.93**
R	--											1.00	-.29*
E	--												1.00

4.6.2.4. Players of all types of Gambling (excluding National Lottery Only Players)

The relationship between the REI sub-scales and the other variables (Gamblers on All Forms)

Rational Engagement correlated with Fallacies (r=0.23) and with Loss of Control (r=0.24). Rational Ability correlated negatively with Length, (r=-0.26). See Table 4.14 for the correlation matrix. The correlations with RE suggest that the more one enjoys analytical activities, the greater the number of fallacious beliefs held and the greater the loss of control. However, as the RA correlation with Length suggests, as the participants' perception of how good they were at such tasks increased, the typical length of a gambling episode decreased.

The Inter-correlations between the other variables measured (Gamblers on All Forms)

Dissociation correlated with Loss of Control (r=0.49) and with Fallacies (r=0.71); and Loss of Control correlated with Fallacies (r=0.50). Amount also correlated with Dissociation (r=0.50), Loss of Control (r=0.33) and Fallacies (r=0.43). Fallacies correlated with Number of Forms (r=0.28). See Table 4.14 for the correlation matrix.

Participants' Frequency of playing did not correlate with any variables. One question raised in the introduction to this section asked whether higher frequency players were more prone to experience dissociation, held more fallacious beliefs and experienced a greater loss of control. As there were no significant correlations there was no evidence to

Table 4.14. Correlation Matrix for Main Population, All Forms ; (* = p<.05, ** = p<.01).

	No. of Forms	Frequency	Length	Amount	Loss of Control	Dissociation	Fallacies	RA	RE	EA	EE	R	E
No. of Forms	1.00	-.12	-.04	.20	.08	.18	.28*	.08	.18	.12	.16	.15	.15
Frequency		1.00	-.01	-.04	-.04	-.07	.17	-.12	-.15	-.12	-.06	-.15	-.10
Length			1.00	-.02	-.05	.06	-.02	-.26*	-.19	-.08	-.12	-.25*	-.11
Amount				1.00	.33**	.50**	.43**	-.13	-.07	.03	.22	-.11	.14
Loss of Control					1.00	.49**	.50**	.09	.24*	.16	.13	.18	.15
Dissociation						1.00	.71**	.13	.11	.00	-.01	.13	-.00
Fallacies							1.00	.07	.23*	.15	.11	.17	.14
RA								1.00	.66**	.10	-.13	.90**	-.03
RE									1.00	.24*	-.06	.91**	.08
EA										1.00	.70**	.19	.90**
EE											1.00	-.10	.94**
R												1.00	.03
E													1.00

suggest that higher frequency gamblers score any higher on these other variables than low frequency players. However, within-group correlations (by Frequency) demonstrate that the higher the frequency, the more likely the three-way relationship between Fallacies, Loss of Control and Dissociation was to appear. See Table 4.15 for this correlation matrix.

Table 4.15. Within-group correlations - for Frequency; (* = p<0.05, ** = p<0.01).

Frequency		Loss of Control	Dissociation	Fallacies
1 (Less than twice a year)	Loss of Control	1.00	0.30	0.46
N=11	Dissociation		1.00	0.84**
	Fallacies			1.00
2 (More than twice a year)	Loss of Control	1.00	0.86*	0.77
N=6	Dissociation		1.00	0.93**
	Fallacies			1.00
3 (More than once a month)	Loss of Control	1.00	0.64**	0.50*
N=22	Dissociation		1.00	0.80**
	Fallacies			1.00
4 (More than once a week)	Loss of Control	1.00	0.45**	0.52**
N=36	Dissociation		1.00	0.65**
	Fallacies			1.00

4.6.3. Discussion

For both groups in the analysis, Loss of Control correlated with the level of fallacious beliefs held. The more fallacious beliefs a person held, the more loss of control they reported experiencing. The more fallacies that a person held was also positively related to the level of dissociation experienced. What was of additional interest with the Main population sample was that the level of dissociation also correlated positively with the Loss of Control, such that the more dissociated a person reported being whilst gambling on their chosen forms, the higher the loss of control they experienced. With participants reporting playing on a variety of forms these three variables also correlated with the Amount spent on a typical gambling episode, suggesting that the more money they spent, the higher the loss of control, the greater the dissociation experience and the greater the number of fallacious beliefs held.

In terms of the relevance of the REI to gambling beliefs and activities, the Main study demonstrated some relationships between the REI sub-scales and the gambling items.

Strangely, the more one prefers to take part in activities requiring a more rational approach to the task (i.e. tasks unlike gambling tasks) the greater the loss of control and the greater the number of fallacies. This was contrary to what one would expect. However, people's perceptions of their ability to process the task in a rational way correlated negatively with the length of the typical gambling episode, hence the better they thought they were at using a rational process the shorter the gambling episode. For the Main population neither of the Experiential sub-scales correlated in a significant way to any of the gambling items.

For the National Lottery Only players, Rational Engagement correlated with Frequency and with Length. What is interesting about this relationship is that the correlation coefficient was positive, suggesting that the more one enjoys taking part in the analytic type activities, the longer and more regularly one plays the National Lottery. The correlation between these variables and Experiential Engagement was in addition stronger and negative, suggesting that the more one likes taking part in activities in which heuristics can play a part, less time is spent playing on the Lottery, and less often. Drawing conclusions from this must however be done with caution, particularly due to the scoring of the items. The size of the coefficients can be explained by the nature of a National Lottery gamble as discussed earlier. A bet on the Lottery does not require much time, costs a set amount per go, and the number of draws is restricted to two per week. This issue has obvious affects on the Frequency, Amount and Length items in the analysis. In addition, these rather unpredicted relationships could be explained in terms of the advertising and presentation of the National Lottery surrounding each event. For example, when the balls are selected, the narrator informs the audience of how many times that particular ball (number) has been selected; in order to attract attention to irrelevant information in an attempt to encourage the belief both that this information is in fact relevant, and that the prediction task does need some analytical skills to take part.

The significant correlation between fallacies and the number of forms taken part in suggests that the more forms one takes part in the greater the number of fallacious beliefs are held. Implications of this will be addressed in the general discussion section below.

4.7. General Discussion

For both Study 1 and Study 2, for the National Lottery Only players there was a significant positive correlation between Fallacies and Loss of Control. The greater the number of fallacies believed in, the greater the loss of control. For the National Lottery Only players in the Main population study the relationship between the number of fallacies and the level of dissociation also reached significance. This relationship also occurred for both studies for people who reported playing on a variety of forms, as did the relationship between the level of dissociation and loss of control. This provides strong support for the notion that the dissociation may be experienced whilst gambling, and is linked to erroneous perceptions and the ability to keep control of one's gambling behaviour. These three variables, Fallacies, Dissociation and Loss of Control all correlated positively with one another, with only the correlation between Fallacies and Loss of Control for the student sample (Study 1) not reaching significance ($r=0.24$). For the Main population data, the three way relationship extended to include the typical amount spent on a gambling episode. The amount spent on a gambling episode was positively correlated with all three variables.

Although no causal relationships can be inferred from these correlational results, there is sufficient evidence to conclude that the three variables of Fallacies, Loss of Control and Dissociation are related. The way in which they are related is open for interpretation and some further analysis.

4.8. Further Analysis - Modelling

The inter-correlations observed in the above analysis suggest that there is indeed a significant relationship between the measured variables of Fallacies, Dissociation and Loss of Control. This is the first evidence of this relationship. Correlations between these variables could be used to predict (with some caution) one variable's value given the knowledge of another. For example, if one has a measure of the extent to which someone holds fallacious beliefs, it may be possible to predict the extent to which they become dissociated and/or lose control with their gambling behaviour. However, it is very important to note that mere correlations do not imply that that one variable causes the other(s). Correlations only offer a measure of the extent to which the measured variables vary in harmony with each other, thus representing a measure of the degree to which they are related. It is not possible to imply causality from correlational analyses due to there potentially being other unmeasured variables which intervene that could have heavy influences, causing the observed correlations. It is still not clear from the current studies whether there is any underlying implicit behaviour causing the erroneous perceptions to exist or whether the erroneous perceptions are a cause in their own right. Further studies would need to be done to investigate the processing that occurs online, whilst actually gambling.

There are however a number of models that could explain the relationships observed. These will be presented before using the statistical approaches of Confirmatory

Factor Analysis and Structural Equation Modelling to provide evidence on the relative merits of these models in accounting for the data.

Four possible non-recursive models have theoretical relevance that exist to fit the data, and these are presented in Table 4.16 below. Model "F-D-LoC" for example represents the case where the extent of Fallacious beliefs that a person holds has a direct influence on the level of Dissociation that is experienced. This induced Dissociation then leads, due to the dissociative experience rendering the individual unaware of the amount of time and money that they have invested in the activity to the individual experiencing a Loss of Control. In addition to these non-recursive models, any recursive model could also be in the running to account for the data. Recursive models include any non-recursive model in which there are additional feedback loops. For example, it could be the case that Model F-D-LoC had an additional feedback loop allowing for the induced Loss of Control to exaggerate (hence cause) further Dissociation or further Fallacies being developed in the individual's attempt at further explaining why they are continuing with the behaviour. Alternatively or additionally there may be a process by which the level of Dissociation can feedback and influence the degree of Fallacious beliefs, or that Fallacies have a direct influence on the extent of the Loss of Control experienced.

Table 4.16. Possible models with theoretical relevance.

Model	Factors				
F-D-LoC	Fallacies	→	Dissociation	→	Loss of Control
D-F-LoC	Dissociation	→	Fallacies	→	Loss of Control
F-LoC-D	Fallacies	→	Loss of Control	→	Dissociation
D-LoC-F	Dissociation	→	Loss of Control	→	Fallacies

Note that there are two potential non-recursive models which were excluded from the investigation which would not be of much theoretical relevance. These would have been models which had, as their starting point and influence, the Loss of Control. If this was the case, then one would have to hypothesise about other factors that may influence the Loss of Control, separate to the notion of erroneous perceptions and dissociation. Given that other candidates have not come to light, and are not strongly suggested in the gambling literature, these models were excluded from consideration.

The models under the current investigation view the holding of erroneous perceptions or the level of Dissociation experienced, as the initial influences, which ultimately leads to a Loss of Control. This can occur, within the models outlined, either directly from either Fallacies or Dissociation (as in models F-LoC-D or D-LoC-F) or as a result of some prior relationship between these two concepts, (as in models F-D-LoC and D-F-LoC). Models F-LoC-D and D-LoC-F assume therefore that as a consequence of experiencing a Loss of Control, the individual either gets dissociated, or develops fallacious beliefs in order to explain or rationalise their loss of control.

Fitting these models to the data using Confirmatory Factor Analysis and Structural Equation modelling techniques enables one to investigate the relative merits of each, as Structural Equation provides a way of looking at the data and evaluating how consistent it is with causal models.

The purpose of model fitting, as explained by Dennis, Newstead and Wright (1996), carried out here using EQS (a statistical software package), "is to predict the entire pattern of covariances and variances amongst the variables in the analysis. EQS determines values for the unknown parameters of the model in such a way as to minimise the discrepancy between the observed variances and covariances and those predicted by the model" (p. 524), and in this case, a maximum likelihood criterion was used. Under the assumption of multivariate normality this criterion leads to a function which is approximately distributed as chi-squared with a number of degrees of freedom which depends on the number of measured variables and on the number of parameters which are estimated in fitting the model. The value of this statistic can be used to assess the overall compatibility of the model with the data, a value which represents the extent to which the model fits the data. Each model can be fitted, and models can therefore be compared in this way.

To facilitate the Factor analysis, the 15 Loss of Control items were grouped into three parcels. The number of items that were responded to with a "Yes" response within each of the three groups constituted the Loss of Control score for that group. The items were grouped by their content into questions relating to problems associated with gambling, feelings associated with gambling, and chasing behaviour. Table 4.17 below displays the items groupings. The responses from both the student population and the main population (Study 1 and 2 participants) were included in this factor analysis.

Table 4.17. Loss of Control Item Groupings for Factor Analysis

Associated Problems

8. Do you see your gambling activities as ever having lead to a problem?
9. Have you sought or thought of seeking help for your gambling behaviour?
14. Do you ever get into debt as a result of your gambling?
15. Have you borrowed money to gamble or pay gambling debts?
22. Have you hidden betting slips, lottery tickets, gambling money, or other signs of gambling form your spouse, children, or other important people in you life?

Associated Feelings

10. Was there any time when the amount you were gambling made you nervous?
17. Do you need to gamble with more and more money to achieve the desired excitement?
18. Do you ever have unsuccessful attempts to control, cut back, or stop gambling?
21. Have you felt guilty about the way you gamble or about what happens when you gamble?

Chasing

11. After winning, do you feel you ought to gamble more to increase your winnings?
12. Do you gamble until all your spare cash has gone?
13. After losing, do you spend more money to try to make up for your losses?
16. Do you find you gamble for longer than you intended?
19. When you gamble, do you go back another day to win back the money you lost?
20. Do you ever gamble more money than you intended to?

The model predicted that these three variables would be influenced by what was labelled Factor 1.

The 7 Fallacious beliefs items were entered as individual variables. The model predicted that these variables would be influenced by what was labelled Factor 2. Likewise, Factor 3 was predicted to influence the four Dissociation items which were entered into the Factor Analysis. Table 4.18 presents some descriptive statistics for the variables involved in the Factor Analysis.

Table 4.18. Descriptive Statistics for Variables in Factor Analysis. N=192

		Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Loss of Control	LOC1	0	4	0.1458	0.6305	5.157	27.336
	LOC2	0	3	0.2031	0.5272	2.976	9.544
	LOC3	0	6	0.5313	1.1618	2.686	7.27
Fallacious Beliefs	F27	1	3	1.5312	0.6383	0.791	-0.411
	F28	1	3	1.5729	0.6591	0.72	-0.549
	F29	1	4	1.9219	0.8617	0.397	-0.968
	F30	1	4	1.7031	0.7995	0.768	-0.453
	F31	1	4	1.4583	0.5952	1.057	0.873
	F32	1	4	2.0365	0.9674	0.449	-0.919
	F33	1	4	1.7396	0.7893	0.751	-0.233
Dissociation	D23	1	3	1.6875	0.636	0.373	-0.691
	D24	1	4	1.6563	0.7837	0.946	0.09
	D25	1	3	1.4375	0.6108	1.069	0.099
	D26	1	3	1.4115	0.5439	0.845	-0.383

One important point to note with the above descriptive statistics are the Skewness and Kurtosis figures for the Loss of Control items. These figures (much higher than zero) represent the fact that these measures, especially the first Loss of Control parcel, are not normally distributed. The maximum likelihood method used assumes that the measures which are used are normally distributed, which is clearly not the case for this parcel, which could cause concern for any models which result. To partially alleviate this concern, the Robust method (as developed by Satorra and Bentler 1988, 1994) was used throughout the modelling, which takes some account of the lack of normality in distribution for the measures involved.

Table 4.19 below displays the correlation matrix for the Loss of Control, Fallacious Beliefs and Dissociation variables, the relationship between which the Factor Analysis was used to investigate.

Table 4.19. Correlations and p values for Variables in the Factor Analysis.

		LOC1	LOC2	LOC3	F27	F28	F29	F30	F31	F32	F33	D23	D24	D25	D26
Loss of	LOC1	1	.304**	.358**	.054	.151*	.002	.128	-.026	.111	.129	-.055	.144*	-.017	-.023
Control	LOC2		1	.669**	.362**	.372**	.277**	.305**	.119	.324**	.342**	.300**	.411**	.259**	.237**
	LOC3			1	.380**	.441**	.319**	.362**	.123	.346**	.414**	.311**	.552**	.386**	.348**
Fallacious	F27				1	.729**	.590**	.434**	.348**	.443**	.515**	.476**	.534**	.529**	.664**
Beliefs	F28					1	.623**	.623**	.381**	.534**	.620**	.467**	.616**	.480**	.507**
	F29						1	.536**	.458**	.581**	.555**	.548**	.487**	.453**	.493**
	F30							1	.309**	.583**	.690**	.424**	.471**	.321**	.355**
	F31								1	.353**	.345**	.256**	.239**	.468**	.433**
	F32									1	.637**	.351**	.431**	.354**	.359**
	F33										1	.379**	.439**	.379**	.397**
Dissociation	D23											1	.529**	.529**	.570**
	D24												1	.447**	.530**
	D25													1	.700**
	D26														1

** Correlation is significant at the .01 level
* Correlation is significant at the .05 level

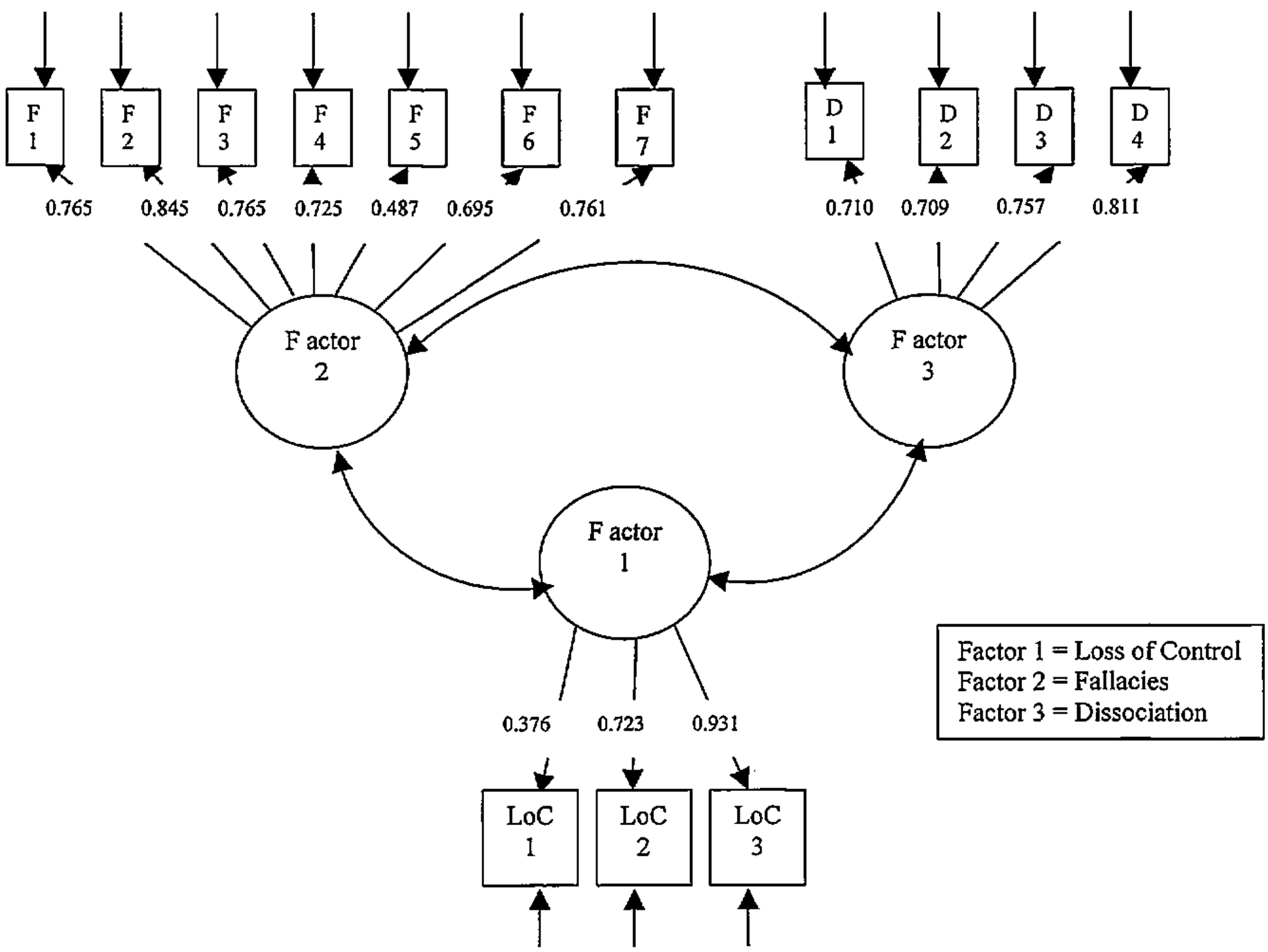
The first stage in the analysis was to establish whether each variable was measuring what it was supposed to be measuring. This is done by running a measurement model, in which all possible relationships between the three latent variables in the analysis are allowed to exist.

The path diagram for the measurement model explored with the data is shown in Figure 4.1 where "F" denotes a Fallacy Item, "D" a Dissociation Item, and "LoC" a Loss of Control Item. It follows the standard convention for such diagrams. The variables in circles are latent variables which the model assumes influence the manifest or measured variables, which are represented by squares. The Factor Analysis was run to investigate the measurement model, using EQS.

The Robust Comparative Fit Index of .910 indicated that the model did indeed fit the data adequately, with a Satorra-Bentler Scaled χ^2 of 166.4, with 74 degrees of freedom.

However, what also became apparent was that the output from the factor analysis suggested that the Dissociation item (D24), "Sometimes I forget the time when gambling", was also measuring (loading on) Factor 1, the Loss of Control factor. The nature of the content of this item could well fit into the loss of control category. The Lagrange Multiplier test (for adding parameters) suggested that the model would fit the data significantly better if this variable was allowed to load on to the Loss of Control factor.

Figure 4.1 The Path Diagram for the Measurement Model Which Was Investigated, (with Standardised values)



The factor analysis was then re-run with this amendment, see Appendix 5c for the output of running this measurement model. The model fit was improved, represented by the increase in the Robust Comparative Fit Index to .919, and by the fact that the measurement equation outputs specified that this item was significantly loaded on by

Factor 3 (Dissociation). Furthermore the Satorra-Bentler Scaled χ^2 with 73 degrees of freedom had decreased from 166.4 to 156.3. All the items loaded significantly on the factors they were intended to load on. Additionally, generally more than 50% of the variance in the measured variables could be explained by the factors, except for the two items; Loss of Control 1 and the "I've carried a lucky charm when gambling" within the Fallacy items. This latter measure on closer reflection is not necessarily a true fallacy as it addresses a particular behaviour rather than assessing a particular belief. In other words, an individual responding positively to this item does not necessarily believe that although he or she may carry a lucky charm, this lucky charm will have any positive effect on whether or not they win at the gambling activities. The estimates for the correlations between the three Factors were remarkably strong. The correlation between Loss of Control (Factor 1) and Fallacies (Factor 2) was estimated by the model at .55, between Loss of Control and Dissociation (Factor 3) at .46, and between Fallacies and Dissociation the estimated correlation was .77.

Given that above measurement model suggested that the measured variables were measuring what they were planned to measure, and that each of the Loss of Control, Fallacies and Dissociation factors appeared to be unitary constructs, Structural Equation Modelling was then performed using EQS to investigate how the underlying constructs influence each other. This procedure also acts as a check that the observed variables were measuring the factors (the underlying concepts) that were proposed. Here though, one only allows correlations between the constructs that are predicted from our theoretical predictions.

Several variants of the model, those discussed earlier, were assessed using EQS. Table 4.20 provides the χ^2 values and the fit indices for each of the models, where larger fit indices indicate a better fit to the data, and the maximum index value is approximately one. The value of χ^2 provides an indication of how well the model under investigation fits the data. It can be used to test the null hypothesis that the departure of the data from the model is no higher than what would be expected by chance if the model were true. Even in moderate samples though, non-significant χ^2 are unusual. The smaller the χ^2 for any given degrees of freedom the better the model fit. In addition, when one model is a constrained version of another model, then one can use the change in χ^2 to test whether the constraint has made the model worse at fitting the data. If the change in χ^2 is significant this means that the constraint has made the model worse. If the change in χ^2 is non-significant, then the constrained model is a simpler model which fits the data equally well.

Table 4.20. Measures of fit for a number of variants of the model depicted in Figure 4.1

Model	F-(D-LoC)	D-(F-LoC)	F-D-LoC	D-F-LoC	F-LoC-D	D-LoC-F
	Recursive	Recursive	Non-recursive	Non-recursive	Non-recursive	Non-recursive
Robust Comparative Fit Index	.919	.919	.916	.920	.863	.863
χ^2	222.5	222.5	232.9	222.9	291.2	291.2
Satorra-Bentler Scaled χ^2	156.3	156.3	160.4	156.1	214.6	214.6
Degrees of Freedom	73	73	74	74	74	74

Note: See the text and Table 4.16 for a description of the models.

The fit of each of these models will be examined in turn. The F-(D-LoC) recursive model of Table 4.20 specifies that the Loss of Control factor was influenced by both the degree of fallacious beliefs and by the level of dissociation. It is recursive in that Fallacies also influenced Dissociation. The Robust Comparative Fit Index (CFI) suggests that this model adequately explains the data.

However the path coefficient in this model between Dissociation and Loss of Control (0.046) was not significant. The ratio of the path coefficient to its standard error of estimate (0.619), which is approximately distributed as z, was less than the criterion value of z of 1.96, hence this path coefficient was not significant at the 5% level. This suggests that the direct path between Dissociation and Loss of Control is superfluous, and can be removed from the model without making the model significantly worse. The path coefficients between Fallacies and Loss of Control (0.238) and between Dissociation and Fallacies (0.711) were both significant at the 5% level, with ratios of 2.936 and 8.087 respectively. These demonstrate that Fallacies had a significant influence on Loss of Control, and that Dissociation had a significant influence on Fallacies.

Model D-(F-LoC) was run reversing the influence so that the level of Dissociation loaded on Fallacies. Identical fit indexes resulted as structural equation modelling would not be able to distinguish between variants of the similar recursive model with the same three factors. The standardised path coefficients demonstrated again that the influence of Dissociation on Loss of Control was not significant (path coefficient of 0.047), whereas the influence of Fallacies on the Loss of Control (0..238) and of Dissociation on Fallacies (0.839) were both significant at the 5% level.

Either of these two models therefore could explain the inter-correlations between the measured variables, although it was not possible to distinguish between which of these two models was better. However, the fact that the influence of Dissociation directly on Loss of Control was not significant, suggests that a simpler non-recursive model such as D-F-LoC (without the additional loading of Dissociation on Loss of Control) would adequately account for the data. These recursive models were therefore dropped as explanations of the relationship between the constructs. Investigating non-recursive models would indicate the relative importance of the position of the three factors in terms of causality.

Structural Equation modelling was used to investigate the relative merits of the non-recursive models discussed earlier (see Table 4.16 above). In particular the aim was to distinguish between models which have Loss of Control as the end point and those that do not (e.g. F-D-LoC vs. F-LoC-D) and between which of the two concepts, Fallacies (the Ladouceur model) or Dissociation, appears to be the best candidate for the antecedent (between F-D-LoC and D-F-LoC).

Table 4.20 shows the fit indices for these non-recursive models. The D-LoC-F model can effectively be ruled out for further investigation as the fit indices are low and below the accepted rule of thumb level of 0.9. In addition, the Lagrange Multiplier test (for adding parameters) suggested that a significant improvement to the model would involve allowing Fallacies to load on to Dissociation, thereby reverting to the recursive model.

The F-LoC-D model can also be ruled out as the fit indices relating to this model are low, and as there are alternative models that better explain the relationship between the variables, represented by their higher fit indices. The fact that the χ^2 values for both these latter two models was substantially higher than for the F-D-LoC and the D-F-LoC models also informs that these models are not as good at accounting for the data.

Thus the two models that appear to account for the data best are the two models investigated with Loss of Control being the consequent rather than the antecedent as predicted. See Appendix 5d and 5e for the output from the equation modelling for these two models.

Table 4.21 below shows the differences in χ^2 for the four non-recursive models under investigation.

Table 4.21. Differences in χ^2 for the Non-recursive Models Under Investigation

	F-D-LoC	D-F-LoC	F-LoC-D	D-LoC-F
F-D-LoC	-	7.8	31.6	31.5
D-F-LoC	7.8	-	23.8	23.7
F-LoC-D	31.6	23.8	-	.1
D-LoC-F	31.5	23.7	.1	-

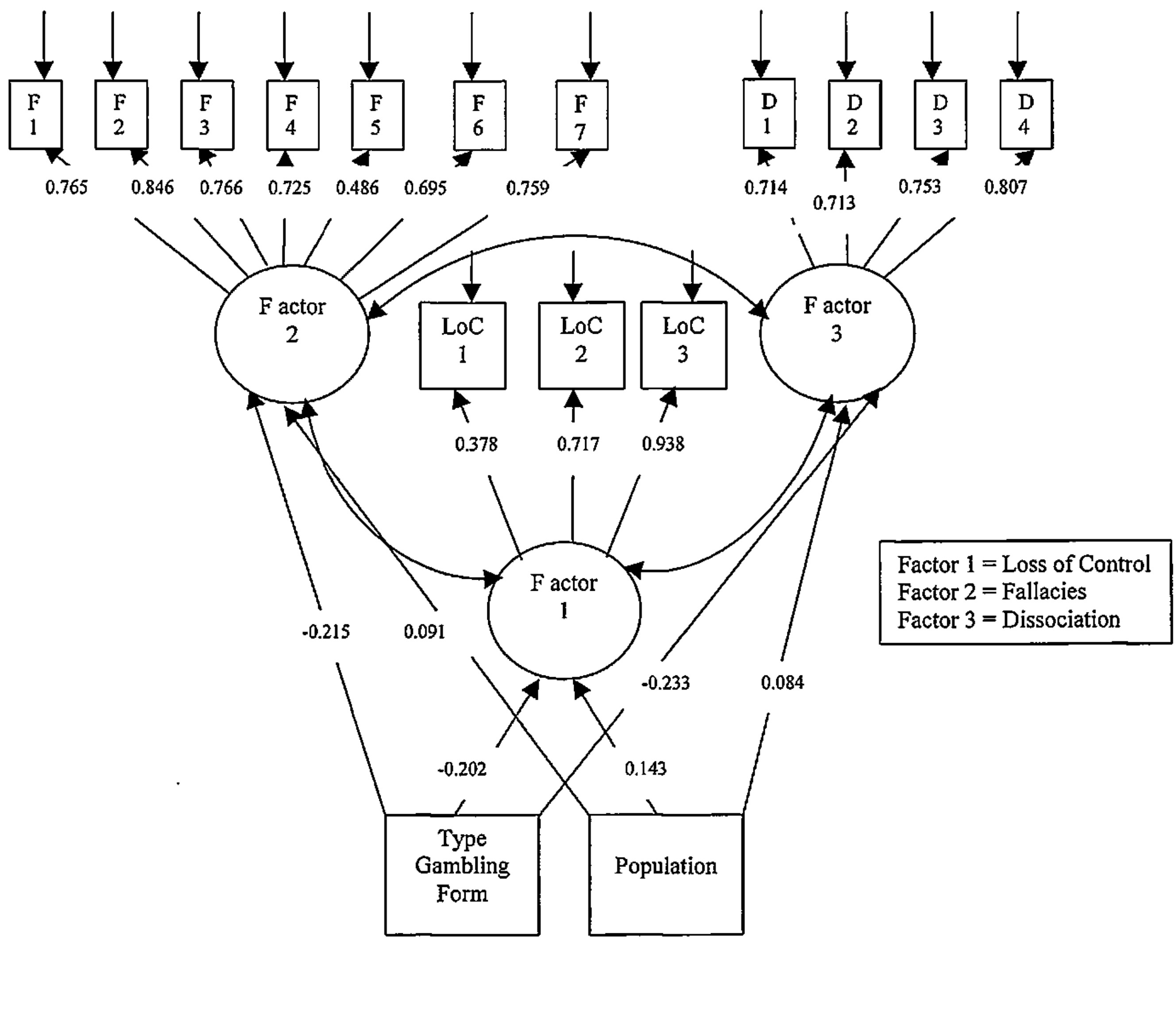
In terms of distinguishing between these two non-recursive models in evaluating which of the two fits the data the best, two sources of information can be used. Firstly the fact that the Robust CFI was higher (but only marginally) for the non-recursive D-F-LoC model than that of the F-D-LoC model, suggests that the Dissociation leading to Fallacies model was better. The second source of information relates to the outcome of the Lagrange Multiplier test (for adding parameters into the model). The suggestions that this output indicated, were that for the Fallacies leading to Dissociation model (F-D-LoC) the model would be significantly improved in its ability to account for the relationship between the variables, if further links between the three factors were added to the model; thereby making it a recursive model. However, even with these changes (allowing Dissociation to load on to Loss of Control, and Loss of Control onto Fallacies) it would fare no better than the non-recursive model in which additional relationships between the factors were not recommended (i.e. in the D-F-LoC model). Therefore, although it was clear that the F-D-LoC and the D-F-LoC provide better models for the data, concluding which of the two best fits the data is not viable as the fit indices were indeed very close.

One additional capability of EQS is to investigate the impact of different samples. The above modelling treated the data set as a unitary sample. One could argue however, that the student population data could be different (and therefore ought to be treated separately) to the data drawn from the main population. Likewise one could argue (as argued earlier) that gambling on the National Lottery only is inherently different from gambling on a variety of other forms.

To investigate this, a Multiple Indicator Multiple Cause (MIMIC) model was run within the EQS package. This investigates whether the sample or the nature of the individual's gambling activities have any effects on the latent constructs in the model. The MIMIC model treated the gambling type and the population (student versus general population) from which the participants were drawn as further variables that could potentially influence the three main constructs of Fallacies, Dissociation and Loss of Control. By looking at the paths from these two background variables one can see if the three constructs differ across type of gambling form and population. This model is presented in Figure 4.2 below.

The MIMIC model fit was strong, with a Robust Comparative Fit Index of 0.910, with a Satorra-Bentler Scaled χ^2 of 198.35, with 96 degrees of freedom. This tends to indicate that the measurement model is satisfactory for all subgroups within the sample.

Figure 4.2 The Path Diagram for the MIMIC Model (with Standardised values)



The point of reporting this procedure and the results stemming from it, is that there was no significant impact of population on the constructs. All three path coefficients from Population to the three main factors were not significant at the 5% level. Here then there were no differences observed between the use of a student sample and a sample drawn from the general population. However, there were signs that the nature of the relationship between the constructs for people who played only on the National Lottery differed from that for people who gamble on a variety of forms. All three path coefficients from Gambling Type to the three main variables were significant at the 5% level. It suggested that National Lottery Only players tended to become less dissociated, held a lower degree of fallacious beliefs, and experienced less loss of control. From viewing the nature of a National Lottery gamble, as discussed earlier, this difference would be expected. For example, due to the short length of time that is required to take this kind of gamble, there is less chance for someone to experience the characteristics of a dissociative experience. This also confirms that in the earlier analysis it was advisable to investigate the National Lottery only players on their own.

This is the first time that evidence for the existence of a relationship between these three factors has been demonstrated. There is strong evidence to suggest that a dissociative experience plays an important role in the development of loss of control, in addition to fallacious beliefs held by the gambler.

This raises questions for the Ladouceur view that central to the loss of control are erroneous perceptions. Although this study has not shown that this is not the case, it has added an important dimension to the model. It appears that although erroneous perceptions may be important in the progression to a loss of control state, what appears to precede this loss of control is the degree to which the individual gets dissociated, using the gambling activity for an altogether different experience from their everyday life.

This begs the question of whether any general dissociative personality trait or tendency could partly explain an individuals' gambling activities, and whether high frequency gamblers have an increased tendency, both within and outside of the gambling context, to become dissociated. The following chapter therefore investigates these possibilities. In addition, the following chapter investigates whether or not high frequency gamblers use heuristics more readily in decision making tasks than non- or low frequency gamblers. Of additional interest is whether gamblers utilise heuristics more readily generally, or whether their heuristical use is context specific. In other words, is it the case that high frequency gamblers utilise heuristics more readily but only within the gambling context?

5. Chapter 5: Dissociation, Erroneous Beliefs, Heuristics and Biases, and Loss of Control

5.1. Introduction

The results from the studies in Chapter 4 suggested that there was no relationship between the extent of the use of either the rational or the experiential processing style (as measured by the REI) and people's reported gambling behaviour. Although there was little evidence for the weak cognitive hypothesis with respect to the processing styles, the relationship observed between the other variables did suggest some support for the integrative hypothesis.

Although the studies were questionnaire based, and therefore did not take measures during a real gambling task, the results did demonstrate a clear relationship between the level of dissociation experienced within the gambling task, the level of erroneous perceptions and the extent of the loss of control experienced. Furthermore the results of the Structural Equation modelling suggested that the models that best accounted for the data were the ones in which the relationship between erroneous perceptions and dissociation influenced the extent of loss of control, although it was hard to distinguish between the F-D-LoC and the D-F-LoC models. Developing both the erroneous perceptions and gambling dissociation scales by increasing the number of relevant items may provide a clearer picture of which concept precedes the other in terms of progression to state where the individual loses control over their gambling behaviour.

The dissociation items that were involved in the previous study related to dissociative experiences within the gambling context. The items referred only to feelings of dissociation whilst involved with the individual's chosen gambling activities. This begs the question of whether any general dissociative personality trait or tendency could partly explain an individuals gambling activity, or whether the dissociation is in fact context specific. It may be that the level of dissociation experienced is only relevant when an individual experiences it whilst taking part in their chosen gambling form.

If the extent to which someone becomes dissociated in everyday life (one measure of which is the DES, Bernstein and Putman, 1986) was measured in relation to erroneous perceptions, gambling dissociation and loss of control, and a clear relationship was demonstrated, this would support the weak cognitive hypothesis. It could be that individual differences in general dissociation are a predictor of the relationship between dissociation and other variables in the gambling context. The nature of the relationship of this general dissociation with the other variables could be investigated with a structural equation modelling technique, the results of which could be used to evaluate the weak hypothesis. This chapter therefore investigates the role of general dissociation in explaining continued gambling, and its relation to the other variables found to be of importance. The measures of fallacious beliefs and gambling dissociation were developed for the current investigation in order to both replicate the previous analysis with an increased number of relevant items and to increase the likelihood of being able to distinguish between which of the two constructs precedes the other in the progression to the loss of control state.

The cognitive perspective assumes that gamblers are actively involved with the task, although the results of Chapter 2 suggested that the cognitive perspective could not provide a completely clear picture. As stated, there was no evidence resulting from the investigation conducted in Chapter 4 to suggest that the processing style employed has any effect on people's gambling beliefs or behaviour. However, that does not rule out the possibility that there are other individual differences that could partly explain gambling beliefs and behaviour. An alternative individual difference approach, to be investigated here, involves the extent to which people reason with the use of some heuristics and biases.

In relation to this individual difference approach, Stanovich and West (1998) have examined a wide variety of tasks from the heuristics and biases literature, and observed that there is in fact considerable internal consistency in performance on these tasks. Participants who provide the normative response on one task were usually significantly more likely to provide the normative response for another task.

This suggested to the authors that the departure from the normative responses on each of the tasks was more likely to be due to systematic factors and not to non-systematic performance errors (e.g. temporary lapses of attention, memory deactivation and other sporadic information-processing mishaps). They investigated a variety of tasks whilst measuring intelligence, using the Scholastic Aptitude Test (SAT). They observed that overall, the people demonstrating responses that more closely resembled the normative response were those that achieved higher SAT scores.

For example, participant SAT scores were strongly and positively correlated with performance scores on syllogistic reasoning tasks ($r=0.470$). Likewise, on the abstract original version of the Wason selection task, where typically only 10% of participants choose the correct card selections, those that did, tended to be those with higher SAT scores (with a correlation between the two of $r=0.394$). Furthermore on the Statistical reasoning tasks that they examined, participant performance scores again correlated significantly with the intelligence measure, $r=0.347$. In fact across a wide range of tasks the correlations between participant performance and their SAT scores tended to be significant, strong and positive, (see Stanovich 1999, Stanovich and West, 1998).

One potential application of this programme of work lies in the proposition that if it is the case that gamblers gamble because they are more prone to exhibiting the use of heuristics and biases, and hence provide responses further away from the normative response, the individual difference may itself not be proneness to heuristical reasoning, but rather to their lower intelligence.

Although the intelligence of those participants in the current work was not measured, it would have been interesting to have done so. However, there has been evidence in the gambling literature which contradicts this application of Stanovich's work. Ceci and Liker (1986) provide evidence that their high frequency on-course horse race gamblers were more intelligent than population norms, as measured by the Wechsler Adult Intelligence Scale (WAIS). Furthermore, they argued that their findings suggested that IQ is unrelated to skilled performance at the racetrack and additionally, unrelated to real-world forms of cognitive complexity.

However, Stanovich and West (1998) do argue that there is another underlying factor which could partly account for people's performance on the reasoning tasks that they investigated which they labelled "thinking disposition". This thinking disposition was conceptualised (in line with Baron, 1985) as the extent to which an individual would weigh new evidence against a favoured belief, would spend time on a problem before giving up, or would, in forming one's own opinion, weigh heavily on the opinions of others. Stanovich and West (1998) provided evidence that in addition to cognitive ability, this thinking disposition also correlated positively and significantly with performance on the tasks. Although their results suggested that cognitive capacity was the strongest unique factor, individual differences in thinking disposition and cognitive capacity jointly accounted for 31.3% of the variance in performance.

In line with Stanovich's notion of individual differences in performance, this chapter looks at the performance of participants across a range of heuristics and biases in relation to their gambling behaviour.

In relation to the "weak cognitive hypothesis" this chapter therefore investigates the degrees of bias held by gamblers gambling at varying degrees of frequency, and looks at whether high frequency gamblers are more prone to the use of heuristics and influenced

more readily by biases than low frequency players. Furthermore, if this is the case, this chapter investigates whether high frequency gamblers are affected by these more in the gambling situation specifically, or whether they make use of them more readily generally (even in non-gambling contexts). In other words, do high frequency gamblers have the same biases outside of the gambling context?

Wagenaar (1988) argued that gamblers are not a limited group of people who have less than optimal reasoning strategies. Rather he argued that gamblers gamble because they tend to select heuristics at the wrong time. In the reasoning literature there is substantial evidence to suggest that certain biases play a role in the decisions that people arrive at. The heuristics and biases approach to probabilistic inference and judgement is mostly associated with the work Kahneman and Tversky (see Kahneman, Slovic and Tversky, 1982 for a review).

As discussed in the introductory chapter, the general theoretical approach takes the perspective that intuitive assessments of probability appear to reflect the use of simple strategies, rather than reflecting true probability theory. Although the use of these can result in more efficient decision making, they can often lead to systematic errors. See Evans (1989), Evans and Over (1996) and Caverni, Fabre and Gonzalez (1990) for a discussion of some of these heuristics and biases.

The rest of this introduction is devoted to specific heuristics and biases which are assessed in the study that follows. A presentation of the base rate fallacy, the availability and representative heuristic, items assessing the perception of randomness and the hindsight bias follows over the coming pages. The precise items that were used in the questionnaire are presented in the methodology section.

A substantial amount of research has been conducted into investigating how people combine prior probabilities with specific information when these two elements are apparently opposing each other. The fallacy that results has become to be known as the "base rate fallacy". When given information about a student's personality, one might conclude that the student is studying library services rather than engineering, just on the basis of a stereotyped view of these professions, even though numbers of students studying for engineering greatly exceeds the numbers studying library services. Hence people can tend to ignore the base rate information when making their decisions.

Within gambling decision making, people's subjective probability of success can often be significantly higher than the objective probability would warrant. Hence it appears that people tend to ignore the base rate information of the probability of success specified by the nature and characteristics of the task itself. The gambler may cherish their strong belief that tonight will be their lucky night in which they will make up for all their previous losses, ignoring the base rate information which would suggest that they are in fact equally likely to lose on this occasion as they were on the previous gambling episodes.

A typical example of the base rate fallacy, used in the current investigation, is that of the 'cab problem' (Kahneman and Tversky, 1972a, Bar-Hillel, 1980). The individual is presented with the following information.

> A taxi cab was involved in a hit and run accident at night. Two cab companies, the Green and the Blue, operate in the city. 85% of the cabs in the city are Green, 15% are Blue.
> A witness identified the cab as Blue. The Court tested the reliability of the witness under the same circumstances that existed on the night of the accident, and concluded that the witness correctly identified each one of the two colours 80% of the time, and failed 20% of the time.

They are then asked "What is the likelihood that the cab involved in the accident was Blue rather than Green?" The modal response by untrained judges is usually observed to be about 0.8, whereas the correct mathematical solution is 0.43, (Birnbaum, 1983).

This kind of task demonstrates that people often ignore important information which has a direct effect on realistic probability judgements. Is it the case that gamblers who partake with varying frequency are different in terms of the likelihood of their ignoring base rate information. Do they do this in gambling activities only, or is it general to their problem solving and decision making ability? These are questions which the current investigation attempts to address.

Two of the most well known heuristics are the availability and the representative heuristics which were presented earlier.

The observation that people appear to reliably make use of past information which is in fact irrelevant when making the next decision, (e.g. Ladouceur et al, 1996, 1997) suggests that people tend not to be aware of the independence of events, suggesting a belief in the law of small numbers, that short sequences should be representative of the larger population from which they are drawn, (Tversky and Kahneman 1971, Kahneman and Tversky 1972). Of course there are gambling forms (e.g. horse racing) where past information is relevant to some extent. However, when the outcome of the task is determined purely by chance (e.g. as in the game of roulette) past information is completely irrelevant. This heuristic induces people to expect that any small sample drawn from a population should be representative of the population as a whole, that chance operates to produce all possible outcomes with equal frequencies in the short run. This is embodied in the well known gamblers fallacy that after a long run of "heads" a "tail" becomes increasingly likely.

Wagenaar (1977) presented participants with a selection of sequences of white and black dots which were supposed to represent possible outcomes of 100 flips of a coin. The participants' task was to indicate which of the sequences was most likely to have been the one really produced by flipping a coin. He observed that there was a reliable preference for sequences in which there was low repetition in outcomes, i.e. sequences within which there were few long runs of one particular outcome. This again supports the participants focus on the law of small numbers. The question remains as to whether there are any individual differences with respect to the extent to which people employ this heuristic. Two similar types of sequences were presented to participants in the current investigation, one series of sequences from a gambling context and the other from a non-gambling context. The probability of repetition was modelled on the Wagenaar (1977) study, in that the sequences had a probability of repetition of 0.2, 0.4, 0.6 and 0.8.

As previously discussed, one of the problems with the heuristics and biases approach is that it is difficult to distinguish between which heuristic may have been used on a particular occasion. The discussion of the availability and representative heuristics presented the case that both heuristics could predict alternative behaviours in the same situation, and as such association of a particular heuristic with a particular gamble is rather post-hoc.

Rather than attempting to distinguish between the two, and assigning post-hoc reasons for why the particular prediction was made (on the basis of the representative or availability heuristic for example) the current study focused on the confidence which the participants had in their prediction. The assumption made here was that confidence responses which differed from the objective probability of success would signal the fact that the participants had utilised the information presented in the item in some way.

Following the points raised so far in the thesis that the amount of information made available tends to increase peoples confidence in their prediction ability, two amounts of information were presented. In an attempt to identify the extent to which the amount of previous recent outcome information affected peoples confidence, several sequences representing previous outcomes from the spins of a roulette wheel (for the gambling specific items) were presented, following which participants were asked to make both a prediction as to the next unknown outcome (predicting a Red or a Black outcome) and to express their degree of confidence on a 0-100 scale that their prediction was correct.

In addition to manipulating the amount of information (short or long) presented to the participants, the information can also be varied in relation to whether a particular previous outcome was more "available". This can be done by manipulating the proportion of each of the binary outcomes so that either both are equally available (over the course of the presented sequence) or one particular outcome is most available.

The differential effects of these manipulations on people's confidence in their decisions, and hence the use of this heuristic, was investigated.

Another bias that has been demonstrated to play a role in probability judgements is that of the conjunction fallacy, (e.g. Tversky and Kahneman, 1983).

The probability of a conjunction, two things occurring at once, cannot exceed the probability of its constituent parts, i.e. the probability of the first occurring and the probability of the second occurring, because the extension (or probability set) of the conjunction is included in the extension of its constituents.

Judgements under uncertainty however are often mediated by intuitive heuristics that are not bound by the conjunction rule, and instances of a specific category can be easier to imagine or to retrieve than instances of a more inclusive category. The representativeness and availability heuristics therefore can make a conjunction appear more probable than one of its constituents. The extent to which people were affected by this conjunction fallacy was investigated using the following example.

> In four pages of a novel (about 2000 words), how many words would you expect to find have the form _ _ _ _ i n g (seven letter words that end with "ing") ?
>
> In four pages of a novel (about 2000 words), how many words would you expect to find have the form _ _ _ _ _ n _ (seven letter words with "n" as the sixth letter) ?

The greater the difference between people's responses to each of these two items represents the extent to which the availability heuristic has played a role. The first item is a subset of the second and by definition there are less instances when this occurs. However, if availability plays a role then responses would be greater for the first item as remembering items with the "ing" form would be more available.

It has been demonstrated that people are often over confident with respect to the likelihood that their prediction is correct; in foresight therefore people overestimate the likelihood of success. Additionally, there is ample evidence to suggest that people often demonstrate what has become known as the hindsight bias (e.g. Fischhoff, 1975, Fischhoff and Beyth, 1975). The reasoning literature has observed that people are over confident in their ability to have predicted an event once the event has occurred. For example Gilovich (1983) showed that gamblers displayed hindsight bias with respect to the results of football matches. In hindsight people consistently exaggerate what could have been anticipated in foresight. People believe that others should have been able to anticipate events much better than was actually the case. They even tend to misremember their own predictions so as to exaggerate in hindsight what they knew in foresight, Fischhoff and Beyth (1975).

Hindsight bias has been identified in many areas. Of relevance is the common finding that even intense involvement with a particular topic can not reduce the extent of hindsight bias, (Fischhoff, 1975). For example, Detmer, Fryback and Gassner (1978) found hindsight bias in the judgements of surgeons appraising an episode involving a possible leaking abdominal aortic aneurism. Arkes Wortmann, Saville and Harkness (1981) demonstrated the bias with physicians, whilst Pennington et al (1980) observed it with pregnant women judging the results of personal pregnancy tests. The results of these studies suggest that neither educational achievement nor heavy experience with the topic reduce people's ability to be influenced by the hindsight bias.

It could be argued that high frequency gamblers are "educated" in their domain, in that they are especially aware of the procedures (betting choices available, rule of the activities etc) required for gambling in their chosen activities. This argument could be postulated to predict that high frequency gamblers would be less likely to affected by the hindsight bias than low frequency gamblers. However, in light of the above research, this argument is not sustainable. This is particularly the case when one considers the availability and ease at which hindsight could take effect, considering the potential vast number of predictions and outcomes due to the speed at which outcome information is made available in most gambling forms. The degree to which high and low frequency gamblers were affected by hindsight within a gambling specific and non-gambling specific context was investigated.

For the higher frequency gambling group of participants, recruitment took place within two off-course gambling establishments. Due to the fact that the participant sample was on location to gamble, and not to take part in research, it was envisaged that motivating people to take part would be difficult, particularly as only a very small financial incentive could be offered. To increase the chances of people willing to participate, the amount of time required to complete the current investigation had to be kept to a minimum (25-30 minutes). Hence although the measure of heuristics and biases involved in the current investigation is by no means exhaustive, the limits imposed by the nature of the recruitment process favoured the restriction to the above main items.

In summary then, in relation to the "weak cognitive hypothesis" this chapter examines whether there are any individual differences in the degree to which people make use of these heuristics when making decisions. Also in relation to this hypothesis this chapter addresses the potential role of general dissociation in explaining the dissociative state experienced whilst gambling and therefore contributing to continued play, whilst in the light of the integrative hypothesis, re-addresses the relationship between fallacious beliefs, gambling specific dissociation and their influence on the extent of the loss of control experienced.

5.2. Study 3

5.2.1. Method

Participants

Recruitment was attempted at Newton Abbott Race Course an hour and a half before the days races commenced. No one agreed to take part out of the 40 people approached. 38 Gamblers were recruited from within two Betting Offices, one run by Hoopers, the other the William Hill Group. This group made up the majority of the higher frequency gambling group. 92 participants were recruited from the University of Plymouth Undergraduate population. All participants were given a small financial incentive to fill in the questionnaire which took 25 minutes to complete.

Materials

A questionnaire was prepared. The latter part of the questionnaire constituted the same items as the questionnaire used in Experiment 5 with respect to frequency of gambling, choice of gambling forms participated in and loss of control. The fallacious beliefs section was developed further to include a wider range of items. The dissociation scale was also developed for gambling specific items. The items in this part of the questionnaire are presented in Table 5.1 below. The complete questionnaire is presented in Appendix 6a.

Table 5.1. Questionnaire Items for Loss of Control, Dissociation (Gambling) and Fallacious Beliefs

Loss of Control Items YES / NO

8. Do you see your gambling activities as ever having lead to a problem?
9. Have you sought or thought of seeking help for your gambling behaviour?
10. Was there any time when the amount you were gambling made you nervous?
11. After winning, do you feel you ought to gamble more to increase your winnings?
12. Do you gamble until all your spare cash has gone?
13. After losing, do you spend more money to try to make up for your losses?
14. Do you ever get into debt as a result of your gambling?
15. Have you borrowed money to gamble or pay gambling debts?
16. Do you find you gamble for longer than you intended?
17. Do you need to gamble with more and more money to achieve the desired excitement?
18. Do you ever have unsuccessful attempts to control, cut back, or stop gambling?
19. When you gamble, do you go back another day to win back the money you lost?
20. Do you ever gamble more money than you intended to?
21. Have you felt guilty about the way you gamble or about what happens when you gamble?
22. Have you hidden betting slips, lottery tickets, gambling money, or other signs of gambling form your spouse, children, or other important people in you life?

Dissociation Items (Gambling) Strongly Agree - Strongly Disagree

23. Gambling makes me feel really alive.
24. Sometimes I forget about the time when I am gambling.
25. I get a real buzz that lifts me when I gamble.
26. Whilst gambling I feel I'm free, able to do and choose what I like.
27. I feel less stressed when I gamble.
28. Whilst I'm in the gambling environment, I usually don't notice what other people are up to.
29. As soon as I start gambling I feel different to how I did before.
30. If I were feeling down, gambling would probably pick me up.
31. I like gambling because it helps me to forget my everyday problems.

Fallacious Beliefs Strongly Agree - Strongly Disagree

32. If I have not won any bets for a while, I am probably due for a big win.
33. I know when I'm on a streak.
34. It is important to feel confident when I'm gambling.
35. No matter what the game is, there are betting strategies that can help you to win.
36. I have carried a lucky charm when I gambled.
37. I must be familiar with a gambling game if I am going to win.
38. To be successful at gambling, I must be able to identify streaks.
39. I sometimes find myself saying or thinking "I feel that I'm going to win this time".
40. I sometimes find myself saying or thinking "I knew it was going to be that, I said so".
41. I sometimes find myself saying or thinking "How come I didn't win?"
42. I sometimes find myself saying or thinking "This time wasn't very good, I could have played better."

Although the Loss of Control items in Table 5.1 are drawn mainly from established checklists and the Fallacious Belief items are closely representative of long identified erroneous perceptions, the Dissociation items are a new attempt to measure dissociation specifically in gambling. Since several items (23, 25, 27, 39 and 30) could possibly be construed as having face validity for the measurement of mood management or even arousal, further work may need to be done in the validation of that sub-scale to ensure that it is measuring dissociation and not something else.

The general dissociation (non-gambling) items that were used in the current study were extracted from the DES (Bernstein and Putman, 1986) which assesses dissociation in everyday life, and are presented in Table 5.2 below.

<u>Table 5.2. General Dissociation Items extracted from the DES, Bernstein and Putman 1986</u>

<u>Dissociation (General)</u> Strongly Agree - Strongly Disagree

43. Some people have the experience of driving a car and suddenly realising that they don't remember what has happened during all or part of the trip.
44. Some people have the experience of finding themselves in a place and having no idea how they got there.
45. Some people have the experience of feeling as though they are standing next to themselves or watching themselves do something and they actually see themselves as if they were looking at another person.
46. Some people find that they have no memory for some important events in their lives.
47. Some people have the experience of not being sure whether things that they remember happening really did happen or whether they just dreamed them.
48. Some people have the experience of being in a familiar place but finding it strange and unfamiliar.
49. Some people find that when they are watching television or a movie they become so absorbed in the story that they are unaware of other events happening around them.
50. Some people sometimes find that they become so involved in a fantasy or daydream that it feels as though it were really happening to them.
51. Some people find that in one situation they may act so differently compared with another situation that they feel almost as if they were two different people.
52. Some people sometimes find that they hear voices that tell them to do things or comment on things that they are doing.

The first part of the questionnaire however was designed to assess the use of a range of heuristics and biases that have been suggested to play a role in decision making during gambling. Heuristics that were assessed in the questionnaire were those that are most relevant to the gambling situation; those discussed earlier in the Introduction to this chapter; Availability, Representativeness, Base Rate fallacy, Hindsight Bias, Illusion of

Control / Gamblers Fallacy, and a replication (but with shortened sequences and with the two types of content) of Wagenaar's perception of randomness items.

In addition to participants being required to select the outcome they thought most likely to occur (following the information provided), they were also asked to express how confident they were that they had chosen the "correct" response, on a 0-100 scale.

Where possible, for each type of question there were two versions of the question, one indicating a gambling situation and one out of the gambling context. The items in this part of the questionnaire are presented in Table 5.3 below.

Table 5.3. Items in the Heuristic and Bias section (Performance section)

Qu.	
	Baseline Confidence (no past information)
7a.	You turn up at a Casino to play Roulette. You arrive at the table and place a bet. What would you choose to go for first? Red or Black?
1a.	A friend takes a coin out of a pocket and is about to flip it into the air. Would you go for Heads or Tails?
	Availability and Representativeness – Gambling Specific
2.	You have been observing the outcomes at a Roulette table. The outcomes so far on the table you've been looking at have been: Black, Red, Black, Black, Black, Black, Black, Red,..... What do you think the next outcome will be? Please Circle: Red Black How confident would you be? Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)
	Other Previous Outcome Information Presented
23.	Red, Black, Black, Red, Black, Red, Red, Black....
28.	Red, Red, Black, Red, Red, Red, Black, Red, Black, Red, Red, Red, Red, Red, Red, Black.....
11.	Red, Red, Black, Red, Black, Black, Red, Red, Black, Red, Black, Black, Black, Red, Red, Black...
	Availability and Representativeness – Non-gambling
22.	Imagine everybody in every city in the world was photographed. From studying the photos, it appears that 50% of the photos show people with their heads facing to the left, whilst the other 50% of the people are looking to the right. You are presented with a series of these photos in which the direction of gaze, in the order that you receive them, is as follows: Right, Left, Right, Right, Right, Right, Right, Left, ... If presented with another photo, which direction do you think the person's head will be facing? Please Circle: Right Left
	Other Previous Outcome Information Presented
13.	Left, Right, Right, Left, Right, Left, Left, Right, ...
25.	Left, Left, Right, Left, Left, Left, Right, Left, Right, Left, Left, Left, Left, Left, Left, Right....
8.	Left, Left, Right, Left, Right, Right, Left, Left, Right, Left, Right, Right, Right, Left, Left, Right....

Table 5.3. (continued)

Other Availability Items

6a. In four pages of a novel (about 2000 words), how many words would you expect to find have the form _ _ _ _ i n g (seven letter words that end in "ing")?

14a. In four pages of a novel (about 2000 words), how many words would you expect to find have the form _ _ _ _ _ n _ (seven letter words with "n" as the sixth letter) ?

5a. Suppose you sample a word at random from an English text. Is it more likely that the word starts with the letter "k" or that "k" is its third letter?

Base Rate – Gambling Specific

26. Trainer A enters 15 horses and Trainer B enter 10 horses into the season's races. Before entering the paddock before a particular race, a punter points to a horse and reports that it comes from Trainer B. It is known that even from a distance, the punter can correctly report which Trainer the horse belongs to 80% of the time, and fails 20% of the time.

a. What is the likelihood that the horse that the punter points to, comes from Trainer B?

Please Indicate from 0 (Completely Unlikely) to 100 (Completely Likely)

Base Rate – Non-gambling

3. A taxi cab was involved in a hit and run accident at night. Two cab companies, the Green and the Blue, operate in the city. 150 of the cabs in the city are Green, 100 are Blue. A witness identified the cab as Blue. The Court tested the reliability of the witness under the same circumstances that existed on the night of the accident, and concluded that the witness correctly identified each one of the two colours 80% of the time, and failed 20% of the time.

a. What is the likelihood that the cab involved in the accident was Blue rather than Green?

Please Indicate from 0 (Completely Unlikely) to 100 (Completely Likely)

Table 5.3 (continued)

Perception of Randomness – Gambling Specific

4. A new Wheel of Fortune has 50 segments that you can bet on. Half of the numbers are even (E), half are odd (O), and they are distributed around the wheel equally.

How random do you think the sequence below is as arising from the spinning of the Wheel?

0.2 E E O E O E E O E O E O E O E E O E O E O O E E O E

Please Indicate from 0 (Not at all Random) to 100 (Completely Random)

Other Perceptions of Randomness – different probabilities of repetition

0.4 O O E O E E O E E E E E O O O E E O E O E O O E O E

0.6 O O E E E E E O E O O O E E E E O O E E E O O E O O

0.8 O O O O O O O O O E E O O O O O E E E E E E E E O E E

Perception of Randomness – Non-gambling

20. How likely do you think the sequence of outcomes below is to occur from flipping a coin:

0.2 ●○●○●○○●○●○●○●○○●○●○●○○●●○●○●○●●○●○○●●○○●○●○●○●○○○

Please Indicate from 0 (Completely Unlikely) to 100 (Completely Likely)

Other Perceptions of Randomness – different probabilities of repetition

0.4 ●○●○●●○●●●●●○○○●●○●○●○○●○●●○○○○●○●○○○●●●○○●○●○●○○●

0.6 ○○●●●●●○●○○○●●●●○○●●●○○●○○○○●○○●●●●●○○○○○○●●●○○●●●

0.8 ○●●●●●●●●○○●●●●●○○○○○●●●○○○●●●●●●●○○○○●○○○●●●●●●●●

Gamblers Fallacy

10. You decide to go to a Casino for the evening. You arrive and watch some of the players playing the various games, before making your way to one of the roulette tables. You decide to play yourself, and have won the last few trials. You decide to stick to betting on Red or Black for the time being.

a. How confident are you that you will win the next round?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

Table 5.3 (continued)

Hindsight Bias – Gambling Specific, Pre-outcome

12. The outcomes of the spin of the Roulette wheel are clearly displayed for you to look at. Out of the last 8 outcomes, there was a sequence of four red in a row, followed by four black numbers.

a. What do you think the following outcome was? Please Circle: Red Black

b. How confident are you that your choice is the correct one?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

Hindsight Bias – Gambling Specific, Post-outcome

27. The outcomes of the spin of the Roulette wheel are clearly displayed for you to look at. Out of the last 8 outcomes, there was a sequence of four red in a row, followed by four black numbers.

a. Given that the next outcome that you've just seen was in fact Red, how confident would you have been in predicting it?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

Hindsight Bias – Non-gambling, Pre-outcome

9. Two countries were at battle against each other. Country A had only 1000 soldiers to start with, but had a much stronger technological weapons backing, compared to the much stronger army of 2000 soldiers in Country B with a much weaker technological backing. Although the battle was fierce and a close-call for both countries, one country did finally win the battle.

a. Which one do you think it was?

b. How confident are you that your decision is the correct one?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

Hindsight Bias – Non-gambling, Post-outcome

24. Two countries were at battle against each other. Country A had only 1000 soldiers to start with, but had a much stronger technological weapons backing, compared to the much stronger army of 2000 soldiers in Country B with a much weaker technological backing. Although the battle was fierce and a close-call for both countries, Country A country did finally win the battle.

a. How confident would you have been in predicting this?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

The order of the 28 questions was randomised subject to a few conditions. For the assessment of the Hindsight bias, there were two pairs of questions; one for the gambling specific and one for the non-gambling content. For each pair, one question had to appear later in the questionnaire than the other for any chance of identification of the bias having effect. Certain other questions could not appear next to each other or on the same page. These included the availability items with the varying outcome ratios. The positions of these items were therefore re-randomised until they met the criteria.

Procedure

The student sample were recruited by placing adverts around the University Campus, advertising that a 30 minute experimental session would be taking place, for which they would receive the sum of £3. 92 students turned up to take part. They were seated in a lecture theatre and were given the questionnaires along with brief instructions. They were instructed to fill in the questionnaire on their own without consulting others, to answer all questions; that there were no right or wrong answers and that they should not spend too long on any one item. Before leaving the theatre participants were debriefed, handed back the questionnaires, and received their financial incentive.

The other participants were recruited from within a Plymouth branch of Hoopers Bookmakers, and within a London branch of William Hill bookmakers. Consent to ask patrons was obtained from the office managers before approaching prospective gamblers.

Participants here were approached individually and asked if they would be willing to help out with some research into decision making. They were informed of the small financial incentive for taking part, and of the confidentiality of their responses. Those who agreed to take part were then given the brief instructions and a copy of the questionnaire. Approximately a third of people approached agreed to take part. For some people, spending time taking part in research was simply out of the question, for others the financial incentive of £3 was not enough.

Once those who agreed had completed the questionnaire, they were given the £3 and were debriefed.

5.2. Results and Discussion for Study 3

Firstly some descriptive statistics on the frequency data relating to the current sample is presented. The analysis on the data was separated into three sections. In the first instance an analysis was conducted on the constructs involved that were identical to those involved in Chapter 4, namely the relationship between Fallacious Beliefs, Dissociation and Loss of Control. Using a confirmatory factor analysis on the data, the models discussed in the previous chapter were reassessed with the current data set, which involved higher frequency gamblers.

The second part of the analysis was carried out to investigate, using exploratory Factor Analysis, the relationship between the performance measures on the heuristic and bias items in the questionnaire, to see if any number of factors underlying the responses to these items could be identified and interpreted. Before this procedure could occur, measures of bias had to be calculated. Further details of this procedure will follow.

Following this, the third and final stage of this analysis was to run a confirmatory factor analysis to investigate the existence of a relationship between the Fallacious Beliefs, Dissociation, and Loss of Control constructs and the factors coming out of the performance factor analysis. This would enable some discussion to take place with respect to how these constructs may interact with or influence the extent to which an individual is biased.

5.2.1. Breakdown of Frequency and Forms Participated In

Table 5.4 shows the frequency of gambling forms taken part in by the sample. Almost 80% of this sample played the National Lottery, whilst 40% bought scratch cards. As can be seen from this table, the numbers of people taking part in the various forms is more evenly spread than the previous sample.

Table 5.4. Number and Percentage of Participants reporting playing on the various forms. N=120.

Form	Number	Percentage
Horse Racing (Off Course)	46	38.3
National Lottery	95	79.2
Bingo	18	15.0
Horse/Dog Racing (On Course)	36	30.0
Scratch Cards	46	38.3
Pools	12	10.0
Gaming Machines	54	45.0
Casinos	18	15.0
Sports Betting	33	27.5
Other	12	10.0

Table 5.5 below shows the numbers of people who partake in a varying number of forms. Again, the majority of people played up to and including three forms, although there were a number of people playing five to eight forms of gambling.

Table 5.5. Study 3. Frequency of Number of Forms taken part in, and the degree of National Lottery and Scratch Card players

Number of Forms	Frequency	No. of People Playing National Lottery and Scratch Cards
1	27(22.5%)	15(55.6%)
2	27(22.5%)	21(77.8%)
3	28(23.3%)	25(89.3%)
4	12(10.0%)	11(91.7%)
5	15(12.5%)	14(93.3%)
6	5(4.2%)	5(100%)
7	3(0.03%)	3(100%)
8	3(0.03%)	3(100%)
Missing	14	-

Table 5.6 provides information as to the frequency of the participants' gambling behaviour, their typical length of gambling episode, and their typical expenditure at a session.

Table 5.6. Frequency Statistics for Frequency, Length and Expenditure

	Frequency
Frequency of Gambling Episodes	
Less often than once every six months	12
Less than once a month, but more than once every six months	23
Less than once a week, but more than once a month	25
Less than every day, but more than once a week	33
Every day	18
Length of Gambling Episode	
No Response	5
0-10 mins	62
11-30 mins	11
30-60 mins	6
1-2 hours	19
more than 2 hours	17
Expenditure per Session	
No Response	22
£1-£5	68
£6-£10	11
£11-£25	7
£26-£50	7
£51-£100	3
over £100	2

5.2.2. Confirmatory Factor Analysis on the Relationship Between Fallacies, Dissociation and Loss of Control

This study included the same measures as the study in Chapter 4. However there were four additional Fallacy items, and five additional gambling related dissociation items. All these items are presented in Table 5.1 above. In addition, although not initially inserted into the current factor analysis, there were 10 general dissociation items, relating to how dissociated people get in every day life. A presentation and discussion of these additional general dissociation items will follow. As a multivariate normal distribution of responses to the measured variables is assumed when conducting a maximum likelihood factor analysis, some descriptive statistics were calculated. Table 5.7 below provides statistics for all the items under investigation.

Table 5.7. Descriptive Statistics for Items in Factor Analysis. N=120

		Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Loss of	LoC 1	.00	5.00	.4333	.9503	2.734	8.462
Control	LoC 2	.00	4.00	.6333	1.0202	1.514	1.343
	LoC 3	.00	6.00	1.1250	1.5695	1.487	1.507
Fallacious	F32	1.00	4.00	1.9417	.8431	.539	-.417
Beliefs	F33	1.00	4.00	2.1167	.8218	.149	-.773
	F34	1.00	4.00	2.4167	.7841	-.463	-.605
	F35	1.00	4.00	2.2833	.8320	-.130	-.836
	F36	1.00	4.00	1.7083	.6908	.925	1.376
	F37	1.00	4.00	2.5333	.8881	-.395	-.645
	F38	1.00	4.00	2.1417	.7917	.051	-.776
	F39	1.00	4.00	2.5167	.7777	-.656	-.303
	F40	1.00	4.00	2.5667	.7964	-.578	-.229
	F41	1.00	4.00	2.3333	.7485	-.267	-.612
	F42	1.00	4.00	2.2833	.7580	-.174	-.659
Dissociation	D23	1.00	4.00	2.0667	.8475	.125	-1.066
	D24	1.00	4.00	2.0333	.8593	.340	-.742
	D25	1.00	4.00	2.2000	.8461	.027	-.873
	D26	1.00	4.00	2.0667	.8475	.377	-.532
	D27	1.00	4.00	1.8000	.7053	.450	-.349
	D28	1.00	4.00	2.0750	.8009	.262	-.549
	D29	1.00	4.00	2.0250	.8040	.152	-.967
	D30	1.00	4.00	2.0667	.9591	.679	-.399
	D31	1.00	4.00	1.7750	.7272	.641	.069
General	DG43	1.00	4.00	2.7917	.7548	-.587	.368
Dissociation	DG44	1.00	4.00	2.5083	.7559	-.088	-.299
	DG45	1.00	4.00	2.2500	.7247	.118	-.231
	DG46	1.00	4.00	2.6083	.7367	-.511	.021
	DG47	1.00	4.00	2.8167	.6215	-.711	1.303
	DG48	1.00	4.00	2.7083	.5855	-.610	.578
	DG49	1.00	4.00	3.0167	.5648	-.849	3.446
	DG50	1.00	4.00	2.6667	.6395	-.748	.598
	DG51	1.00	4.00	2.5583	.6835	-.294	-.083
	DG52	1.00	4.00	2.2667	.8475	.131	-.628

The Loss of Control items were grouped into three parcels in an identical fashion to previously. The story in relation to the non-normality of the distribution in relation to the Loss of Control measures was improved with the current data set, (see Table 5.7 above for the Skewness and Kurtosis measures of normality). However, as the Loss of Control 1 measure (related to the problems associated with the individuals' gambling activities) was not especially normally distributed, the Robust technique (as developed by Satorra and Bentler 1988) was again used. This method takes some account of the fact that some measures are not normally distributed. Confirmatory Factor analysis was run on the data to see if a similar model would account for this data, as it did for the data for the study in Chapter 4.

The measurement model, run to check that the measures were measuring the factors that they were supposed to be measuring, was identical to that run with the previous data set (as depicted in Figure 4.1, Chapter 4), using a Maximum Likelihood criterion. This resulted in a robust comparative fit index (CFI) of 0.929, suggesting that the model fit was adequate, with all the items loading significantly on the factors which they were supposed to load on. The resulting Satorra-Bentler scaled χ^2 was 285.37, with 227 degrees of freedom and a probability value of 0.0052.

The Lagrange Multiplier Test (for adding parameters) again suggested that the model would account for the data significantly better if the Question 24 (the same dissociation item as before) was allowed to load on the Loss of Control Factor. As this was a replication of the previous analysis, and made theoretical sense, the measurement model was re-run with this loading. The resulting Robust Comparative Fit index increased to 0.938, whilst the Satorra-Bentler scaled χ^2 fell to 276.37 with 226 degrees of freedom. This loading was therefore followed through into all the subsequent analysis.

One interesting and important point to note was that with the previous measurement models, the Lagrange Multiplier Test had suggested that the model would benefit significantly with the additional loading of the first fallacy item on the Dissociation factor. This additional loading, as mentioned, did not make theoretical sense. With the increased number of items within the fallacies and dissociation constructs and with this population, this suggested improvement was not significant. This indicated that the improvement suggestion may have been spurious, and confirmed the decision not to allow this particular loading.

The correlations between the Factors are displayed in Table 5.8 below. The strongest correlation was between the Fallacy and Dissociation factors, replicating the findings from the analysis on the previous chapter's data set. Additionally, all three factors were very strongly correlated. In this measurement model however, the Dissociation factor was more strongly correlated with the Loss of Control Factor, than the Fallacy factor was. This would favour the non-recursive model in which Fallacies lead to Dissociation that lead to Loss of Control, (F-D-LoC). However, the models that were raised in the previous chapter to offer accounts of the relationship between these constructs were assessed with the current data set.

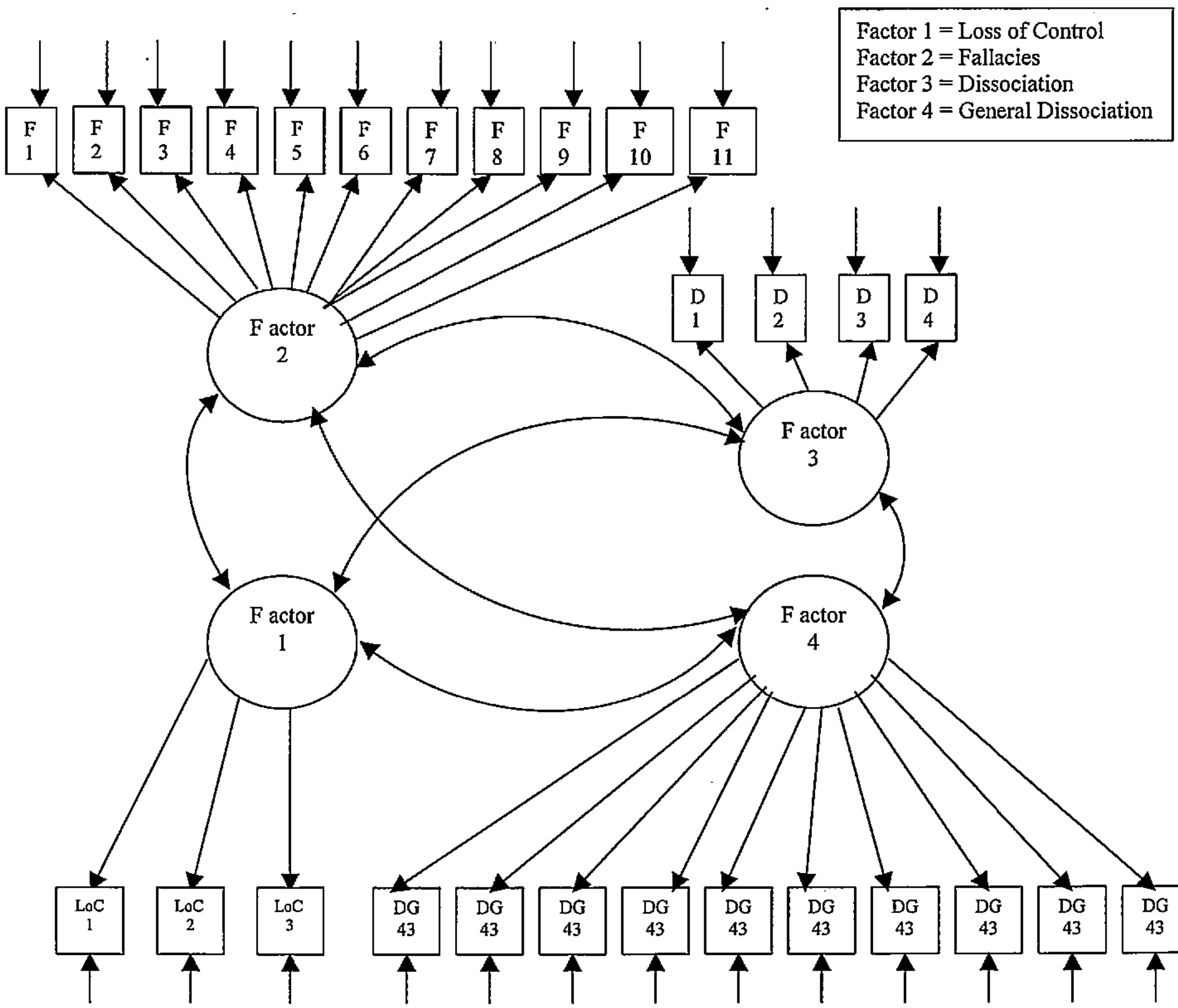
Table 5.8. Correlation Matrix for Factors

Factor	Loss of Control	Fallacies	Dissociation
Loss of Control	1.00	0.560	0.657
Fallacies		1.00	0.787
Dissociation			1.00

Before these models were investigated using EQS, the fourth factor of possible interest was that of the general dissociation factor, measured by the items extracted from the DEI (Bernstein and Putman 1986).

The measurement model was run with this additional factor to investigate the possible relationships between this general dissociation factor and the other constructs in the analysis, and also to check that the 10 General Dissociation items had in fact been measuring a General Dissociation factor. The model assessed is presented in Figure 5.1, with these additional items loading on this additional factor (Factor 4). These four Factors, Loss of Control, Fallacies, Dissociation (gambling) and General Dissociation were allowed to covary within the model.

Figure 5.1. The Path Diagram for the Measurement Model Which Was Investigated



The output from this analysis suggested that there were some problems with respect to the fourth factor, that of General Dissociation. The model fit was not especially strong, with a Robust Comparative Fit Index of 0.887. The largest standardised residuals all appeared to be in relation to items within this measure. In addition, the Lagrange Multiplier test (for adding parameters) suggested that the model would be significantly better at accounting for the data if extensive adjustments were made. The majority of these adjustments were in relation to some of these general dissociation items being allowed to load on Factor 1 (Loss of Control factor), some on Factor 2 (Erroneous Perceptions) and some on Factor 3 (Dissociation - gambling specific). This suggested that some of the items within those extracted from the DEI were measuring different things.

The final point regarding the concern over this general dissociation measure, is that in the measurement model, it failed to correlate in any way with the other constructs (see Table 5.9 for the correlation matrix), whereas the inter-correlations between the other constructs were strong.

Table 5.9. Correlation Matrix for Factors with General Dissociation

Factor	Loss of Control	Fallacies	Dissociation	General Dissociation
Loss of Control	1.00	0.561	0.657	0.109
Fallacies		1.00	0.787	0.026
Dissociation			1.00	0.053
General Dissociation				1.00

Although a complete investigation of the General Dissociation factor is beyond the scope of the current work, a preliminary investigation into a single (and then two) factor solution was conducted, to see if the general dissociation measures were measuring a unitary factor.

A single factor Factor Analysis was run on the General Dissociation measures on their own. The resultant fit was particularly poor; with a Comparative Fit Index of 0.772. This suggested that there may in fact be two or more sub-factors within the construct of General Dissociation as measured with the 10 items used in the current study. A two factor exploratory factor analysis was therefore conducted to see whether the items used appeared to load on two different factors. The results provided evidence to suggest that there were some items loading on the two factors separately. Factor 1 was loaded on by 6 items (DG - 43, 44, 46, 47, 48, 50, See Table 5.2 above). These items appeared to be generalised dissociation, whereas the items that loaded on Factor 2 (items DG- 45, 51, and 52) appeared to be to do with a method of relinquishing responsibility, potentially blaming another person for their actions by either implying that they often feel that they are watching themselves (from an external perspective) doing the task - and that that is their role in the activity; or that they hear someone telling them what to do.

However, these are somewhat arbitrary conceptualisations of these two factors and are rather ad-hoc. In addition to this, further concern relates to the fact that the measures used for the dissociation scale, although extracted from a validated general dissociation scale (Bernstein and Putman 1986), were still only a subset of the original questionnaire. Further research involving all 40 items in the original scale would be necessary to evaluate whether or not this General Dissociation scale could involve more than one factor. These sub-factors could then be re-investigated as to their relationship with the other constructs, to see whether or not this Factor 2 both exists and is of relevance. It would be unlikely that the General Dissociation factor (Factor 1) would have much to offer the model fitting, because as a single factor concept it did not. However this would also need to be investigated further.

The fact that the General Dissociation factor did not relate to any of the other variables under investigation, and that the items appeared to be measuring more than one construct, lead to the conclusion that as a unitary construct it did not offer any useful information in the present context and was therefore dropped from the model and subsequent analysis.

In summary therefore, the three factor measurement model outlined above was the most suitable model to work with, having a good Robust Comparative Fit Index (0.938), with the items loading on the constructs that they were supposed to load on.

The models that were raised and discussed in the previous Chapter, were then re-assessed with the new data set. Table 5.10 presents these models again whilst Table 5.11 below provides the statistics resulting from the model fitting which can be used to assess the relative merits of the models.

Table 5.10. Possible models with theoretical relevance

Model	Factors				
F-D-LoC	Fallacies	→	Dissociation	→	Loss of Control
D-F-LoC	Dissociation	→	Fallacies	→	Loss of Control
F-LoC-D	Fallacies	→	Loss of Control	→	Dissociation
D-LoC-F	Dissociation	→	Loss of Control	→	Fallacies

Table 5.11. Measures of fit for a number of variants of the model depicted in Figure 4.1.

Model	F-D-LoC	D-F-LoC	F-LoC-D	D-LoC-F
	Non-recursive	Non-recursive	Non-recursive	Non-recursive
Robust Comparative Fit Index	0.939	0.929	0.900	0.900
χ^2	328.9	340.0	367.2	367.2
Satorra-Bentler Scaled χ^2	277.1	284.9	308.7	308.6
Degrees of Freedom	227	227	227	227

Note: See Table 5.10 for a description of the models.

The important objective was to evaluate which of these models best fits the data collected in the current study, and whether the conclusions reached in the previous Chapter were replicated with this new sample with the extended items.

What is a meaningful difference for one model to be significantly better than another? There are several criteria one can use. Firstly, one can observe the goodness of fit indices, (i.e. the Robust Comparative Fit Index (Robust CFI) of each model). A good, albeit a somewhat arbitrary, cut off point for a good model to data fit, would be in the absolute value for the Robust CFI to be above 0.9. The second method is observing the size of the χ^2 for the model; the smaller the value the better the fit of the model (with respective degrees of freedom).

First of all it appeared that all four models had an adequate fit, represented by their strong Robust Comparative Fit Indices. As the Robust CFI is a measure of fit, the higher the index, the better the fit of the model to the data. Hence on initial comparison the F-D-L model appears to fit the best.

In Chapter 4 the results indicated that it was hard to determine between the D-F-LoC and the F-D-LoC models as the difference between them was minimal. Although the χ^2 for the D-F-LoC model was smaller than the χ^2 for the F-D-LoC model (a difference of 4.3), and the correlation between Fallacies and Loss of Control was stronger (0.549) than the correlation between Dissociation and Loss of Control (0.459), the Robust Comparative Fit Indices differed only marginally by 0.04 (Robust CFI's of 0.916 for the F-D-LoC model, and 0.920 for the D-F-LoC model). Thus with that data set it was hard to evaluate which of these two models best fit the data.

The differences between the χ^2 values for the four non-recursive models under investigation from the current population are presented in the matrix Table 5.12 below.

Table 5.12. Differences in χ^2 for the Non-recursive Models Under Investigation.

	F-D-LoC	D-F-LoC	F-LoC-D	D-LoC-F
F-D-LoC	-	7.8	31.6	31.5
D-F-LoC		-	23.8	23.7
F-LoC-D			-	0.1
D-LoC-F				-

One point to note is that the χ^2 difference between the F-D-LoC and the D-F-LoC models is less than the difference between either of these two models and any model in which LoC is in the middle (i.e. F-LoC-D or D-LoC-F). This again replicates the results from the Chapter 4 study and supports the notion that the models that involve LoC at the end (as a consequence of the relationship between Fallacies and Dissociation) fit the data the best.

What was therefore clear was that these two (F-D-LoC and D-F-LoC) models were substantially better fits of the data than either of the models in which LoC was not a direct consequence of the relationship between Fallacies and Dissociation.

Furthermore, with the current data sample and with the additional Fallacy and Dissociation items, it became easier to distinguish between these two models. The fit indices for the F-D-LoC model was 0.939 which was higher, representing a better fit, than the D-F-LoC model, which had a fit index of 0.929. Additionally, the F-D-LoC had a smaller χ^2 of 277.1, with 227 degrees of freedom, as compared to 284.9 for the D-F-LoC model.

The correlation between Fallacies and Dissociation was stronger than the correlation between Fallacies and Loss of Control. Likewise, the correlation between Dissociation and Loss of Control was stronger than the relationship between Fallacies and Loss of Control. Both of these correlations along with the differences in χ^2 between the models, and the respective Robust CFI's, suggest that the F-D-LoC model fitted the data most appropriately.

5.2.3. Factor Analysis for the Heuristics and Biases - "Performance" Analysis

This study sought to investigate the relationship between the variables of Fallacies, Dissociation and Loss of Control and people's performance on the tasks. What is meant by performance is the extent to which the individual is biased or applies the certain heuristics when making a decision about the outcome of a future uncertain event. The extent to which the participants' responses differed from the objective expected (normative) rate was calculated and taken as this measure of "bias".

For each item therefore, the objective normative response or the appropriate confidence level was subtracted from the participants' response, such that a signed difference resulted. For example, on the first question which asked how confident of their prediction the participants would be if they were to predict the outcome of a flip of a coin (a baseline confidence measure), if the individual's response was above 50 they would end up with a positive integer, representing the fact that they were over confident. Likewise for the Base Rate item (Kahneman and Tversky 1973), which the posterior probability of the cab being blue was 0.41, the participant's response was converted into a deviance from this normative probability. If the response was higher than this then this represented the fact that they had ignored the base rate information about the actual percentage of cabs in the city.

An exploratory factor analysis was run to extract four factors [2]. All four resulting factors had clear item loadings. Table 5.13 below shows the Factor Loadings on each of the items within the analysis, whilst Table 5.14 presents the correlation matrix for these factors. See Appendix 6b for the complete output of this factor analysis.

[2] A three and a five factor solution were also investigated. The results however suggested that clear identification of the resulting factors within each solution did not occur. Furthermore, the resulting factors were not particularly interpretable, hence the analysis rested on the reported four factor solution.

Table 5.13. Pattern Matrix Showing Item-Factor Loadings. for the Four Factor Solution

	Factor 1	Factor 2	Factor 3	Factor 4
baseline gambling (g)	.293	.280	-.071	-.290
baseline non-gambling (ng)	.188	-.135	.000	.005
sequences,g,short info,25/75	**.442**	-0.029	-.072	.031
sequences,g,long info,25/75	**.795**	-.110	.013	.093
sequences,g,short info,50/50	**.805**	.028	-.086	.001
sequences,g,long info,50/50	**.599**	-.064	.106	-.083
sequences,ng,short info,25/75	**.757**	-.002	.031	.001
sequences,ng,long info,25/75	**.802**	-.079	.073	.024
sequences,ng,short info,50/50	**.606**	.066	-.058	-.099
sequences,ng,long info,50/50	**.537**	-.011	.151	-.021
availability - word estimate ing-n	-.036	.015	.114	-.067
Avail. but confidence in k - word estimate	-.055	-.037	-.009	.017
avail. confidence in k word (m)	.335	-.102	-.062	.165
base rate gambling	.010	-.189	-.085	.394
base rate non-gambling	.000	-.051	-.130	.377
percept of randomness,g,0.2	-.078	**.473**	.099	.156
percept of randomness,g,0.4	.053	**.621**	-.188	.286
percept of randomness,g,0.6	-.064	**.759**	-.242	.230
percept of randomness,g,0.8	-.094	**.812**	.075	-.173
confidence in g,p.r. 0.2	.053	.072	.040	**.761**
confidence in g,p.r. 0.4	.049	.106	.007	**.845**
confidence in g,p.r. 0.6	-.053	.104	.084	**.738**
confidence in g,p.r. 0.8	.056	.175	.116	**.586**
percept of randomness,ng,0.2	-.109	**.460**	.286	-.037
percept of randomness,ng,0.4	-.070	**.281**	.146	.024
percept of randomness,ng,0.6	.125	**.823**	-.025	-.179
percept of randomness,ng,0.8	-.034	**.799**	.141	-.285
confidence in ng,p.r. 0.2	.026	.001	**.890**	.035
confidence in ng,p.r. 0.4	.079	.132	**.787**	.017
confidence in ng,p.r. 0.6	.076	.115	**.829**	-.035
confidence in ng,p.r. 0.6	.076	.115	**.829**	-.035
confidence in ng,p.r. 0.8	-.052	-.097	**.932**	-.044
confidence in ng,p.r. 0.8	-.052	-.097	**.932**	-.044
hindsight, gambling	-.113	-.128	.012	.316
hindsight, gambling	-.113	-.128	.012	.316
hindsight, non-gambling	.144	.303	-.249	-.140
hindsight, non-gambling	.144	.303	-.249	-.140
gamblers fallacy	.360	.213	-.130	-.087
gamblers fallacy	.360	.213	-.130	-.087

Extraction Method: Maximum Likelihood. Rotation Method: Promax with Kaiser Normalization. Rotation converged in 7 iterations.

Table 5.14. Correlation matrix for the four factors extracted

Factor	1	2	3	4
1	1.00	0.104	0.417	0.371
2		1.00	0.381	0.479
3			1.00	0.549
4				1.00

Table 5.13 presents the Pattern Matrix for the loadings that each of the items had on each of the factors. As can be seen, the Sequences items loaded heavily on Factor 1. These items related to the individual's use of past information in making both their decision about the next outcome and their confidence in their judgement. One explanation of why people would be confident following the presentation of the information is that they would have actually used it to make a decision. If they had not utilised the information, as would be appropriate as past information has no bearing on future outcomes on these chance determined events, then individuals would be expected to be no more confident than objective probability would warrant. The scale offered was from zero to 100, with the implied midway of 50 as uncertain, i.e. neither confident nor unconfident.

No other items loaded heavily on this Factor, and these items did not load heavily on any other Factor. Interpreting Factor 1 therefore, it appeared that it had to do with the inappropriate use of past information when making a decision about a future event. This factor explained 21.90% of the variance. The gamblers fallacy item also loaded to some extent on this factor. This item asked how confident the respondent would be on the next trial, given that they had just won the recent trials. Again then, this is a past information item, and those who were more confident having just won the recent trials, tended also to be those who made use of past information. What was interesting about the items that loaded on this factor, is that it was not type specific. In other words, it was not only the gambling sequence item responses that loaded on this factor, but also the non-gambling sequence items. This suggests that the factor relates to a general tendency to use past information when making a decision, and also suggests that those people who make use of past information in the gambling context also appear to make use of past information in non-gambling situations as well.

This factor would therefore be expected to be correlated with Fallacies, Loss of Control, Dissociation, Frequency, Amount spent and typical Length of an episode. The investigation of this will follow the discussion of the other factors.

From viewing Table 5.13 in relation to the second factor extracted, there was a different cluster of items that loaded on it. These were the perception of randomness items, again both in a gambling and non-gambling context. As there were no other items that loaded heavily on this factor, and as these items did not load heavily on any other factor, this factor can be interpreted as an understanding of the principle of randomness. This factor explained 10.77% of the variance (see Table 5.15) and was loaded on by both the gambling and non-gambling specific perception of randomness items which suggested that it was a general understanding of randomness factor. People who understand the principle of randomness and the independence of events do so in any context. This would be expected as it would be strange if the principle was understood and applied in one, but not another, context. However, although people may have a clear understanding of the principle of randomness they may not actually use it.

Table 5.15. Percentage of Variance Explained by Each Factor

Factor	% of Variance	Cumulative %
1	21.90	21.90
2	10.77	32.67
3	5.05	37.72
4	4.82	42.55

The third and fourth factors extracted were loaded on by the items relating to people's confidence in their judgements of the apparent randomness of the sequences which they were presented with. The third factor was loaded on by the non-gambling confidence items whereas the fourth was loaded on by the gambling confidence items. These factors therefore appeared to have less to do with bias, but rather to do with the observation that some people have inflated confidence with respect to gambling items (Factor 4) whereas others have inflated confidence with respect to non-gambling randomness judgements (Factor 3). Additionally, these factors only accounted for a very small percentage of the variance.

Stanovich's individual difference approach has received some support in that these factors do seem to offer some account for the differences in performance across the tasks. The extent to which the two main factors interpreted here as the inappropriate Use of Past information and the Understanding of the Principle of Randomness, are related to the intelligence and the thinking disposition factors that Stanovich proposes would need some exploration in a future study.

One way to assess whether the interpretation of these factors not only makes theoretical sense but also that the interpretation is valid, is to calculate factor scores for each participant and correlate them with the other variables measured. At the same time this procedure allows for the investigation of the relationship between these other variables (Frequency items, Loss of Control, and Dissociation) with these four factors. If there were significant relationships observed, this would provide information as to whether or not higher frequency gamblers were more or less affected by the heuristics and biases, and whether or not the context (gambling or non-gambling) in which the item was presented made a difference in this respect.

As mentioned above, Factor 1 interpreted as having to do with the use of past information when making a decision about a future uncertain event, would be expected to correlate positively with Fallacies, Dissociation, and potentially therefore Loss of Control, in addition to the frequency type items.

If people do not make use of past information, as they are aware that its use will not objectively increase the chance of success on any particular trial, in other words they maintain the understanding of the randomness principle (Factor 2), then they would be expected to not partake in gambling activities to the same degree, and to hold less fallacious beliefs about the tasks. This Factor should therefore correlate negatively with these other variables. Table 5.16 below presents these correlations.

Table 5.16. Correlations for Factor Scores with other variables

	No of forms	Frequency	Amount spent over 12 months	Length	Total LoC	Total F	Total D	Total DG	Total conf	Amount spent	Factor 1	Factor 2	Factor 3	Factor 4
No of forms	1.000	.536*	.376*	.437*	.488*	.446*	.449*	.017	.130	.162	.131	-.035	.177	.033
Frequency	.536*	1.000	.238*	.439*	.419*	.430*	.415*	-.122	.034	.193	.143	-.127	.035	-.076
Amount 12 months	.376*	.238*	1.000	.162	.311*	.242*	.293*	.050	.102	.462*	.095	.077	.187	-.090
Length	.437*	.439*	.162	1.000	.424*	.510*	.523*	-.048	-.048	.239*	.020	-.179	.048	-.028
Total LoC	.488*	.419*	.311*	.424*	1.000	.455*	.570*	.052	.145	.186	.080	-.126	.175	.062
Total F	.446*	.430*	.242*	.510*	.455*	1.000	.656*	.006	-.013	.145	.055	-.154	.064	-.010
Total D	.449*	.415*	.293*	.523*	.570*	.656*	1.000	.049	.189	.223*	.193*	-.016	.256*	.145
Total DG	.017	-.122	.050	-.048	.052	.006	.049	1.000	.068	-.148	-.008	.096	.142	.016
Total confidence	.130	.034	.102	-.048	.145	-.013	.189	.068	1.000	-.030	.802*	.402*	.798*	.672*
Amount spent	.162	.193	.462*	.239*	.186*	.145	.223*	-.148	-.030	1.000	-.030	-.054	-.014	-.010
Factor 1	.131	.143	.095	.020	.080	.055	.193*	-.008	.802*	-.030	1.000	.079	.443*	.379*
Factor 2	-.035	-.127	.077	-.179	-.126	-.154	-.016	.096	.402*	-.054	.079	1.000	.406*	.510*
Factor 3	.177	.035	.187	.048	.175	.064	.256*	.142	.798*	-.014	.443*	.406*	1.000	.580*
Factor 4	.033	-.076	-.090	-.028	.062	-.010	.145	.016	.672*	-.010	.379*	.510*	.580*	1.000

(Significant correlations are suffixed with a *, $p<0.05$)

Generally where the correlations failed to reach significance, they were still in the predicted direction. The correlation between Factor 1 (Use of Past Information) and Dissociation (gambling) was significant at the 5% level. This suggested that the people who used past information tended also to be the people who experienced the greatest level of gambling specific dissociation. This factor also correlated positively, although weakly and not significantly, with Loss of Control, Fallacies, Number of Forms and the Frequency of gambling behaviour. So although this relationship was not significant, the direction of the relationship suggested that those people who gamble more frequently were also the ones who tended to be the people who made use of past information more readily.

Factor 2 (Understanding of Randomness principle) did not correlate significantly with these other variables. Again however, the relationship was in the predicted direction. The more someone understood the independence of events principle, the individual took part in less gambling Forms, less Frequently, spent less money in a typical gambling episode, became less Dissociated and held fewer Fallacious beliefs about the activities. One correlation which was significant was between this factor and the total confidence measure. This positive correlation suggested that the more the individual understood the principle of randomness, the more confident they would be. Although this may appear an obscure result, it is possible that this correlation arose due to it being a total confidence score. This measure therefore includes, for example, the confidence in the participants judgements of randomness perception. It is likely that these people who believed that the outcome sequences presented were equally random (and very random) were also very confident in their judgements.

The main interesting correlation with respect to Factor 3 (Confidence in non-gambling items) was the significant positive relationship it had with gambling Dissociation. Factor 4 (Confidence in gambling items) would have been expected to be more strongly correlated with this variable. However, both correlations were positive, suggesting that those people who were confident in gambling and non-gambling items tended to be those who became dissociated during gambling. This is backed up by the positive (although not significant) correlation between Total Confidence and Dissociation. Both of these factors correlated positively and significantly with the Total Confidence measure. The four factors extracted and their interpretation appear therefore to have validity. However, the interpretation of Factors 3 and 4 must be treated with some caution as these Factors are particularly weak, explaining only a very small percentage of the variance, (5.05% and 4.82% respectively).

The next stage of the process was to investigate the nature of the relationship between these four factors and the factors identified in the previous analysis, namely the Fallacies, Dissociation and Loss of Control constructs.

5.2.4. Analysis Combining 7 Factors

People who understand the principle of randomness (Factor 2 in the "performance" analysis) would be less likely to develop erroneous perceptions about the task. If they have grasped the concept that each outcome is independent of those that have occurred before, they would be fully aware that the use of past information would be futile, in terms of objectively increasing the likelihood of success on any given future trial. These people would therefore be less likely to become dissociated on the task, as they would not be expected to be focusing on the past information. They would also therefore be less likely to lose control over their gambling behaviour and perhaps also less likely to gamble in the first place.

In the same vain, Dissociation would also be expected to be related to the "Use of past information" factor, (Factor 1 in the "performance" analysis). People who believe that past information can and should be used, will need to focus consciously on the previous outcome information so that they can subjectively increase their chance of success on a subsequent trial. In doing so, the dissociative experience, as characterised by a narrowing of attention on the task at hand, would be more likely to result.

Another expected relationship to appear would be between Fallacies and the factor relating to confidence in choice on gambling outcomes, (Factor 4 in the "performance" analysis). The people who hold many fallacious beliefs about the tasks are likely to be those that are more confident in their choice of gamble than those that hold very few fallacious beliefs. If they haven't grasped the notion of independence of events, then they are likely to believe that after a long series of Red's on the roulette wheel, a Black outcome is increasingly more likely; and would therefore be more confident in betting on a Black outcome.

However, before any of these could be investigated, a measurement model was run within EQS to ensure that there were no extensive cross loadings of items on other factors; i.e. the measures within each hypothesised factor were loading on that factor alone, and not on any others.

The model emerging from the above "performance" factor analysis was incorporated into a confirmatory factor analysis in order to find out about the correlation between the constructs emerging from the exploratory factor analysis and those previously considered, namely Fallacies, Dissociation and Loss of Control.

Only the items that loaded heavily on each of the four factors were carried through into the following procedure.

Within the resulting measurement model each of the four "performance" factors were allowed to covary with each of the factors already considered. When conducting a confirmatory factor analysis with factors that have been derived by extraction from an exploratory factor analysis, caution needs to be exercised in relation to the fit of the exploratory derived portion of the combined model or any fit statistics which incorporate this. This is because this part of the model is bound to fit the data because of the way it has been derived.

The measurement model that resulted did not fit the data particularly well. The Robust CFI was 0.827. The Lagrange Multiplier Test (for adding parameters) did not suggest any significant improvements to the model which would have made theoretical sense.

Before rejecting the model fit however, the correlations between the seven factors are presented in Table 5.17.

Table 5.17. Correlations Among Independent Variables

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Loss of Control 1	1.00	0.555*	0.653*	0.025	-0.160	0.060	0.073
Fallacies 2		1.00	0.781*	-0.100	-0.336*	-0.126	-0.175
Dissociation 3			1.00	0.032	-0.232*	-0.058	-0.169
Use of Information 4				1.00	0.011	0.463*	0.366*
Understanding of Randomness 5					1.00	0.399*	0.565*
Confidence in non-gambling items 6						1.00	0.622*
Confidence in gambling items 7							1.00

Significant correlations are marked with an *; $p<0.05$.

What is apparent is that none of the factors extracted from the exploratory ("performance") factor analysis correlated significantly with the Loss of Control factor. This might be due to the possibility that Loss of Control is far removed from these other factors; in other words, that there may be another intervening variable (or other variables) that play their part before the Loss of Control state is reached.

It is also worth noting that it appears that those people who do understand the principle of randomness are those that do not develop many fallacious beliefs about the task, experience less dissociation and do not suffer from a loss of control. Noteworthy correlations therefore include the significant correlation between the "Understanding Randomness" factor and Fallacies, -0.336. This was as predicted, and is consistent with the notion that the more a person understands the principle of randomness, the less fallacious beliefs that person will develop and maintain about the gambling activity.

This Understanding of Randomness factor also correlated negatively (-0.126), although not significantly, with Loss of Control, such that the more an individual believed in the independence of events, the lower the loss of control they experienced.

The correlation between Dissociation and Understanding of Randomness was also significant, with a correlation coefficient of -0.232. The negative correlation represents the finding that the less a person understands the basic principle of randomness, the greater the dissociative experience.

The expectation that the relationship between Dissociation and the "Use of Past Information" factor would be strong and positive did not result, with a very weak but positive correlation of 0.03. The correlation between Fallacies and Confidence in Gambling items, was not significant either, nor was it in the predicted direction, with a correlation coefficient of -0.175.

However, as this measurement model did not fit the data particularly well, the reason for this negative correlation could be lie in the fact that this Confidence in Gambling items factor was not a particularly valid construct (it only explained a small proportion of the variance in responses).

In addition, an important observation was that out of these extra four "performance" factors, only the Understanding of Randomness factor correlated in any interesting way with the Fallacies, Dissociation and Loss of Control. The other factors correlated among themselves, but did not interact with these other constructs. These other factors therefore had no clear relationship (direct or indirect) with the Loss of Control, and would therefore not be particularly useful in a model explaining continued play. For the next stage of the analysis, only this Understanding of Randomness factor was brought forward.

In relation to the evaluation of the four factor models in which the Understanding of Randomness factor was involved with the Fallacies, Dissociation and Loss of Control, it would be odd if the Understanding of Randomness factor (R) did not load better on Fallacies directly (R-F-D-LoC) than it did on Dissociation (R-D-F-LoC). Examining the correlations between the factors resulting from the measurement model would provide clarification of this.

A four factor measurement model was therefore run within EQS, allowing Understanding of Randomness, Fallacies, Dissociation and Loss of Control to covary within the model.

Although the resulting fit was still not particularly strong, the fit index had increased from 0.827 to 0.837 suggesting that this four factor model was better at predicting the data than the model with all the "performance" factors. The correlations between the factors are presented in Table 5.18 below.

Table 5.18.Correlations Among Independent Variables

	Loss of Control	Fallacies	Dissociation	Understanding of Randomness
Loss of Control	1.00	0.553*	0.651*	-0.162
Fallacies		1.00	0.782*	-0.345*
Dissociation			1.00	-0.239*
Understanding of Randomness				1.00

Significant correlations are marked with an *; $p<0.05$.

The strength of the correlations between the constructs signals the probable direction of their relationship. The fact that again the correlation between Fallacies and Dissociation was stronger than the correlation between Fallacies and Loss of Control, suggested that Fallacies become established leading to a Dissociation leading to Loss of Control.

The reason why the measurement model did not fit the data particularly well had to be investigated. Considering that the three factor model (Fallacies, Dissociation and Loss of Control) fitted the data, this suggested that the reason may lie with the fourth factor, namely the Understanding of Randomness construct.

Further investigation revealed that the correlations between the randomness items were heavily over-represented within the residual matrix, suggesting that this one factor might not have been enough. A single factor model on the Understanding of Randomness construct was therefore conducted to see if there was any evidence to suggest that more than one factor should be employed to account for the responses to these "randomness" items.

Again the model fit was found not to be particularly strong, with a Robust CFI of 0.796. All the items loading on this Understanding of Randomness factor had to do with their perception of randomness of a presented sequence of outcomes. It is possible that the participants recognised that the gambling and non-gambling items within this perception of randomness material was related, and might also have been able to remember what they wrote on the previous items. The fact that all the gambling items came first, followed later in the questionnaire by all the non-gambling perception of randomness items, lends support to this idea. Because of the fact that these responses were therefore likely to be related, residual pairs were allowed to covary within the model, to see if this benefited the model fit. Each gambling probability item residual was allowed to correlate with its counterpart non-gambling item. For example, the residual for the gambling 0.2 perception of randomness item was allowed to correlate with the equivalent non-gambling item.

The resulting model fit was an improved 0.873. However, although the resultant residual correlation matrix (see Table 5.19) provided evidence that two of the pairs were correlated (strongly and positively) as allowed for, there were two item pairs that did not correlate to the same extent.

If the reason for the lack of initial fit had been solely due to the notion that participants could have remembered their previous responses, and hence these responses were correlated, then one would expect all item pairs to be correlated both positively and strongly. As Table 5.19 shows, this was not the case, raising concern regarding this technique for improving the fit of the model.

Table 5.19. Correlation Matrix for Independent Variables (residuals)

	Non-Gambling			
Gambling Item	0.2	0.4	0.6	0.8
0.2	0.408			
0.4		-0.064		
0.6			-0.486	
0.8				0.408

If they had been of the same sign (specifically all positive), this would have suggested that the participants could have responded to the later similar items in relation (with the help of their memory) to their responses to the previous (and related) items.

The fact that the correlation between two pairs were strong and positive (0.408) suggests that for these items, there was some priming effect of the previous items responded to. However, of the other two pairs (the 0.4 and 0.6 probability) one was strong whilst the other was weak, and both negative.

This raises some concerns with respect to the measurement of this "Understanding of Randomness" factor. However, this factor did correlate with Dissociation and Fallacies, but not with Loss of Control. This does provide evidence that this factor is important and may well be a precursor to extended play and loss of control. Running and testing the fit of various models (structural equation modelling) would help to identify at which point the Understanding of Randomness factor had most effect. It would help determine whether most of its effect was directly onto Fallacies then on to Dissociation, before Dissociation influenced Loss of Control, or whether the Understanding of Randomness factor heavily influenced the Dissociation factor directly. However, as the measurement model's fit index was not particularly strong, structural equation modelling which was used to help distinguish between the various non-recursive models, could not be implemented here. Further research would have to be done expanding on and developing the items that measured this Understanding of Randomness factor. The implications of this factor will be further discussed in the final chapter.

5.3. Discussion

In summary therefore, several findings of theoretical importance have come to light. Firstly, the relationship between Fallacies, Dissociation and Loss of Control was replicated within the current study. Furthermore, the evidence tended to favour the account of the data provided by one of the models. The model that fitted the data best was the model in which the level of Fallacious beliefs influenced the level of Dissociation within the gambling activity, the result of which influenced the degree of the Loss of Control. This has expanded upon the Ladouceur model in which the development and maintenance of erroneous perceptions are seen as the primary and main cause for an individuals loss of control. The current analysis has however, demonstrated that the picture is not as simple as that. What emerges is the important influence of erroneous perceptions on the extent to which someone becomes dissociated whilst gambling. The correlation between Dissociation and Loss of Control was stronger than the correlation between Fallacies and the Loss of Control. This, along with the model fit indices and the χ^2 values, represents the fact that the extent of fallacious beliefs held does have an effect on the level of loss of control experienced, but via an intervening construct, that of Dissociation.

The study also showed that the concept of General Dissociation had no observable relationship with the other constructs under investigation. The extent to which an individual became dissociated in everyday life, had no bearing on whether or not they became dissociated within the gambling context, and additionally had no effect on gambling behaviour or consequences. However, it was noted that only a subset of the DES (Bernstein and Putman, 1986) items were used to measure this general dissociation. Furthermore, it was noted that the items used to assess this, appeared to be potentially loading on two separate factors, suggesting that the DES may itself benefit from a factor analytical technique, to ensure that this general dissociation factor is a singular construct.

From the performance analysis, it was possible to conclude that although there appeared to be four factors resulting, the only factor of theoretical interest which had some bearing on the other constructs under investigation, was the factor relating to an individual's grasp of the independence of events concept, particularly the ability to acknowledge and understand the principle of randomness. The other candidate which came close to being of value was the Factor relating directly to the use of past information. Although the correlation between this factor and the other constructs was not significant (except for with Dissociation) the correlations were in the predicted direction. Further research could attempt to develop the measurement of this factor to discover whether it does in fact have a significant bearing on the current discussion.

Although Frequency did correlate strongly with Loss of Control, the Understanding of Randomness factor did not. The other performance factors relating to the degree that heuristics and biases play a role in excessive play did not correlate with any of these variables. Even the Understanding of Randomness factor, although it correlated with Fallacies and Dissociation in the predicted direction (it correlated negatively and significantly with both), it did not correlate directly with Loss of Control. The clear conclusion to be drawn from these results is that higher frequency gamblers did not appear to be more biased than the lower frequency players in the sample.

There are several reasons why the analysis on the use of heuristics and biases was not more fruitful. Firstly, only a limited range of heuristics were assessed. Secondly, the way in which they were assessed may have been too far removed from actual gambling situations. Asking questions presented on paper with hypothetical past outcomes may have been too different from actually sitting at a roulette table to have invoked the use of the same thought processes that the real gambling scenario would. A further possible cause may have been the sample recruited. The majority of the higher frequency gamblers that were asked to take part declined to do so. Recruitment was attempted at Newton Abbott Race Course an hour and a half before the days races commenced. No one agreed to take part out of the 40 people approached, representing the fact that those participants who agreed to take part (from those asked within the off-course betting agencies) may themselves reflect a bias in sampling. A further bias in sampling arises due to the fact that the higher frequency group were all recruited from within these agencies, thereby reflecting a bias in terms of the gambling activities that the participants frequented. The majority of these gamblers bet mainly on horse and dog races, whilst many items within the questionnaire related to games which are available within a Casino establishment. Running further studies offering greater incentives with participants covering a much wider range of gambling forms, whilst tapping these gambling forms more thoroughly with the questionnaire items, may provide more fruitful results.

What is clear from the current Performance factor analysis, which is consistent with Stanovich's individual difference approach, is that there appear to be consistent general factors that seem to offer some account for performance across a range of heuristic and bias type tasks. The Performance factor analysis here revealed two factors, interpreted as the Understanding of the Principle of Randomness and the Use of Past Information, which appeared to underlie performance.

As discussed earlier, Stanovich (1990) and Stanovich and West (1998) demonstrated evidence for two factors underlying performance on the tasks that they investigated. The extent to which the two factors extracted in the current work relate to their cognitive capacity and thinking disposition factors needs to be explored. It is not unlikely that that intelligence levels would be good predictors of whether or not someone believes in the independence of events.

However the relationship between the observed factors and loss of control with respect to gambling is less clear. In the current work neither of the two resulting factors correlated significantly with Loss of Control. Additionally, no particular differences appeared in the way that high and low frequency gamblers responded to and displayed the use of the heuristics and biases assessed.

So although there may be individual differences in the performance on these tasks and in the decision to gamble or not to gamble, based on the current results this approach seems unlikely to differentiate between those maintain control over their gambling and those who continue to problematic levels. However, the possibility that the two factors that Stanovich proposed are related to Loss of Control can not be ruled out, and warrants further investigation.

The relationship between the level of Fallacious beliefs, Dissociation (gambling specific) and Loss of Control was replicated very clearly with the current investigation. What was also clear was that evidence tended to favour the F-D-LoC model in terms of accounting for the data. These results therefore suggest that the level of Fallacious beliefs does not act as a solitary construct in influencing the level of loss of control experienced. Rather, the extent of the fallacious beliefs held encourages the experience of a dissociative state, which in turn influences the loss of control. Although not too strong an emphasis can be placed on the observations with respect to the Understanding of Randomness factor, the correlation between Understanding of Randomness and the Fallacies factor was stronger than the correlation between Understanding of Randomness and Dissociation. This suggests that underlying the Fallacies factor is the understanding of the principle of randomness, implying that the less people are aware of the independence of events, the greater the number of erroneous perceptions are built up and maintained, which encourage the dissociative state, which in turn increases the chance of reaching the position at which it is infinitely harder to cease one's gambling behaviour.

6. Chapter 6: Discussion

6.1. Introduction

This thesis aimed to investigate the role of the cognitive perspective in the explanation of gambling behaviour. In particular, the thesis set out to test the validity of three versions of the cognitive perspective, which were labelled the "strong", "weak" and "integrative" hypotheses in Chapter 1. The strong cognitive hypothesis was tested in relation to whether the order of information participants receive during a task can itself can lead to exaggerated perceptions of success, but particularly to differential levels of future success rate predictions and hence future expected play. The focus here was on testing the claim from Langer and Roth (1975) that early wins can induce a magnified illusion of control as compared to other types of sequence. The weak cognitive hypothesis was tested with a view to investigating the notion that although the way people react to what happens during the task is important, an individual differences perspective is necessary to explain differential levels of play. In relation to this, the extent to which people employed a rational or experiential processing style was examined, along with the extent to which people used some heuristics and were affected by biases in their decision making. This investigation also focused on whether there were any individual differences in the extent to which someone becomes dissociated in everyday life. Finally, the integrative hypothesis was investigated by evaluating the relationship between erroneous beliefs during gambling, levels of dissociation experienced whilst gambling, and loss of control of gambling behaviour.

The main aim of this chapter is to discuss the results of the studies presented above with a view to final evaluation of the three hypotheses. Initially the evidence for each of these hypotheses will be considered in turn, and a number of caveats to the experimental work are presented along with recommendations for future research. Finally the chapter will examine the implications the results have for the explanation of both normal and problematic levels of gambling behaviour, and the implications for therapy are discussed.

6.2. Summary of findings

6.2.1. The Strong Cognitive Hypothesis

The first two experimental chapters investigated the "strong cognitive hypothesis". It was argued that if it was the case that cognitive processes alone could account for the different levels of play, then the order of the events experienced during a task may be good predictors of the levels of play. The case was presented that gambling activities can be viewed as decision making tasks. People have to decide how confident they are in their chosen outcome for the next event when both choosing between alternatives and placing a bet itself. The chapters investigated the role of outcome information gathered during the task in relation to its effect on people's short and longer term confidence levels.

First of all, in relation to the turtle tasks presented at three different probabilities, the effect of the precise win sequence had very little effect on participants' short and long term measures at the end of the task. This demonstrates the finding that although participants had developed an Illusion of Control, represented by their over inflated confidence and future success rate predictions, the standard order effects (as observed by Langer and Roth, 1975) were not cleanly replicated.

The lack of difference between the Descending and the Ascending sequences could be explained in terms of the effect of eliciting measures throughout the trials. The late wins experienced by those in the Ascending sequence could have had the effect of raising responses to similar levels to those of early win participants. This indeed was the case, as the analysis on the step by step measures revealed. This methodology had therefore obliterated the order effects as observed by Langer and Roth (1975), supporting in part the belief revision model of Hogarth and Einhorn (1992). The importance of this lies in the fact that the methodology used within these experiments more closely resembles the real gambling scenario. Here the win sequence had no significant bearing on participants' confidence in the next trial and their longer term estimates of success at the end of the trials. The Illusion of Control and specifically the order effects observed by Langer and Roth (1975) may therefore be less pertinent to the explanation of gambling as was previously thought.

Although these results do not provide sufficient evidence for the strong cognitive hypothesis in terms differential levels of play, they do support this hypothesis in relation to gambling in general. This was particularly the case in relation to the measures elicited on a trial by trial basis. A clear recency effect was observed that was consistent across all three experiments conducted. It was clear that participants were basing their responses throughout the task on the success or failure of their recent predictions. Throughout the early stages of the early win sequence, participants were consistently responding with higher estimates, both in terms of short term confidence and longer term estimates of success than participants who were losing predominantly early on. By the end of the trials, those having lost early on, became more confident (short and longer term) when they began winning trials as they approached the end of the sequence. Those in the early win sequence then became less confident (short and long term) throughout the latter part of their sequence when they were predominantly losing.

Interestingly, there was a consistent difference between participants' short term confidence and their longer term estimates of success. Furthermore, this difference became greater as the probability of success inherent in the task decreased. Confidence generally started off (and remained) higher than Next 100 predictions of success. What appeared to be happening was that confidence remained mid-way on the confidence scale (nearer to the 50% confident mark) and did not appear to be as dependent upon the likelihood of success on the task, (i.e. the number of turtles in the race). This lead to severely over inflated responses when the probability of success decreased. On the other hand, Next 100 predictions were more dependent upon (more anchored to) the objective rate of success; as the probability decreased so did participants' longer term estimates of success.

This suggests that participants were aware of the fact that in the long run they would only win at a chance rate as prescribed by the probability of success inherent within the task. Participants were able to adjust their longer term estimates of success much more appropriately across all three probability tasks. However, people still tended to think that if they were distracted then they would perform significantly worse at the task. This implies that they believe that they have to concentrate in order to perform well.

When participants were not encouraged to think longer term throughout the task, they provided responses that appeared to reflect their neglect of the fact that they would only win at a chance rate in the long term. Under these conditions they were experiencing an important narrowing of attention, focusing in on the information extractable from the task.

The implications of this for the real gambling environment lie in the fact that when presented with a gambling opportunity, although people may realise that over time the chances that they will win more than to be expected are slim, they may bet more on individual events. They may bet more due to their over confidence and lack of understanding of the independence of outcomes, and believe that they can in fact utilise recent outcome information to their benefit. In terms of therapeutic value, it seems that getting people to focus on the longer term, getting them to focus away from merely the local recent information, may prevent them from becoming excessively "unobjective" and exaggerated in their confidence.

Participants' memory of past success was affected by the previous win sequence. A clear primacy effect resulted in that participants who had won early on in their trials exaggerated their previous success history, providing responses that were significantly higher than those who had experienced their wins in the latter part of the trials. This raises a rather paradoxical issue. Why is it that participants who won early on believed they had performed significantly better at the task, but did not think they would perform significantly better over the following trials? This is a question that would require further investigation particularly when one considers the observation in Experiment 3 that the more confident someone was, the greater the number of trials they played.

The manual coin presentation of the paradigm did however show up some different results which were discussed in Chapter 3. The previous win sequence did have an effect of increasing responses on both participants' memory of past success and on future estimates of success, but only when this measure had not been elicited throughout. Although these effects were small, and the coin tossing trials were arguably less ecologically valid than the Turtle experiments, this suggested that caution should be applied when generalising to all forms of gambling.

A further point to note with respect to the observations from the studies within these two chapters, is that it was clear that one can not safely assume that males and females respond to sequences of wins and losses in an identical fashion. The extra loss sequence presented in Chapter 3 revealed that although female participants became less confident throughout this, their male counterparts on the whole did not. This may be due to the case that males are generally more susceptible to the gambler's fallacy, that after every loss, a win is increasingly more likely. Further research should take account of this finding and further investigate any differences between the way that the two sexes respond to the experience of the task.

Although the "Continued Play" measure was only utilised in the final Turtle experiment where participants won four out of the 32 trials, there was an interesting result. Although participants were not affected by the previous win sequence in terms of how many extra trials they chose to play, those people who were more confident at the end of the trials played on for longer. This striking affect of viewing gambling as a decision

making task is very important, as it demonstrates that there is an association between participants' confidence and the extent to which they continue to play. Further research could make use of this type of measure whilst investigating tasks with different probability of success, and different absolute numbers of wins.

The ability of these studies to reject the strong cognitive hypothesis with respect to problem gambling is not as limited as would be suggested by the fact that the sample used was drawn only from a student undergraduate population. The student population represented a cross section of the gambling population. Additionally, the MIMIC model run as part of the factor analysis in Chapter 5 confirmed that there were no differences in respect of the variables under consideration between the student sample used in the final study or the high frequency gamblers recruited from the betting establishments.

The related issue to the non-use of high frequency gamblers is that of the ecological validity of the laboratory experiments. The tasks involved participants taking part in a laboratory setting where none of the usual gambling environmental cues were available. Participants were not actually gambling and no money was involved. Although the type of task that was used here has been shown to be arousing, further research could make the laboratory task more similar in terms of the external cues and potential monetary gain.

One must also consider the probabilities of success related to the tasks used in the current work. The Experiments only investigated participants' responses to tasks in which their win rate mapped onto the probability of success. For Experiment 1, in which there were two possible outcomes, hence there was a probability of success of 0.5, participants won 50% of all trials. Likewise, for Experiments 2 and 3, the probabilities were 0.25 and 0.125 with win rates of 25% and 12.5% respectively. Particular differences may arise with respect to the "Continue to Play" measure. Increasing or decreasing the absolute number of wins (with or without altering the probability associated with the task) may result in the position of the wins and losses inducing people to continue play to varying degrees. This could also be investigated.

Another point with respect to the generalisability of the results to all gambling forms is that within each of these Experiments the probability of success was set and controlled throughout the duration of the task. Many gambling activities are structured in such a way that there can be within-activity probability changes dependent upon the decision of where to place the bet taken by the gambler. For example, in roulette the gambler can choose to bet on an even shot (with slightly less than a 50% chance of success) or on a single number where the chance of success is 1 in 37. One possible technique for investigating differences between tasks in which the probability of success is constant and tasks with within-activity probability changes, would be to design and run a series of computer based experiments. The turtle task used here could be modified to enable the participant to vary the probability of success on any particular trial whilst still having the position of their wins and losses predetermined by the Experimenter.

6.2.2. The Weak Cognitive Hypothesis

Chapters 4 and 5 investigated the "weak cognitive hypothesis". In Chapter 4 the investigation focused on the relationship between the individual difference measure of the REI and the degree of erroneous perceptions held by the gambler. In Chapter 5 the extent to which people get dissociated in everyday life (general dissociation) and the extent to which people exhibit the use of heuristics and biases was examined.

First of all, the results from the analysis with respect to the processing style as measured by the REI provided no evidence for the weak cognitive hypothesis. There were no significant relationships between any of the four sub scales of the REI (Rational Ability, Rational Engagement, Experiential Ability, Experiential Engagement) and any of the gambling frequency items within the questionnaire.

Gambling is one activity where the opportunity for experiential processing is rife and where the use of a rational processing style would be expected to have the effect of reducing the activity. With the current sample the extent to which someone preferred using an experiential style had no significant relationship with the level of their gambling behaviour. In fact the REI scores had little bearing on the any of the gambling activity items.

One reason why the REI did not come up with any interesting findings in terms of relationships of the subscales with the gambling items within the questionnaire may be due to the measure itself. The measure only asks people for their preference and their ability to think and engage in rational or experiential forms of processing. It is a self report measure and does not actually measure performance or ability in actually using these two types of processing, and as such may not be sensitive to the implicit processes postulated in the dual process account. Developing a way to measure their actual use and ability of these two forms of processing may provide results indicating that these processes are relevant in a model of gambling behaviour.

With respect to the general dissociation construct introduced in Chapter 5, again there was little evidence from this individual differences variable to support the weak cognitive hypothesis. There were some concerns with respect to the measurement of this construct, (by the DES, Bernstein and Putman 1986), which may have been part of the reason for why this variable had no relationship with the other variables of interest. It appeared from the exploratory factor analysis that the items that were used were loading on two separate factors, suggesting that general dissociation may not be a unitary construct. Even though the items used were only a subscale of the original Bernstein and Putman scale, this does not bode well for the full scale. This highlights the need for future research to apply factor analytical techniques to the measures of dissociation, to ensure that they do in fact measure the same thing.

The final individual difference variable which was addressed in relation to the level of erroneous beliefs, gambling dissociation and loss of control, as well as the other gambling frequency items, was the extent to which people exhibit some heuristics and biases when making decisions. Here there was some support for the weak cognitive hypothesis. Of the four factors that were extracted, the two that accounted for most of the variance were interpreted as a Use of Past Information factor, and an Understanding of the Principle of Randomness factor. These factors will be returned to in a later section when discussing a possible model.

However only this Understanding of the Principle of Randomness factor correlated in any significant way with Fallacious Beliefs and gambling Dissociation. None of the four factors extracted correlated with Loss of Control, which was itself correlated with frequency of gambling behaviour.

Because of the fact that the extent to which someone understood the principle of randomness correlated significantly and negatively with the level of fallacious beliefs and the level of dissociation, there was ample evidence to suggest that this factor requires further investigation. The reason why this factor did not correlate with the Loss of Control may be because it is too far removed from the Loss of Control (i.e. there are intervening variables - Fallacious Beliefs and Dissociation). Apart from the findings in relation to this particular factor, there was no evidence to suggest that higher frequency gamblers were any more prone to the use of the heuristics and biases assessed in the current work, than low frequency gamblers. Neither was there any significant evidence therefore, that higher frequency gamblers were more prone to the use of the assessed heuristics within the gambling context in comparison to outside the gambling environment.

However, as stated above, there was some evidence for this weak cognitive hypothesis, stemming from the outcome of the factor analysis in relation to the Understanding of Randomness factor. With further development this concept may be very fruitful in terms of developing a stronger account for gambling behaviour. One hypothesis for the influence of this factor would be that it directly affects the extent to which someone builds and maintains fallacious beliefs about the tasks. The benefit of including this factor in any model to account for loss of control could then be evaluated.

In line with Stanovich's individual differences approach to performance on reasoning tasks, there did appear to be two general factors that could partly explain the variance in performance. The appearance of these two factors (the Understanding of the Principle of Randomness and the Use of Past Information) offers support for the individual difference approach. Further studies could be carried out to investigate the nature of the relationship that these two factors have with those proposed by Stanovich (1999) and Stanovich and West (1998).

The results of the current work did not reveal any factor that appeared to differentiate between the individuals' level of play. That does not mean that either of the two factors proposed by Stanovich (1999) and Stanovich and West (1998) could not differentiate between levels of play, as neither were measured in the current work. In relation to the intelligence factor it is unclear how this may apply to the gambling situation, particularly when one considers the Ceci and Liker (1986) study reported above. The role of their second factor, that of thinking disposition certainly warrants further investigation, as do any other individual differences that may arise from further studies conducted in this vain.

As discussed in the final section to the previous chapter, only a small number of the whole range of heuristics were assessed in the current work, and perhaps more importantly the method by which they were assessed may not have tapped the use of them appropriately. The bias in sampling may also have had an effect. Both the fact that the sample size with respect to the gamblers was fairly limited (due to both the resource restraints and to the difficulty with which higher frequency gamblers could be recruited) and additionally because those gamblers that were successfully recruited were all recruited within two off-course betting agencies. This part of this study's sample were primarily

horse and dog race gamblers and may therefore not be particularly representative of gamblers as a whole. This is particularly a concern when we consider the argument that gambling is not a homogenous activity as discussed earlier. To improve on this situation, further research would need to investigate the use of a wider range of heuristics and biases, and could attempt a much wider recruitment strategy, involving a larger sample of higher frequency gamblers and one that is drawn from a wider range of domains.

6.2.3. The Integrative Hypothesis

Chapters 4 and 5 presented studies which were conducted with the aim of evaluating the strength of the "integrative hypothesis" in investigating the relationship between erroneous beliefs that people might maintain about gambling and the level of dissociation experienced specifically during the task. These two constructs were evaluated in the light of the relative influences on the third construct, that of the extent of the loss of control experienced. There was substantial evidence in support of this hypothesis, making this integrative explanation the most likely candidate for explaining differential levels of gambling behaviour out of those investigated in the current programme of work.

The study reported in Chapter 4 on the student and general population provided evidence that the relationship between the level of fallacious beliefs held and the extent of the dissociative experience whilst gambling was a good predictor of the extent of loss of control reported by individuals.

The results clearly indicated that recursive models that allowed feedback loops between the constructs were no better at accounting for the data than the non-recursive ones. Furthermore, the models that involved the Loss of Control construct intervening between the Fallacious Beliefs and Dissociation constructs clearly did not fit the data as well as the models in which the Loss of Control was a consequence of the relationship between these other two variables. The question that remained was whether the Fallacious beliefs element was a precursor or more of a consequence of the extent to which people became dissociated whilst gambling. This question was answered with the results from the study reported in Chapter 5.

The results in this study replicated the findings observed in Chapter 4. Of additional interest was that with the development of the Fallacies and the gambling Dissociation measures, and with the more representative sample, there was sufficient evidence to report that the two non-recursive models in which Fallacies and Dissociation preceded Loss of Control were different in terms of their ability to fit the data. The Fallacies-Dissociation-Loss of Control model appeared the best model to account for the data obtained.

There are a couple of points to mention with respect to the Structural Equation modelling technique used for the investigation into these models. Firstly, some concern ought to be raised regarding the fact that, particularly as problem gambling is likely to develop over time, the technique only relates to data collected at a single point in time. Although the constructs investigated here are likely to be relatively stable dispositions, this stresses the importance of conducting further research of a longitudinal nature, to investigate further the antecedents which appear before one reaches problematic levels of gambling. Secondly, it is possible that both the extent to which someone holds erroneous perceptions and the extent of their gambling specific dissociation, are both correlated with another factor not assessed within the current work, which could partly account for the observed relationships. Such unsuspected additional factors might undermine the conclusions reached from the modelling of experiments. The modelling technique can not prove any particular model, but rather can only disprove models hence further investigation into other models with additional factors could be conducted. Both of these above issues would need further investigation.

The results reported suggest that the Ladouceur perspective (that erroneous perceptions are central to excessive gambling and loss of control) although not incorrect, is not complete. It has ignored a crucial construct which in conjunction with erroneous perceptions provides a better predictor of continued play. The mediating variable it seems is that of the extent to which people become dissociated throughout the task. The implications of this both for a model of gambling behaviour and for therapy are considerable.

6.3. Towards a Model of Gambling Behaviour

One could argue that the studies in the current work did not focus heavily on real gamblers, and for that reason the work has limited implications for pathological (or problem) gambling. However, Dickerson's (1993) perspective that one should move away from a two category approach to gambling was adopted throughout the thesis. Dickerson argues that rather than making the distinction between pathological and non-pathological, gambling should be viewed on a continuum from low to high frequency. Hence we should be looking at levels of gambling frequency, rather than purely those who have reached "pathological" status as defined by various classification tools. So although there was not a particularly high proportion of people who would have normally been defined as "pathological" gamblers, the thesis investigated participants who ranged from low to high frequency in their gambling behaviour.

At the outset of the thesis it was argued that the success of any theory would best be judged on two criteria. Firstly, as the majority of western industrialised societies gamble (Walker 1992) any proposed theory would first have to provide an adequate account of normal gambling. The second criterion on which a theory ought to be judged, is to what extent it can explain why some people lose control and gamble at excessively high frequencies, whilst others manage to control their gambling behaviour. The model to be proposed here attempts to account for both of these issues in relation to the degree of the constructs exhibited by individuals.

We can begin a with consideration of the explanation of gambling in general. Firstly, overconfidence was rife throughout the studies. Participants were systematically over confident in their predictions of success. If people believe that they are more likely to win than chance would determine then, even though this is a fallacious belief, this alone can account for why they are likely to gamble as they are less likely to be consciously aware of the negative expected return. Secondly it was observed that erroneous beliefs are not the domain of the high frequency gambler alone, but they also characterise gambling and gambling decision making generally. The student, general population and the higher frequency gambling groups all expressed beliefs in the fallacious beliefs items to a varying degree. One explanation of why people do not learn from the negative winning experience, is that they do in fact win often enough. In addition to the occasional wins, as discussed earlier, a loss can also confirm and hence encourage the false beliefs that people hold. Take, for example, the belief in the gamblers fallacy that after a sequence of reds on the roulette wheel a black becomes more likely. If a black occurs the belief is confirmed. If however, further reds result the belief is easily strengthened that a black is even more likely on the following trial. Hence both wins and losses can reinforce and hence maintain the false beliefs that individuals may hold.

As Coventry (in press) has suggested, the use of past information in order to make future decisions during gambling characterises normal decision making. The Understanding of Randomness factor that was extracted from the factor analysis correlated negatively with the level of erroneous beliefs and the level of dissociation experienced within the gambling task. The greater the individual's understanding that each trial is independent of the others in the sequence, and that use of past information in chance determined events is futile, the lower the number of erroneous beliefs held by the

individual. Additionally, the more they understood this principle, the less dissociated people became during the task. The level of erroneous beliefs and the level of dissociation experienced both correlated positively with the loss of control which correlated with frequency. The higher the number of fallacious beliefs the greater the loss of control experienced. This was also true for the level of dissociation. The important interpretation of this is that those people who understand the principle of randomness are less likely to gamble. However, this does not mean that they do not gamble at all. If decision making during gambling is largely an implicit, unconscious process, then it is not inconsistent for someone to have an understanding of probability theory explicitly, yet still "switch off" during gambling, making decisions implicitly and unconsciously.

The explicit system would suggest to people that continuing to gamble is not in their best interests as losing is generally the most available and explicit outcome. However, the implicit system tells them something completely different. For the gambling behaviour to continue this implicit system would have to dominate. Indeed, the results from the current work suggest that this is the case.

The Illusion of Control studies shed new light on the way in which information is used by participants during decision making tasks. Much of the focus in cognitive approaches to gambling has been centred on the importance of early wins (as initially reported by Langer and Roth 1975), supported by some anecdotal evidence from therapy that problem gamblers often had large wins early on in their gambling careers, (e.g Custer and Milt, 1985). The studies presented above in light of Hogarth and Einhorn's belief revision model (1992), suggest that recent information is much more important in the explanation of gambling behaviour. Although confidence at the end of the task correlates with the extent of continued play, the large fluctuations in confidence levels based on the last few trials indicates blatant 'short-termism' in the behaviour of the gambler. This provides support for the evidential theories (e.g. Cohen 1979) and fits with evidence that participants are even prepared to pay a price for access to previous recent outcomes, (Ladouceur et al, 1996, 1997).

When one considers loss of control of gambling behaviour, the results fit with the notion that short term concerns are paramount for gamblers. The focus on immediate events in the gambling environment and an acute awareness of how and when past recent information can predict future success, can perhaps lead to a lack of awareness of time and outside events; characteristics of the dissociation experience. Due to this narrowing of attention, people may become less aware of the external cues available that would otherwise be effective signals that they ought to terminate the particular activity and how long they have actually been gambling. In the casino for example "Chips" are used to represent money, so that the frequency of loss of real money is less obvious. Features of gambling establishment design minimise the number of temporal cues available to their clients. Two examples of this are not displaying clocks and keeping the number of windows to a minimum (generally none), from which an estimation of the time of day by the changing amount of light external to the establishment could be made.

The important correlations between fallacious beliefs, dissociation during gambling and loss of control fit this overall picture. The fallacious beliefs items were generally tapping the use of past information. It appeared that the more the individual uses past information and therefore held more fallacious beliefs about gambling, the more the individual was forgetting their everyday problems, forgetting the time whilst they were gambling and reported feeling more alive whilst they gamble. These characteristics of the dissociation experience fit the notion that whilst the individual gambles they are dealing with the task implicitly and unconsciously.

6.4. Future Research and Implications for Therapy

It appears that the need to become dissociated may be important in terms of explaining higher frequency gambling. The important relationship between the level of fallacious beliefs held and the extent of dissociation experienced whilst gambling can not go unconsidered. What distinguishes between someone who does not lose control with their gambling behaviour from someone who gambles at excessive levels may be the extent to which they "switch off" during gambling and become dissociated within the gambling context. The DES (Bernstein and Putman 1986) however may not be a good measure of people's desire for this experience. As we saw there were concerns raised as to the measurement of this construct. Further investigation could develop the measure of dissociation, in particular with respect to the specific experience of dissociation within the gambling context. Future research could also evaluate the level of dissociation experienced online, with measures taken much closer to the gambling experience itself. This would tease out whether for example, higher frequency gamblers were actually worse in their judgements of the amount of time that has passed in that gambling episode.

As discussed in Chapter 4, the cognitive therapies that have been developed primarily by Ladouceur, have had some beneficial effects (e.g. Ladouceur et al, 1989). It has however, not been entirely clear how they have worked. The key element to their therapy has been the breakdown of cognitive distortions about gambling tasks, and an attempt at encouraging gamblers' understanding of the principle of randomness. The results presented here shed new light on the possible effects of de-biasing.

Within this model, the therapy would be predicted to work, not purely because of the correction of the erroneous perceptions, but because of the effect this has of making the task more explicit, and of reducing the dissociative experience by breaking the link between erroneous perceptions and dissociation. Developing high frequency gamblers' understanding of the principle of randomness by correcting the fallacious beliefs and getting them to focus on their longer term estimates of success is likely to have the effect of making the activity less enjoyable as the same amount of dissociation is not achieved.

Furthermore, within this model, correction of the erroneous perceptions would not be likely to be sufficient on its own. Once the gambler starts believing in the independence of events, the actual gambling activity itself will undoubtedly become less interesting, as there is then less perceived control and predictability. At this point, it is likely that the individual will have conflicting internal motivations. On the one hand the individual is attempting to overcome a habit which they want to extinguish so that the associated disadvantages can be minimised. On the other hand, the individual is trying to overcome an activity which they have used effectively as a form of escapism from their everyday existence. This attempt to prevent an activity which has had an important role in the life of the gambler, could make the gambler lose the driving force and motivation for this change to occur. A more comprehensive and successful therapy would need to address the subjective value of the dissociation experience, establishing and tackling the reasons for this need for the dissociation experience. Additionally, the identification and encouragement of an alternative and less problematic activity which also offers this experience could be pursued.

This account does not neglect the importance of addressing people's grasp of the principle of randomness and unpredictability. If people fail to grasp this and believe they can in fact beat the game, then they are unlikely to be motivated to curb their behaviour, even in the light of their behaviour being party to destroying their familial, economic and social lives. Rather it stresses the importance for cognitive therapies to not only focus on the erroneous perceptions arising from a misunderstanding of the randomness principle, but also to ensure that a focus on dissociation experience is also present.

7. Appendices.

7.1. Appendix 1: Instructions to Participants (Verbal Briefing)

Experiments 1-3 inclusive

Thank you for agreeing to take part in this study.
First of all I would like to check your understanding of the term Psychokinesis.
(Confirm the working definition that Psychokinesis involves the ability to influence outcomes, to move objects in the external world, without any physical contact.)

This study involves a series of Turtle Races. For each race you can select a Turtle that you think and want to win the next race from the available Turtles, which will appear on the screen. Once you have clicked on your chosen Turtle, you will then be asked (either:) How Confident are you that your chosen Turtle will win the race?" (or:) How many trials you think you would win over the next 100 trials?".
You can enter your response (on a 0-100 scale) directly using the keyboard in front of you.

You will then click on the "Go" button to start the race. The Turtles will appear at the centre of the blue circle and will move in a random fashion towards the edge of the circle. Once a Turtle crosses the white perimeter of the circle the race has been won. The winning Turtle will remain on the screen whilst you are informed whether you won or lost that particular race. The Turtles available for the next race will then reappear on the screen for you to make your selection.

What I would like you to do is to try to encourage your chosen Turtle to win the race, to cross the line before the other Turtle(s) in the race, to win as many races as possible. You can try to encourage your Turtle in any way that you can without touching the computer itself.

I remind you of your right to withdraw at any time throughout the study, if you do you will still keep your participation point (if applicable), and that all your responses will be treated with complete confidentiality.

Are there any questions?

Please write and sign your name on this participation list, and I shall give you your participation point. (If applicable).

Experiment 4

Thank you for agreeing to take part in this study, which shouldn't take long to complete. This study is for my third year project and involves a coin prediction task.
I will ask you to predict the outcome of each flip of the coin, and prior to each trial I will be asking you how confident you feel you are that your prediction is correct. Please give your response to this on the scale that you have in front of you.

Explain:

Completely Confident that you'll lose	Uncertain	Completely Confident that you'll win
-5	0	5

I remind you of your right to withdraw at any time throughout the study, if you do you will still keep your participation point (if applicable), and that all your responses will be treated with complete confidentiality, that is why this screen is here so that you can't see previous participants' responses and that later people can't see yours.

Are there any questions?

Please write and sign your name on this participation list, and I shall give you your participation point. (If applicable).

Quick re-cap on what is required.

If there aren't any (more) questions.........., I'll have your first prediction then please.

7.2. Appendix 2: Short Questionnaire items

(To assess assumption that bet size correlates to confidence).

Bracketed figures represent odds within item, and were not available to participants. Items were presented in a random order, the same random order for each participant.

(1-2)
You are asked to predict the outcome of a flip of a coin. How confident would you be that it will be a Head?

Please indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

(1-2)
You have £100 of your own money, and you have to place a bet on one spin of the Roulette wheel. You decide to bet on Red or Black. How much would you place?

(1-3) You are asked to decide between the fair dice landing on one of the following options. Low (1or2), Middle (3or4) or High (5or6). You choose High. How confident would you be that you will win?

Please indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

(1-3)
You have £100 of you own money. At the Roulette table, you decide that you will bet on the outcome being 12 or below, as opposed to it being a number from 13-36. How much of your £100 would you be prepared to bet on this?

(1-6) You are asked to predict the outcome of a roll of a fair dice. How confident would you be that you are correct?

Please indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

(1-6)
You have £100 of your own money. There are 12 greyhounds in a dog race and you have chosen Number 4 and Number 7. How much money in all would you be prepared to place on this race.

(1-12)
In a local lottery draw, there are 48 numbers to choose from, and you decide to buy up four numbers. How confident would you be that you will win something?

Please indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

(1-12)
All the Jacks, Queens and Kings are taken out of a normal pack of cards and are shuffled properly. You predict that the top card will the King of Spades. You are given £100. How much would you be prepared to bet on your prediction?

(1-20)
You are at a Point to Point, and there are 20 equally fit horses in the next race. You make you choice of horse. How confident would you be that your horse would win?

Please indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

(1-20)
You have £100 of your own money, and asked to bet on picking out one Spotted marble from a bag containing 6 Spotted marbles and 14 normal marbles, all of equal size. How much would you be prepared to place?

(9-13)
A computer prints out one new random number at a time in the range 0 to 104. You predict that the first number to come out w3ill be anywhere from 32-104. How confident are you that you will be right?

Please indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

(9-13)
You predict that the first card drawn from a pack of shuffled cards will be a card with a value of less than 10. You have £100 of your own money. How much of this would you be prepared to place?

(2-3)
At the Roulette table you have placed a bet on each of the numbers from 13 to 36. How confident would you be that one of your numbers will come up?

Please indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

(2-3)
A friend is about to roll a dice on which you are about to bet some of your £100. How much of this would you be prepared to bet on it not being a 1 or a 6?

(5-6)
A turtle race with 24 turtles is about to commence. Four of the turtles are marked with a cross. How confident are you that none of the four marked turtles wins the race?

Please indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

(5-6)
Six children are playing Pooh-sticks (throwing sticks into the flowing river under a bridge, and the owner of the stick which comes out the other side first is the winner). One of the children is a boy. You have £100 of you own money. How much would you be prepared to bet that any one of the girls wins?

7.3. Appendix 3: Statistical Analyses for Experiments 1, 2 and 3

ANOVA tables.

Experiment 1 (Turtle 2)

3a. Baseline Responses

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	52.008	108	371.1102	.140143	.708873
2	2	624.758	108	371.1102	1.683485	.190562
3	1	39.675	108	371.1102	.106909	.744324
12	2	993.358	108	371.1102	2.676721	.073351
13	1	1197.008	108	371.1102	3.225480	.075297
23	2	125.625	108	371.1102	.338511	.713584
123	2	42.858	108	371.1102	.115487	.891042

3b. Illusion of Control: End of Sequence Measures

1- RESPONSEMODE, 2-SEQUENCE, 3-SEX, 4-MEASURE

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	731.504	108	553.5532	1.32147	.252868
2	2	7.204	108	553.5532	.01301	.987071
3	1	3.037	108	553.5532	.00549	.941087
4	1	2961.038	108	259.8106	11.39691	.001023
12	2	914.779	108	553.5532	1.65256	.196366
13	1	403.004	108	553.5532	.72803	.395410
23	2	462.862	108	553.5532	.83617	.436155
14	1	15.504	108	259.8106	.05967	.807474
24	2	252.762	108	259.8106	.97287	.381283
34	1	22.204	108	259.8106	.08546	.770587
123	2	573.504	108	553.5532	1.03604	.358356
124	2	28.754	108	259.8106	.11067	.895332
134	1	28.704	108	259.8106	.11048	.740241
234	2	59.954	108	259.8106	.23076	.794320
1234	2	112.779	108	259.8106	.43408	.648984

3c. Step By Step Analysis

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX, 4-PERIOD

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	12977.90	108	1185.651	10.94580	.001275
2	2	2308.03	108	1185.651	1.94664	.147729
3	1	541.08	108	1185.651	.45636	.500776
4	3	22.55	324	99.164	.22743	.877284
12	2	345.06	108	1185.651	.29103	.748076
13	1	48.05	108	1185.651	.04053	.840827
23	2	873.95	108	1185.651	.73710	.480890
14	3	13.44	324	99.164	.13553	.938801
24	6	271.68	324	99.164	2.73974	.013056
34	3	115.83	324	99.164	1.16807	.321963
123	2	277.65	108	1185.651	.23417	.791625
124	6	174.77	324	99.164	1.76239	.106227
134	3	68.86	324	99.164	.69444	.555998
234	6	55.96	324	99.164	.56436	.758635
1234	6	129.00	324	99.164	1.30088	.256204

3d. Battery Items

Longer Term Items

1- RESPONSEMODE, 2-SEQUENCE, 3-SEX, 4-MEASURE

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	258.403	108	377.2546	.68496	.409710
2	2	138.836	108	377.2546	.36802	.692970
3	1	783.225	108	377.2546	2.07612	.152513
4	2	3412.053	216	153.2898	22.25883	.000000
12	2	122.586	108	377.2546	.32494	.723273
13	1	204.003	108	377.2546	.54076	.463713
23	2	776.108	108	377.2546	2.05725	.132784
14	2	198.819	216	153.2898	1.29702	.275466
24	4	298.344	216	153.2898	1.94628	.103892
34	2	455.408	216	153.2898	2.97090	.053356
123	2	315.503	108	377.2546	.83631	.436092
124	4	168.828	216	153.2898	1.10136	.356863
134	2	65.853	216	153.2898	.42960	.651326
234	4	52.567	216	153.2898	.34292	.848758
1234	4	49.878	216	153.2898	.32538	.860762

Percentage of Trials

1- RESPONSEMODE, 2-SEQUENCE, 3-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	227.438	108	243.1193	.935498	.335599
2	2	1443.945	108	243.1193	5.939243	.003572
3	1	7.746	108	243.1193	.031859	.858671
12	2	558.439	108	243.1193	2.296977	.105455
13	1	358.810	108	243.1193	1.475862	.227073
23	2	1537.720	108	243.1193	6.324959	.002526
123	2	146.579	108	243.1193	.602911	.549048

How Good ?

1- RESPONSEMODE, 2-SEQUENCE, 3-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	99.008	108	257.8694	.38395	.536803
2	2	44.858	108	257.8694	.17396	.840568
3	1	5161.408	108	257.8694	20.01559	.000019
12	2	1008.858	108	257.8694	3.91228	.022890
13	1	.675	108	257.8694	.00262	.959291
23	2	1856.008	108	257.8694	7.19747	.001163
123	2	99.775	108	257.8694	.38692	.680083

Experiment 2 (Turtle 4)

3e. Baseline Responses

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	10863.18	103	317.6577	34.19777	.000000
2	2	230.09	103	317.6577	.72434	.487095
3	1	187.25	103	317.6577	.58947	.444381
12	2	491.49	103	317.6577	1.54722	.217745
13	1	282.38	103	317.6577	.88893	.347974
23	2	141.02	103	317.6577	.44393	.642735
123	2	316.22	103	317.6577	.99546	.373081

3f. Illusion of Control: End of Sequence Measures

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX, 4-MEASURE

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	45.23	105	430.5913	.1051	.746493
2	2	803.94	105	430.5913	1.8671	.159674
3	1	3.23	105	430.5913	.0075	.931166
4	1	42508.09	105	285.6046	148.8354	.000000
12	2	653.50	105	430.5913	1.5177	.223988
13	1	192.67	105	430.5913	.4475	.505011
23	2	9.00	105	430.5913	.0209	.979330
14	1	583.32	105	285.6046	2.0424	.155936
24	2	515.58	105	285.6046	1.8052	.169503
34	1	177.96	105	285.6046	.6231	.431680
123	2	1300.37	105	430.5913	3.0200	.053062
124	2	132.08	105	285.6046	.4624	.631015
134	1	189.16	105	285.6046	.6623	.417588
234	2	829.08	105	285.6046	2.9029	.059280
1234	2	555.14	105	285.6046	1.9437	.148287

3g. Step by Step Analysis

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX, 4-PERIOD

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	31556.91	85	752.1069	41.95800	.000000
2	2	1801.53	85	752.1069	2.39531	.097272
3	1	975.17	85	752.1069	1.29658	.258038
4	3	127.73	255	86.7702	1.47211	.222587
12	2	288.26	85	752.1069	.38327	.682803
13	1	1913.51	85	752.1069	2.54419	.114412
23	2	1154.39	85	752.1069	1.53488	.221393
14	3	380.87	255	86.7702	4.38938	.004939
24	6	559.95	255	86.7702	6.45324	.000002
34	3	120.15	255	86.7702	1.38465	.247915
123	2	1800.19	85	752.1069	2.39352	.097437
124	6	222.42	255	86.7702	2.56334	.019869
134	3	185.30	255	86.7702	2.13549	.096204
234	6	230.39	255	86.7702	2.65516	.016236
1234	6	279.92	255	86.7702	3.22595	.004513

3h. Battery Item Analysis

Longer Term Items

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX, 4-MEASURE

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	4950.625	108	338.9645	14.60514	.000222
2	2	3800.203	108	338.9645	11.21121	.000038
3	1	47.669	108	338.9645	.14063	.708388
4	2	7302.978	216	185.0589	39.46298	.000000
12	2	1293.658	108	338.9645	3.81650	.025030
13	1	550.069	108	338.9645	1.62279	.205437
23	2	450.636	108	338.9645	1.32945	.268918
14	2	4050.033	216	185.0589	21.88510	.000000
24	4	73.769	216	185.0589	.39863	.809514
34	2	108.811	216	185.0589	.58798	.556334
123	2	91.003	108	338.9645	.26847	.765055
124	4	187.792	216	185.0589	1.01477	.400627
134	2	121.744	216	185.0589	.65787	.518989
234	4	173.453	216	185.0589	.93728	.443184
1234	4	199.853	216	185.0589	1.07994	.367318

Percentage of Trials

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	90.0408	108	93.72388	.960703	.329200
2	2	761.2098	108	93.72388	8.121835	.000518
3	1	486.5882	108	93.72388	5.191721	.024662
12	2	617.8734	108	93.72388	6.592487	.001989
13	1	97.1169	108	93.72388	1.036202	.310981
23	2	80.0890	108	93.72388	.854520	.428344
123	2	144.0253	108	93.72388	1.536699	.219756

How Good ?

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	93.633	108	380.5796	.246028	.620894
2	2	1384.725	108	380.5796	3.638463	.029566
3	1	67.500	108	380.5796	.177361	.674488
12	2	869.808	108	380.5796	2.285483	.106625
13	1	480.000	108	380.5796	1.261234	.263908
23	2	268.225	108	380.5796	.704780	.496476
123	2	13.975	108	380.5796	.036720	.963958

Experiment 3 (Turtle 8)

3i. Baseline Responses

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	12525.63	108	430.5611	29.09142	.000000
2	2	317.42	108	430.5611	.73724	.480827
3	1	2358.53	108	430.5611	5.47781	.021096
12	2	924.31	108	430.5611	2.14675	.121824
13	1	333.33	108	430.5611	.77418	.380880
23	2	222.31	108	430.5611	.51632	.598176
123	2	1305.56	108	430.5611	3.03223	.052332

3j. Illusion of Control: End of Sequence Measures

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX, 4-MEASURE

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	6375.70	108	593.8680	10.73589	.001413
2	2	1092.38	108	593.8680	1.83943	.163851
3	1	33.00	108	593.8680	.05557	.814078
4	1	13725.94	108	337.9255	40.61824	.000000
12	2	163.05	108	593.8680	.27456	.760433
13	1	33.00	108	593.8680	.05557	.814078
23	2	1260.08	108	593.8680	2.12182	.124781
14	1	9139.00	108	337.9255	27.04444	.000001
24	2	79.99	108	337.9255	.23670	.789635
34	1	42.50	108	337.9255	.12578	.723540
123	2	1869.20	108	593.8680	3.14751	.046926
124	2	229.38	108	337.9255	.67879	.509383
134	1	6.34	108	337.9255	.01875	.891329
234	2	1098.50	108	337.9255	3.25073	.042568
1234	2	398.51	108	337.9255	1.17929	.311424

3k. Step by Step Analysis

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX, 4-PERIOD

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	55129.21	108	1253.486	43.98071	.000000
2	2	2286.70	108	1253.486	1.82427	.166272
3	1	677.17	108	1253.486	.54023	.463930
4	3	1367.71	324	96.012	14.24515	.000000
12	2	129.70	108	1253.486	.10347	.901790
13	1	610.03	108	1253.486	.48667	.486916
23	2	2107.48	108	1253.486	1.68129	.190968
14	3	143.24	324	96.012	1.49191	.216618
24	6	150.20	324	96.012	1.56441	.156883
34	3	234.61	324	96.012	2.44356	.064053
123	2	4502.80	108	1253.486	3.59223	.030876
124	6	17.84	324	96.012	.18585	.980649
134	3	114.16	324	96.012	1.18906	.313935
234	6	141.61	324	96.012	1.47488	.186079
1234	6	49.72	324	96.012	.51781	.794778

3I. Battery Items

Longer Term Items

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX, 4-MEASURE

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	80.278	108	304.5636	.263583	.608718
2	2	1294.686	108	304.5636	4.250955	.016707
3	1	309.878	108	304.5636	1.017449	.315380
4	2	937.144	216	103.0534	9.093776	.000161
12	2	105.586	108	304.5636	.346680	.707815
13	1	41.344	108	304.5636	.135750	.713265
23	2	2033.886	108	304.5636	6.678035	.001843
14	2	50.978	216	103.0534	.494673	.610459
24	4	14.169	216	103.0534	.137496	.968264
34	2	75.878	216	103.0534	.736296	.480083
123	2	432.186	108	304.5636	1.419034	.246422
124	4	174.361	216	103.0534	1.691949	.152932
134	2	11.411	216	103.0534	.110730	.895231
234	4	59.236	216	103.0534	.574810	.681198
1234	4	255.978	216	103.0534	2.483933	.044695

Percentage of Trials

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	51.381	108	310.2210	.165628	.684833
2	2	2311.967	108	310.2210	7.452645	.000929
3	1	787.293	108	310.2210	2.537845	.114069
12	2	173.763	108	310.2210	.560127	.572787
13	1	145.782	108	310.2210	.469929	.494489
23	2	1250.444	108	310.2210	4.030817	.020497
123	2	63.821	108	310.2210	.205727	.814373

How Good ?

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	175.208	108	164.8602	1.062769	.304888
2	2	6.633	108	164.8602	.040236	.960577
3	1	3.008	108	164.8602	.018248	.892797
12	2	601.033	108	164.8602	3.645715	.029366
13	1	60.208	108	164.8602	.365208	.546895
23	2	1216.133	108	164.8602	7.376756	.000993
123	2	677.433	108	164.8602	4.109138	.019057

Combined Analysis of Experiments 1, 2 and 3.

3m. Illusion of Control: End Of Sequence Measures

1-EXPERIMENT, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX, 5-MEASURE

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	2	40.0798	324	1.576883	25.4171	.000000
2	1	13.1274	324	1.576883	8.3249	.004173
3	2	5.0335	324	1.576883	3.1920	.042384
4	1	.0002	324	1.576883	.0002	.990062
5	1	112.9867	324	.926442	121.9576	.000000
12	2	14.1982	324	1.576883	9.0040	.000156
13	4	1.7976	324	1.576883	1.1400	.337591
23	2	1.7016	324	1.576883	1.0791	.341125
14	2	.1605	324	1.576883	.1018	.903234
24	1	.1150	324	1.576883	.0729	.787279
34	2	2.7685	324	1.576883	1.7557	.174428
15	2	19.6226	324	.926442	21.1806	.000000
25	1	22.0290	324	.926442	23.7781	.000002
35	2	.2440	324	.926442	.2634	.768591
45	1	.1394	324	.926442	.1505	.698297
123	4	.1792	324	1.576883	.1136	.977682
124	2	.1133	324	1.576883	.0719	.930678
134	4	2.7528	324	1.576883	1.7458	.139630
234	2	3.1848	324	1.576883	2.0197	.134364
125	2	18.3904	324	.926442	19.8505	.000000
135	4	.6719	324	.926442	.7252	.575227
235	2	.6827	324	.926442	.7369	.479382
145	2	.0737	324	.926442	.0795	.923587
245	1	.2101	324	.926442	.2268	.634221
345	2	2.5365	324	.926442	2.7379	.066202
1234	4	5.9114	324	1.576883	3.7488	.005357
1235	4	.4481	324	.926442	.4836	.747765
1245	2	.3942	324	.926442	.4255	.653835
1345	4	3.2036	324	.926442	3.4580	.008739
2345	2	.1793	324	.926442	.1935	.824143
12345	4	1.8615	324	.926442	2.0093	.092921

3n. Step by Step Analysis

1- EXPERIMENT, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX, 5-PERIOD

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	2	222.3423	324	3.336715	66.63509	.000000
2	1	243.2688	324	3.336715	72.90668	.000000
3	2	12.2807	324	3.336715	3.68048	.026271
4	1	.2430	324	3.336715	.07284	.787422
5	3	1.7301	972	.341837	5.06120	.001755
12	2	75.0927	324	3.336715	22.50499	.000000
13	4	2.5757	324	3.336715	.77194	.544099
23	2	.1469	324	3.336715	.04402	.956936
14	2	2.4445	324	3.336715	.73261	.481448
24	1	.1995	324	3.336715	.05978	.807004
34	2	1.9243	324	3.336715	.57671	.562320
15	6	3.7040	972	.341837	10.83549	.000000
25	3	.0259	972	.341837	.07565	.973108
35	6	2.3785	972	.341837	6.95802	.000000
45	3	.2915	972	.341837	.85288	.465150
123	4	.4191	324	3.336715	.12559	.973156
124	2	2.7611	324	3.336715	.82750	.438061
134	4	7.1586	324	3.336715	2.14540	.075010
234	2	13.5944	324	3.336715	4.07417	.017885
125	6	1.1068	972	.341837	3.23792	.003723
135	12	.5655	972	.341837	1.65427	.071923
235	6	.4643	972	.341837	1.35820	.228599
145	6	.8831	972	.341837	2.58350	.017295
245	3	.1470	972	.341837	.43004	.731526
345	6	.4532	972	.341837	1.32570	.242675
1234	4	9.5063	324	3.336715	2.84899	.024051
1235	12	.4014	972	.341837	1.17432	.296739
1245	6	.4546	972	.341837	1.32997	.240784
1345	12	.3891	972	.341837	1.13815	.324802
2345	6	.1742	972	.341837	.50956	.801426
12345	12	.2436	972	.341837	.71257	.740216

3o. Battery Items

Longer Term Items

1-EXPERIMENT, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX, 5-MEASURE

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	2	3.08342	324	.877635	3.51333	.030938
2	1	3.43408	324	.877635	3.91289	.048764
3	2	8.90363	324	.877635	10.14503	.000053
4	1	.27075	324	.877635	.30850	.578986
5	2	11.95179	648	.341761	34.97123	.000000
12	2	2.55203	324	.877635	2.90785	.056019
13	4	2.75482	324	.877635	3.13892	.014889
23	2	2.28496	324	.877635	2.60355	.075558
14	2	.92101	324	.877635	1.04943	.351325
24	1	.07268	324	.877635	.08282	.773697
34	2	3.74201	324	.877635	4.26375	.014867
15	4	3.54776	648	.341761	10.38084	.000000
25	2	2.45657	648	.341761	7.18800	.000817
35	4	.01329	648	.341761	.03888	.997120
45	2	.00575	648	.341761	.01684	.983304
123	4	.31527	324	.877635	.35923	.837539
124	2	.53695	324	.877635	.61181	.542991
134	4	5.14414	324	.877635	5.86137	.000145
234	2	.92963	324	.877635	1.05924	.347916
125	4	2.21463	648	.341761	6.48007	.000041
135	8	.12761	648	.341761	.37338	.934736
235	4	.20091	648	.341761	.58785	.671540
145	4	.34615	648	.341761	1.01285	.399948
245	2	.00665	648	.341761	.01946	.980733
345	4	.31410	648	.341761	.91907	.452280
1234	4	1.05116	324	.877635	1.19772	.311673
1235	8	.61880	648	.341761	1.81062	.072114
1245	4	.15222	648	.341761	.44540	.775792
1345	8	.18427	648	.341761	.53918	.827255
2345	4	.92918	648	.341761	2.71880	.028887
12345	8	.53047	648	.341761	1.55217	.135984

Percentage of Trials

1- EXPERIMENT, 2-RESPONSEMODE, 3- SEQUENCE, 4-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	2	6.016687	324	.750418	8.01778	.000399
2	1	.003869	324	.750418	.00516	.942803
3	2	8.804175	324	.750418	11.73236	.000012
4	1	.694744	324	.750418	.92581	.336672
12	2	.280006	324	.750418	.37313	.688869
13	4	3.701037	324	.750418	4.93197	.000715
23	2	1.358610	324	.750418	1.81047	.165228
14	2	2.564544	324	.750418	3.41749	.033982
24	1	.220636	324	.750418	.29402	.588031
34	2	2.120845	324	.750418	2.82622	.060698
123	4	.411123	324	.750418	.54786	.700717
124	2	.463122	324	.750418	.61715	.540111
134	4	3.033301	324	.750418	4.04215	.003261
234	2	.158591	324	.750418	.21134	.809613
1234	4	.330567	324	.750418	.44051	.779303

How Good ?

1- EXPERIMENT, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	2	30567.04	324	275.4463	110.9728	0.000000
2	1	60.84	324	275.4463	.2209	.638676
3	2	2.37	324	275.4463	.0086	.991435
4	1	368.04	324	275.4463	1.3362	.248561
12	2	153.50	324	275.4463	.5573	.573309
13	4	1446.75	324	275.4463	5.2524	.000413
23	2	320.09	324	275.4463	1.1621	.314140
14	2	639.67	324	275.4463	2.3223	.099678
24	1	.90	324	275.4463	.0033	.954452
34	2	279.75	324	275.4463	1.0156	.363323
123	4	664.31	324	275.4463	2.4117	.049025
124	2	759.86	324	275.4463	2.7586	.064867
134	4	976.42	324	275.4463	3.5448	.007553
234	2	614.06	324	275.4463	2.2293	.109249
1234	4	357.53	324	275.4463	1.2980	.270618

7.4. Appendix 4: Statistical Analyses for Experiment 4

ANOVA tables for analysis conducted in Chapter 3.

Experiment 4 (Coins)

4a. Baseline Responses

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	6720.033	108	151.9648	44.22098	.000000
2	2	36.858	108	151.9648	.24255	.785055
3	1	14.700	108	151.9648	.09673	.756386
12	2	82.358	108	151.9648	.54196	.583183
13	1	.033	108	151.9648	.00022	.988211
23	2	74.725	108	151.9648	.49173	.612933
123	2	31.558	108	151.9648	.20767	.812800

4b. Illusion of Control: End Of Sequence Measures

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX, 4-RFACTOR1

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	781.20	108	231.5588	3.37368	.068996
2	2	300.91	108	231.5588	1.29951	.276895
3	1	9.20	108	231.5588	.03975	.842348
4	1	16023.00	108	164.2255	97.56712	.000000
12	2	799.50	108	231.5588	3.45270	.035196
13	1	543.00	108	231.5588	2.34499	.128610
23	2	281.15	108	231.5588	1.21418	.300974
14	1	624.04	108	164.2255	3.79988	.053849
24	2	423.58	108	164.2255	2.57925	.080496
34	1	47.70	108	164.2255	.29048	.591023
123	2	45.88	108	231.5588	.19813	.820559
124	2	194.34	108	164.2255	1.18336	.310188
134	1	82.84	108	164.2255	.50441	.479098
234	2	494.65	108	164.2255	3.01204	.053342
1234	2	35.21	108	164.2255	.21442	.807356

4c. Step by Step Analysis

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX, 4-PERIOD

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	36533.76	108	414.8158	88.07225	.000000
2	2	813.81	108	414.8158	1.96185	.145576
3	1	4.10	108	414.8158	.00989	.920968
4	3	55.88	324	39.0410	1.43136	.233509
12	2	20.20	108	414.8158	.04870	.952487
13	1	364.23	108	414.8158	.87804	.350829
23	2	324.77	108	414.8158	.78293	.459644
14	3	18.78	324	39.0410	.48105	.695684
24	6	129.86	324	39.0410	3.32632	.003417
34	3	44.84	324	39.0410	1.14848	.329619
123	2	298.25	108	414.8158	.71900	.489556
124	6	59.03	324	39.0410	1.51193	.173471
134	3	30.90	324	39.0410	.79150	.499343
234	6	71.72	324	39.0410	1.83694	.091360
1234	6	54.63	324	39.0410	1.39932	.214243

4d. Battery Items

Longer Term Items

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX, 4-MEASURE

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	141.878	108	337.8018	.42000	.518311
2	2	1687.869	108	337.8018	4.99663	.008406
3	1	1408.178	108	337.8018	4.16865	.043616
4	2	895.953	216	62.9787	14.22628	.000002
12	2	1375.103	108	337.8018	4.07074	.019750
13	1	60.844	108	337.8018	.18012	.672115
23	2	355.919	108	337.8018	1.05363	.352225
14	2	39.219	216	62.9787	.62274	.537432
24	4	22.686	216	62.9787	.36022	.836737
34	2	383.436	216	62.9787	6.08835	.002677
123	2	73.219	108	337.8018	.21675	.805479
124	4	101.444	216	62.9787	1.61077	.172634
134	2	363.436	216	62.9787	5.77078	.003618
234	4	57.478	216	62.9787	.91265	.457383
1234	4	29.186	216	62.9787	.46343	.762530

Percentage of Trials

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	.020	108	113.7473	.00018	.989402
2	2	1781.486	108	113.7473	15.66179	.000001
3	1	10.979	108	113.7473	.09652	.756645
12	2	384.954	108	113.7473	3.38430	.037535
13	1	24.945	108	113.7473	.21930	.640515
23	2	76.095	108	113.7473	.66898	.514341
123	2	188.048	108	113.7473	1.65320	.196243

How Good ?

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	67.500	108	195.0926	.345990	.557620
2	2	1577.500	108	195.0926	8.085904	.000534
3	1	440.833	108	195.0926	2.259611	.135706
12	2	52.500	108	195.0926	.269103	.764575
13	1	187.500	108	195.0926	.961082	.329105
23	2	385.833	108	195.0926	1.977693	.143368
123	2	7.500	108	195.0926	.038443	.962299

4e. Extra Loss Sequence

1-RESPONSEMODE, 2-SEQUENCE, 3-SEX, 4-RFACTOR1

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	16283.48	108	251.4560	64.75677	.000000
2	2	11.25	108	251.4560	.04474	.956264
3	1	411.80	108	251.4560	1.63766	.203390
4	1	1076.85	108	45.9878	23.41610	.000004
12	2	7.19	108	251.4560	.02858	.971833
13	1	415.08	108	251.4560	1.65071	.201612
23	2	101.58	108	251.4560	.40398	.668660
14	1	1.41	108	45.9878	.03059	.861482
24	2	17.96	108	45.9878	.39052	.677658
34	1	250.87	108	45.9878	5.45515	.021358
123	2	720.12	108	251.4560	2.86380	.061394
124	2	39.15	108	45.9878	.85127	.429718
134	1	8.30	108	45.9878	.18043	.671851
234	2	120.81	108	45.9878	2.62701	.076910
1234	2	162.36	108	45.9878	3.53048	.032717

Combined Analysis for Chapter 3.

Experiment 4 (Coins) and Experiment 1 (Turtle 2).

4f. Illusion of Control: End of Sequence Measures

1-TYPE, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX, 5-MEASURE

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	653.33	216	384.3792	1.69971	.193714
2	1	1512.30	216	384.3792	3.93440	.048575
3	2	201.61	216	384.3792	.52452	.592591
4	1	5.21	216	384.3792	.01355	.907440
5	1	16380.03	216	221.2245	74.04257	.000000
12	1	.41	216	384.3792	.00106	.974029
13	2	129.25	216	384.3792	.33626	.714809
23	2	1405.39	216	384.3792	3.65627	.027440
14	1	43.20	216	384.3792	.11239	.737766
24	1	30.00	216	384.3792	.07805	.780228
34	2	650.40	216	384.3792	1.69208	.186567
15	1	2604.01	216	221.2245	11.77088	.000721
25	1	221.41	216	221.2245	1.00083	.318229
35	2	.46	216	221.2245	.00210	.997902
45	1	22.53	216	221.2245	.10186	.749920
123	2	7.79	216	384.3792	.02027	.979940
124	1	755.01	216	384.3792	1.96423	.162497
134	2	43.28	216	384.3792	.11260	.893560
234	2	303.01	216	384.3792	.78830	.455920
125	1	418.13	216	221.2245	1.89009	.170617
135	2	851.08	216	221.2245	3.84712	.022818
235	2	112.98	216	221.2245	.51069	.600804
145	1	25.21	216	221.2245	.11395	.736020
245	1	49.41	216	221.2245	.22334	.636984
345	2	188.13	216	221.2245	.85039	.428674
1234	2	157.58	216	384.3792	.40995	.664197
1235	2	106.76	216	221.2245	.48261	.617836
1245	1	34.13	216	221.2245	.15429	.694854
1345	2	761.41	216	221.2245	3.44182	.033772
2345	2	16.21	216	221.2245	.07329	.929350
12345	2	28.78	216	221.2245	.13008	.878093

4g. Step by Step Analysis

1-TYPE, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX, 5-PERIOD

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	1591.35	216	800.2333	1.98861	.159925
2	1	46530.39	216	800.2333	58.14603	.000000
3	2	2796.93	216	800.2333	3.49514	.032072
4	1	319.70	216	800.2333	.39951	.528009
5	3	31.65	648	69.1027	.45800	.711731
12	1	2981.27	216	800.2333	3.72550	.054897
13	2	324.92	216	800.2333	.40603	.666800
23	2	109.26	216	800.2333	.13653	.872455
14	1	225.48	216	800.2333	.28176	.596093
24	1	73.84	216	800.2333	.09228	.761595
34	2	114.67	216	800.2333	.14330	.866577
15	3	46.79	648	69.1027	.67704	.566305
25	3	18.25	648	69.1027	.26416	.851233
35	6	335.13	648	69.1027	4.84977	.000074
45	3	126.29	648	69.1027	1.82754	.140822
123	2	256.01	216	800.2333	.31992	.726553
124	1	338.44	216	800.2333	.42292	.516173
134	2	1084.04	216	800.2333	1.35466	.260219
234	2	575.05	216	800.2333	.71861	.488593
125	3	13.97	648	69.1027	.20211	.894943
135	6	66.42	648	69.1027	.96111	.450739
235	6	132.76	648	69.1027	1.92121	.075128
145	3	34.38	648	69.1027	.49753	.684115
245	3	45.31	648	69.1027	.65569	.579578
345	6	35.40	648	69.1027	.51232	.799233
1234	2	.85	216	800.2333	.00106	.998941
1235	6	101.03	648	69.1027	1.46207	.188713
1245	3	54.46	648	69.1027	.78803	.500821
1345	6	92.28	648	69.1027	1.33537	.239014
2345	6	35.58	648	69.1027	.51485	.797312
12345	6	148.05	648	69.1027	2.14253	.046863

4h. Battery Items

Longer Term Items

1-TYPE, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX, 5-MEASURE

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	2868.012	216	345.5927	8.29882	.004367
2	1	391.612	216	345.5927	1.13316	.288290
3	2	745.893	216	345.5927	2.15830	.118006
4	1	1203.835	216	345.5927	3.48339	.063343
5	2	3845.968	432	118.5464	32.44271	.000000
12	1	8.668	216	345.5927	.02508	.874312
13	2	1059.387	216	345.5927	3.06542	.048668
23	2	1607.113	216	345.5927	4.65031	.010536
14	1	337.568	216	345.5927	.97678	.324101
24	1	49.612	216	345.5927	.14356	.705142
34	2	40.401	216	345.5927	.11690	.889726
15	2	462.038	432	118.5464	3.89752	.021010
25	2	31.929	432	118.5464	.26934	.764013
35	4	55.974	432	118.5464	.47217	.756179
45	2	379.935	432	118.5464	3.20494	.041527
123	2	192.735	216	345.5927	.55769	.573350
124	1	15.901	216	345.5927	.04601	.830356
134	2	1046.551	216	345.5927	3.02828	.050459
234	2	123.754	216	345.5927	.35809	.699423
125	2	206.110	432	118.5464	1.73864	.176987
135	4	116.181	432	118.5464	.98005	.418111
235	4	99.748	432	118.5464	.84142	.499419
145	2	99.360	432	118.5464	.83815	.433212
245	2	101.129	432	118.5464	.85308	.426819
345	4	94.670	432	118.5464	.79859	.526553
1234	2	250.343	216	345.5927	.72439	.485795
1235	4	57.008	432	118.5464	.48089	.749786
1245	2	370.476	432	118.5464	3.12516	.044925
1345	4	27.824	432	118.5464	.23471	.918754
2345	4	41.302	432	118.5464	.34840	.845135
12345	4	68.137	432	118.5464	.57477	.681082

Percentage of Trials

1-TYPE, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	4132.625	216	201.7259	20.48634	.000010
2	1	115.870	216	201.7259	.57440	.449344
3	2	1673.624	216	201.7259	8.29653	.000338
4	1	.284	216	201.7259	.00141	.970114
12	1	111.588	216	201.7259	.55316	.457836
13	2	587.171	216	201.7259	2.91074	.056574
23	2	407.940	216	201.7259	2.02225	.134856
14	1	27.234	216	201.7259	.13501	.713656
24	1	145.980	216	201.7259	.72366	.395889
34	2	12.050	216	201.7259	.05974	.942029
123	2	177.454	216	201.7259	.87968	.416398
124	1	25.190	216	201.7259	.12487	.724155
134	2	205.198	216	201.7259	1.01721	.363328
234	2	218.363	216	201.7259	1.08247	.340587
1234	2	421.761	216	201.7259	2.09076	.126087

How Good ?

1-TYPE, 2-RESPONSEMODE, 3-SEQUENCE, 4-SEX

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	3689.504	216	237.9958	15.50239	.000111
2	1	165.004	216	237.9958	.69331	.405962
3	2	68.629	216	237.9958	.28836	.749778
4	1	1842.604	216	237.9958	7.74217	.005872
12	1	1.504	216	237.9958	.00632	.936709
13	2	3013.379	216	237.9958	12.66148	.000006
23	2	22.804	216	237.9958	.09582	.908668
14	1	175.104	216	237.9958	.73574	.391978
24	1	1012.704	216	237.9958	4.25513	.040328
34	2	545.404	216	237.9958	2.29165	.103552
123	2	207.554	216	237.9958	.87209	.419543
124	1	155.204	216	237.9958	.65213	.420241
134	2	588.654	216	237.9958	2.47338	.086684
234	2	366.979	216	237.9958	1.54196	.216308
1234	2	278.229	216	237.9958	1.16905	.312619

7.5. Appendix 5

5a. Rational-Experiential Inventory, (Pacini and Epstein, 1999)

40-item version.

Rational Ability Subscale

I am not that good at figuring out complicated problems

I am not very good at solving problems that require careful logical analysis

I am not a very analytical thinker

Reasoning things out carefully is not one fo my strong points

I don't reason well under pressure

I am much better at figuring things out logically than most people

I have a logical mind

I have no problem in thinking things through carefully

Using logic usually works well for me figuring out problems in my life

I usually have clear, explainable reasons for my decisions

Rational Engagement Subscale

I try to avoid situations that require thinking in depth about something

I enjoy intellectual challenges

I don't like to have to do a lot of thinking

I enjoy solving problems that require hard thinking

Thinking is not my idea of an enjoyable activity

I prefere complex to simple problems

Thinking hard and for a long time about something gives me little satisfaction

I enjoy thinking in abstract terms

Knowing the answer without having to understand the reasoning behind it is good enough for me

Learning news ways to think would be very appealing to me

Experiential Ability Subscale

I don't have a very good sense of intuition

Using my "gut-feelings" usually works well for me in figuring out problems in my life

I believe in trusting my hunches

I trust my initial feelings about people

When it comes to trusting people, I can usually rely on my gut feelings

If I were to rely on my gut feelings, I would often make mistakes

I hardly ever go wrong when I listen to my deepest "gut-feelings" to find an answer

My snap judgements are probably not as good as most people's

I can usually feel when a person is right or wrong, even if I cant explain how I know

I suspect my hunches are inaccurate as often as they are accurate

Experiential Engagement Subscale

I like to rely on my intuitive impressions

Intuition can be a very useful way to solve problems

I often go by my instincts when deciding on a course of action

I don't like situations in which I have to rely on intuition

I think there are times when one should rely on one's intuition

I think it is foolish to make important decisions based on feelings

I don't think it's a good idea to rely on one's intuition for important decisions

I generally don't depend on my feelings to help me make decisions

I would not want to depend on anyone who described himself or herself as intuitive

I tend to use my heart as a guide for my actions

5b. Complete Questionnaire for Study 1.

1. Do you gamble? YES NO

2. If NO, have you ever gambled NO YES

<u>Please answer the following questions about gambling over the last 12 months.</u>

3. Which of the following activities have you wagered money on? (please circle)

Horse/Dog racing (Off course)	The National Lottery	Bingo
Horse/Dog racing (On course)	Scratch Cards	Pools
Gaming machines (fruit machines etc.)	Casino games	Other:...........
Sports betting (Motor sports, Football etc.)		

4. Which is the form of gambling you take part in most often? ....

5. Over the last 12 months, on average, how often have you gambled? (please circle)

Every day	Less than every day, but more than once a week.	Less than once a week, but more than once a month.
Less than once a month, but more than once every six months	Less often than once every six months	

6. How long is your typical gambling episode? (please circle)

0-10 mins   11-30 mins   30-60 mins   1-2 hours   more than 2 hours

7. On average, how much do you spend per session? (please circle)

£1-£5   £6-£10   £11-£25   £26-£50   £51-£100   over £100

8. Do you see your gambling activities as ever having lead to a problem? NO YES

9. Have you sought or thought of seeking help for your gambling behaviour? YES NO

10. Was there any time when the amount you were gambling made you nervous? YES NO

11. After winning, do you feel you ought to gamble more to increase your winnings? NO YES

12. Do you gamble until all your spare cash has gone? YES NO

13. After losing, do you spend more money to try to make up for your losses? NO YES

14. Do you ever get into debt as a result of your gambling? NO YES

15. Have you borrowed money to gamble or pay gambling debts? YES NO

16. Do you find you gamble for longer than you intended? NO YES

17. Do you need to gamble with more and more money to achieve the desired excitement? YES NO

18. Do you ever have unsuccessful attempts to control, cut back, or stop gambling? NO YES

19. When you gamble, do you go back another day to win back the money you lost? NO YES

20. Do you ever gamble more money than you intended to? YES NO

21. Have you felt guilty about the way you gamble or about what happens when you gamble? YES NO

22. Have you hidden betting slips, lottery tickets, gambling money, or other signs of gambling form your spouse, children, or other important people in you life? NO YES

<u>Please respond to the following items by circling the option that best describes the way you feel.</u>
(Please only circle one option)

23. Gambling makes me feel really alive.

Strongly Agree Agree Disagree Strongly Disagree

24. Sometimes I forget about the time when I am gambling.

Strongly Disagree Disagree Agree Strongly Agree

25. If I were feeling down, gambling would probably pick me up.

Strongly Agree Agree Disagree Strongly Disagree

26. I like gambling because it helps me to forget my everyday problems.

Strongly Disagree Disagree Agree Strongly Agree

27. If I have not won any bets for a while, I am probably due for a big win.

Strongly Disagree Disagree Agree Strongly Agree

28. I know when I'm on a streak.

Strongly Agree　　Agree　　Disagree　　Strongly Disagree

29. It is important to feel confident when I'm gambling.

Strongly Disagree　　Disagree　　Agree　　Strongly Agree

30. No matter what the game is, there are betting strategies that can help you to win.

Strongly Disagree　　Disagree　　Agree　　Strongly Agree

31. I have carried a lucky charm when I gambled.

Strongly Agree　　Agree　　Disagree　　Strongly Disagree

32. I must be familiar with a gambling game if I am going to win.

Strongly Agree　　Agree　　Disagree　　Strongly Disagree

33. To be successful at gambling, I must be able to identify streaks.

Strongly Disagree　　Disagree　　Agree　　Strongly Agree

Thank you for your co-operation.

5c. Measurement Model for Study 1, Chapter 4.

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    PROGRAM CONTROL INFORMATION

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      V3 =  + *F1  + E3;
      V4 =  + *F2  + E4;
      V5 =  + *F2  + E5;
      V6 =  + *F2  + E6;
      V7 =  + *F2  + E7;
      V8 =  + *F2  + E8;
      V9 =  + *F2  + E9;
      V10 =  + *F2  + E10;
      V11 =  + *F3  + E11;
      V12 =  + *F3 + *F1 + E12;
      V13 =  + *F3  + E13;
      V14 =  + *F3  + E14;
      /VARIANCES
      F1 = 1.00;
      F2 = 1.00;
      F3 = 1.00;
      E1 = *;
      E2 = *;
      E3 = *;
      E4 = *;
      E5 = *;
      E6 = *;
      E7 = *;
      E8 = *;
      E9 = *;
      E10 = *;
      E11 = *;
      E12 = *;
      E13 = *;
      E14 = *;
      /COVARIANCES
      F1,F2=*;
      F1,F3=*;
      F2,F3=*;
      /LMTEST
       PROCESS=SIMULTANEOUS;
       SET=PVV,PFV,PFF,PDD,GVV,GVF,GFV,GFF,BVF,BFF;
      /END

       52 RECORDS OF INPUT MODEL FILE WERE READ


    DATA IS READ FROM D:\ANT\ALLSUBS.ESS
    THERE ARE  14 VARIABLES AND   192 CASES
    IT IS A RAW DATA ESS FILE
```

SAMPLE STATISTICS BASED ON COMPLETE CASES

UNIVARIATE STATISTICS

VARIABLE	LOC1	LOC2	LOC3	F27	F28
MEAN	0.1458	0.2031	0.5313	1.5312	1.5729
SKEWNESS (G1)	5.1572	2.9758	2.6856	0.7913	0.7199
KURTOSIS (G2)	27.3362	9.5437	7.2697	-0.4110	-0.5492
STANDARD DEV.	0.6305	0.5272	1.1618	0.6383	0.6591

VARIABLE	F29	F30	F31	F32	F33
MEAN	1.9219	1.7031	1.4583	2.0365	1.7396
SKEWNESS (G1)	0.3965	0.7679	1.0573	0.4490	0.7510
KURTOSIS (G2)	-0.9678	-0.4528	0.8734	-0.9190	-0.2334
STANDARD DEV.	0.8617	0.7995	0.5952	0.9674	0.7893

VARIABLE	Q23	Q24	Q25	Q26
MEAN	1.6875	1.6563	1.4375	1.4115
SKEWNESS (G1)	0.3731	0.9463	1.0692	0.8448
KURTOSIS (G2)	-0.6913	0.0897	0.0986	-0.3832
STANDARD DEV.	0.6360	0.7837	0.6108	0.5439

MULTIVARIATE KURTOSIS

MARDIA'S COEFFICIENT (G2,P) = 130.1328
NORMALIZED ESTIMATE = 42.5959

ELLIPTICAL THEORY KURTOSIS ESTIMATES

MARDIA-BASED KAPPA = 0.5809 MEAN SCALED UNIVARIATE KURTOSIS = 0.9668

MARDIA-BASED KAPPA IS USED IN COMPUTATION. KAPPA= 0.5809

CASE NUMBERS WITH LARGEST CONTRIBUTION TO NORMALIZED MULTIVARIATE KURTOSIS:

CASE NUMBER	88	92	115	121	136
ESTIMATE	697.9184	697.9184	1331.0284	927.1008	717.7889

COVARIANCE MATRIX TO BE ANALYZED: 14 VARIABLES (SELECTED FROM 14 VARIABLES)
BASED ON 192 CASES.

		LOC1 V 1	LOC2 V 2	LOC3 V 3	F27 V 4	F28 V 5
LOC1	V 1	0.397				
LOC2	V 2	0.101	0.278			
LOC3	V 3	0.262	0.410	1.350		
F27	V 4	0.022	0.122	0.282	0.407	
F28	V 5	0.063	0.129	0.338	0.307	0.434
F29	V 6	0.001	0.126	0.319	0.324	0.354
F30	V 7	0.064	0.129	0.337	0.221	0.328
F31	V 8	-0.010	0.037	0.085	0.132	0.150
F32	V 9	0.068	0.165	0.389	0.274	0.340
F33	V 10	0.064	0.142	0.380	0.259	0.323
Q23	V 11	-0.022	0.100	0.230	0.193	0.196
Q24	V 12	0.071	0.170	0.503	0.267	0.318
Q25	V 13	-0.007	0.083	0.274	0.206	0.193
Q26	V 14	-0.008	0.068	0.220	0.231	0.182

		F29 V 6	F30 V 7	F31 V 8	F32 V 9	F33 V 10
F29	V 6	0.743				
F30	V 7	0.369	0.639			
F31	V 8	0.235	0.147	0.354		
F32	V 9	0.485	0.451	0.203	0.936	
F33	V 10	0.377	0.435	0.162	0.486	0.623
Q23	V 11	0.300	0.216	0.097	0.216	0.190
Q24	V 12	0.329	0.295	0.111	0.327	0.271
Q25	V 13	0.239	0.157	0.170	0.209	0.183
Q26	V 14	0.231	0.154	0.140	0.189	0.171

		Q23 V 11	Q24 V 12	Q25 V 13	Q26 V 14
Q23	V 11	0.404			
Q24	V 12	0.264	0.614		
Q25	V 13	0.205	0.214	0.373	
Q26	V 14	0.197	0.226	0.233	0.296

BENTLER-WEEKS STRUCTURAL REPRESENTATION:

NUMBER OF DEPENDENT VARIABLES = 14
DEPENDENT V'S : 1 2 3 4 5 6 7 8 9 10
DEPENDENT V'S : 11 12 13 14

NUMBER OF INDEPENDENT VARIABLES = 17
INDEPENDENT F'S : 1 2 3
INDEPENDENT E'S : 1 2 3 4 5 6 7 8 9 10
INDEPENDENT E'S : 11 12 13 14

NUMBER OF FREE PARAMETERS = 32
NUMBER OF FIXED NONZERO PARAMETERS = 17

3RD STAGE OF COMPUTATION REQUIRED 26236 WORDS OF MEMORY.
PROGRAM ALLOCATED 2500000 WORDS

DETERMINANT OF INPUT MATRIX IS 0.30445E-07

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

CASE CONTRIBUTION TO PARAMETER VARIANCES (IN DESCENDING ORDER)

CASE	121=	0.103	13.55%	CASE	33=	0.061	8.03%
CASE	88=	0.043	5.61%	CASE	92=	0.043	5.61%
CASE	115=	0.039	5.07%	CASE	60=	0.038	4.95%
CASE	53=	0.031	4.10%	CASE	29=	0.027	3.52%
CASE	117=	0.023	3.07%	CASE	11=	0.021	2.78%
CASE	65=	0.020	2.66%	CASE	183=	0.019	2.50%
CASE	70=	0.016	2.05%	CASE	120=	0.015	2.03%
CASE	136=	0.015	2.02%	CASE	66=	0.012	1.59%
CASE	96=	0.011	1.44%	CASE	54=	0.010	1.34%
CASE	95=	0.009	1.12%	CASE	34=	0.007	0.98%
CASE	73=	0.007	0.93%	CASE	112=	0.006	0.84%
CASE	101=	0.006	0.82%	CASE	41=	0.005	0.67%
CASE	93=	0.005	0.63%	CASE	90=	0.004	0.56%
CASE	50=	0.004	0.55%	CASE	1=	0.004	0.55%
CASE	13=	0.004	0.50%	CASE	3=	0.003	0.45%
CASE	6=	0.003	0.44%	CASE	51=	0.003	0.43%
CASE	26=	0.003	0.42%	CASE	16=	0.003	0.42%
CASE	111=	0.003	0.41%	CASE	119=	0.003	0.34%
CASE	158=	0.003	0.34%	CASE	12=	0.002	0.33%
CASE	125=	0.002	0.32%	CASE	87=	0.002	0.32%
CASE	169=	0.002	0.31%	CASE	86=	0.002	0.30%
CASE	154=	0.002	0.30%	CASE	58=	0.002	0.29%
CASE	107=	0.002	0.29%	CASE	178=	0.002	0.29%
CASE	62=	0.002	0.29%	CASE	83=	0.002	0.28%
CASE	27=	0.002	0.28%	CASE	72=	0.002	0.27%
CASE	135=	0.002	0.27%	CASE	190=	0.002	0.26%
CASE	76=	0.002	0.26%	CASE	191=	0.002	0.25%
CASE	123=	0.002	0.25%	CASE	48=	0.002	0.24%
CASE	182=	0.002	0.24%	CASE	4=	0.002	0.23%
CASE	118=	0.002	0.22%	CASE	104=	0.002	0.22%
CASE	100=	0.002	0.21%	CASE	148=	0.002	0.21%
CASE	152=	0.002	0.21%	CASE	186=	0.002	0.21%
CASE	46=	0.002	0.20%	CASE	155=	0.002	0.20%
CASE	192=	0.002	0.20%	CASE	42=	0.002	0.20%
CASE	124=	0.001	0.20%	CASE	131=	0.001	0.20%
CASE	40=	0.001	0.19%	CASE	68=	0.001	0.19%
CASE	145=	0.001	0.19%	CASE	187=	0.001	0.18%
CASE	110=	0.001	0.18%	CASE	106=	0.001	0.18%
CASE	75=	0.001	0.17%	CASE	45=	0.001	0.17%
CASE	5=	0.001	0.17%	CASE	109=	0.001	0.16%
CASE	94=	0.001	0.16%	CASE	81=	0.001	0.15%
CASE	79=	0.001	0.15%	CASE	67=	0.001	0.14%
CASE	122=	0.001	0.14%	CASE	189=	0.001	0.13%
CASE	132=	0.001	0.13%	CASE	64=	0.001	0.12%
CASE	103=	0.001	0.12%	CASE	89=	0.001	0.12%
CASE	85=	0.001	0.11%	CASE	80=	0.001	0.11%
CASE	25=	0.001	0.10%	CASE	129=	0.001	0.09%
CASE	157=	0.001	0.09%	CASE	74=	0.001	0.09%
CASE	71=	0.001	0.09%	CASE	78=	0.001	0.09%
CASE	56=	0.001	0.09%	CASE	69=	0.001	0.09%
CASE	105=	0.001	0.08%	CASE	44=	0.001	0.08%
CASE	8=	0.001	0.07%	CASE	128=	0.001	0.07%
CASE	127=	0.001	0.07%	CASE	28=	0.001	0.07%
CASE	36=	0.001	0.07%	CASE	49=	0.001	0.07%
CASE	22=	0.001	0.07%	CASE	7=	0.000	0.07%
CASE	57=	0.000	0.06%	CASE	184=	0.000	0.06%
CASE	17=	0.000	0.06%	CASE	162=	0.000	0.06%
CASE	160=	0.000	0.06%	CASE	10=	0.000	0.06%
CASE	116=	0.000	0.06%	CASE	9=	0.000	0.06%
CASE	133=	0.000	0.06%	CASE	175=	0.000	0.05%

PARAMETER ESTIMATES APPEAR IN ORDER,
NO SPECIAL PROBLEMS WERE ENCOUNTERED DURING OPTIMIZATION.

RESIDUAL COVARIANCE MATRIX (S-SIGMA) :

		LOC1 V 1	LOC2 V 2	LOC3 V 3	F27 V 4	F28 V 5
LOC1	V 1	0.000				
LOC2	V 2	0.008	0.000			
LOC3	V 3	0.007	0.000	0.000		
F27	V 4	-0.043	0.018	-0.003	0.000	
F28	V 5	-0.011	0.011	0.013	0.035	0.000
F29	V 6	-0.086	-0.014	-0.065	0.003	-0.013
F30	V 7	-0.012	0.006	-0.002	-0.062	0.005
F31	V 8	-0.048	-0.024	-0.084	-0.009	-0.012
F32	V 9	-0.021	0.022	-0.004	-0.055	-0.035
F33	V 10	-0.015	0.015	0.029	-0.034	-0.012
Q23	V 11	-0.072	0.021	0.010	0.024	0.002
Q24	V 12	-0.041	-0.011	0.006	0.045	0.065
Q25	V 13	-0.059	-0.001	0.043	0.028	-0.011
Q26	V 14	-0.059	-0.013	-0.003	0.058	-0.015

		F29 V 6	F30 V 7	F31 V 8	F32 V 9	F33 V 10
F29	V 6	0.000				
F30	V 7	-0.012	0.000			
F31	V 8	0.044	-0.021	0.000		
F32	V 9	0.041	0.060	0.008	0.000	
F33	V 10	-0.019	0.087	-0.012	0.081	0.000
Q23	V 11	0.071	0.014	-0.004	-0.018	-0.018
Q24	V 12	0.029	0.031	-0.021	0.020	-0.003
Q25	V 13	-0.002	-0.055	0.064	-0.037	-0.037
Q26	V 14	-0.002	-0.051	0.038	-0.049	-0.042

		Q23 V 11	Q24 V 12	Q25 V 13	Q26 V 14
Q23	V 11	0.000			
Q24	V 12	0.032	0.000		
Q25	V 13	-0.008	-0.031	0.000	
Q26	V 14	-0.009	-0.010	0.016	0.000

AVERAGE ABSOLUTE COVARIANCE RESIDUALS = 0.0240
AVERAGE OFF-DIAGONAL ABSOLUTE COVARIANCE RESIDUALS = 0.0277

STANDARDIZED RESIDUAL MATRIX:

		LOC1 V 1	LOC2 V 2	LOC3 V 3	F27 V 4	F28 V 5
LOC1	V 1	0.000				
LOC2	V 2	0.024	0.000			
LOC3	V 3	0.009	-0.001	0.000		
F27	V 4	-0.107	0.054	-0.004	0.000	
F28	V 5	-0.027	0.031	0.017	0.083	0.000
F29	V 6	-0.159	-0.031	-0.065	0.005	-0.023
F30	V 7	-0.024	0.014	-0.002	-0.121	0.010
F31	V 8	-0.128	-0.077	-0.122	-0.025	-0.030
F32	V 9	-0.035	0.044	-0.004	-0.089	-0.055
F33	V 10	-0.031	0.035	0.032	-0.067	-0.023
Q23	V 11	-0.180	0.062	0.014	0.058	0.006
Q24	V 12	-0.084	-0.026	0.007	0.090	0.125
Q25	V 13	-0.153	-0.002	0.061	0.071	-0.027
Q26	V 14	-0.171	-0.047	-0.005	0.167	-0.042

		F29 V 6	F30 V 7	F31 V 8	F32 V 9	F33 V 10
F29	V 6	0.000				
F30	V 7	-0.018	0.000			
F31	V 8	0.086	-0.044	0.000		
F32	V 9	0.049	0.078	0.014	0.000	
F33	V 10	-0.027	0.138	-0.026	0.106	0.000
Q23	V 11	0.130	0.028	-0.010	-0.029	-0.036
Q24	V 12	0.043	0.050	-0.045	0.026	-0.004
Q25	V 13	-0.005	-0.113	0.176	-0.063	-0.077
Q26	V 14	-0.003	-0.117	0.117	-0.093	-0.098

		Q23 V 11	Q24 V 12	Q25 V 13	Q26 V 14
Q23	V 11	0.000			
Q24	V 12	0.063	0.000		
Q25	V 13	-0.019	-0.064	0.000	
Q26	V 14	-0.025	-0.025	0.047	0.000

AVERAGE ABSOLUTE STANDARDIZED RESIDUALS = 0.0485
AVERAGE OFF-DIAGONAL ABSOLUTE STANDARDIZED RESIDUALS = 0.0560

LARGEST STANDARDIZED RESIDUALS:

V 11,V 1	V 13,V 8	V 14,V 1	V 14,V 4	V 6,V 1
-0.180	0.176	-0.171	0.167	-0.159
V 13,V 1	V 10,V 7	V 11,V 6	V 8,V 1	V 12,V 5
-0.153	0.138	0.130	-0.128	0.125
V 8,V 3	V 7,V 4	V 14,V 8	V 14,V 7	V 13,V 7
-0.122	-0.121	0.117	-0.117	-0.113
V 4,V 1	V 10,V 9	V 14,V 10	V 14,V 9	V 12,V 4
-0.107	0.106	-0.098	-0.093	0.090

DISTRIBUTION OF STANDARDIZED RESIDUALS

```
   -------------------------------------
   !                                   !
60-                                    -
   !                 *                 !
   !                 *                 !
   !                 *                 !
   !                 *                 !              RANGE      FREQ PERCENT
45-                  *                 -
   !                 *                 !    1   -0.5  -  --         0   0.00%
   !                 *                 !    2   -0.4  -  -0.5       0   0.00%
   !                 *                 !    3   -0.3  -  -0.4       0   0.00%
   !                 *                 !    4   -0.2  -  -0.3       0   0.00%
30-                  *  *              -    5   -0.1  -  -0.2      10   9.52%
   !                 *  *              !    6    0.0  -  -0.1      58  55.24%
   !                 *  *              !    7    0.1  -   0.0      30  28.57%
   !                 *  *              !    8    0.2  -   0.1       7   6.67%
   !                 *  *              !    9    0.3  -   0.2       0   0.00%
15-                  *  *              -    A    0.4  -   0.3       0   0.00%
   !                 *  *              !    B    0.5  -   0.4       0   0.00%
   !              *  *  *              !    C     ++  -   0.5       0   0.00%
   !              *  *  *  *           !    -------------------------------
   !              *  *  *  *           !              TOTAL       105 100.00%
   -------------------------------------
      1  2  3  4  5  6  7  8  9  A  B  C    EACH "*" REPRESENTS  3 RESIDUALS
```

GOODNESS OF FIT SUMMARY

INDEPENDENCE MODEL CHI-SQUARE = 1480.833 ON 91 DEGREES OF FREEDOM

INDEPENDENCE AIC =	1298.83295	INDEPENDENCE CAIC =	911.40087
MODEL AIC =	76.52717	MODEL CAIC =	-234.26999

CHI-SQUARE = 222.527 BASED ON 73 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS LESS THAN 0.001
THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS 236.192.

SATORRA-BENTLER SCALED CHI-SQUARE = 156.3208
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS 0.00000

BENTLER-BONETT NORMED FIT INDEX=	0.850
BENTLER-BONETT NONNORMED FIT INDEX=	0.866
COMPARATIVE FIT INDEX (CFI) =	0.892
ROBUST COMPARATIVE FIT INDEX =	0.919

ITERATIVE SUMMARY

ITERATION	PARAMETER ABS CHANGE	ALPHA	FUNCTION
1	0.307062	1.00000	2.50006
2	0.096850	1.00000	1.39587
3	0.042296	1.00000	1.17779
4	0.006874	1.00000	1.16653
5	0.003242	1.00000	1.16530
6	0.001003	1.00000	1.16510
7	0.000474	1.00000	1.16506

```
MEASUREMENT EQUATIONS WITH STANDARD ERRORS AND TEST STATISTICS
(ROBUST STATISTICS IN PARENTHESES)


LOC1   =V1   =     .241*F1    + 1.000 E1
                   .047
                  5.119
               (    .090)
               (   2.682)

LOC2   =V2   =     .386*F1    + 1.000 E2
                   .036
                 10.603
               (    .072)
               (   5.352)

LOC3   =V3   =    1.062*F1    + 1.000 E3
                   .078
                 13.704
               (    .147)
               (   7.210)

F27    =V4   =     .488*F2    + 1.000 E4
                   .040
                 12.137
               (    .033)
               (  14.676)

F28    =V5   =     .557*F2    + 1.000 E5
                   .040
                 14.101
               (    .031)
               (  18.143)

F29    =V6   =     .659*F2    + 1.000 E6
                   .054
                 12.129
               (    .046)
               (  14.327)

F30    =V7   =     .580*F2    + 1.000 E7
                   .051
                 11.257
               (    .047)
               (  12.258)

F31    =V8   =     .290*F2    + 1.000 E8
                   .042
                  6.876
               (    .041)
               (   7.147)

F32    =V9   =     .673*F2    + 1.000 E9
                   .063
                 10.650
               (    .058)
               (  11.544)

F33    =V10  =     .601*F2    + 1.000 E10
                   .050
                 12.068
               (    .045)
               (  13.441)

Q23    =V11  =     .450*F3    + 1.000 E11
                   .042
                 10.594
               (    .039)
               (  11.385)
```

```
Q24   =V12 =    .292*F1    +  .382*F3    + 1.000 E12
                 .054          .055
                5.363         6.957
              (   .091)     (   .060)
              (  3.206)     (  6.403)


Q25   =V13 =    .474*F3    + 1.000 E13
                 .039
               12.023
              (   .039)
              ( 12.056)

Q26   =V14 =    .458*F3    + 1.000 E14
                 .034
               13.496
              (   .032)
              ( 14.499)
```

VARIANCES OF INDEPENDENT VARIABLES

```
                V                            F
               ---                          ---
                       I F1   -   F1                 1.000 I
                       I                                   I
                       I                                   I
                       I                                   I
                       I                                   I
                       I                                   I
                       I F2   -   F2                 1.000 I
                       I                                   I
                       I                                   I
                       I                                   I
                       I                                   I
                       I                                   I
                       I F3   -   F3                 1.000 I
                       I                                   I
                       I                                   I
                       I                                   I
                       I                                   I
                       I                                   I
```

VARIANCES OF INDEPENDENT VARIABLES

```
                E                            D
               ---                          ---
E1  -  LOC1            .339*I                              I
                       .036 I                              I
                      9.514 I                              I
                   (   .145)I                              I
                   (  2.334)I                              I
                            I                              I
E2  -  LOC2            .129*I                              I
                       .018 I                              I
                      7.083 I                              I
                   (   .028)I                              I
                   (  4.599)I                              I
                            I                              I
E3  -  LOC3            .221*I                              I
                       .095 I                              I
                      2.326 I                              I
                   (   .105)I                              I
                   (  2.108)I                              I
                            I                              I
```

```
E4  -  F27          .169*I                I
                    .020 I                I
                   8.429 I                I
               (    .026)I                I
               (   6.487)I                I
                         I                I
E5  -  F28          .124*I                I
                    .017 I                I
                   7.380 I                I
               (    .020)I                I
               (   6.299)I                I
                         I                I
E6  -  F29          .309*I                I
                    .037 I                I
                   8.432 I                I
               (    .042)I                I
               (   7.362)I                I
                         I                I
E7  -  F30          .303*I                I
                    .035 I                I
                   8.719 I                I
               (    .040)I                I
               (   7.591)I                I
                         I                I
E8  -  F31          .270*I                I
                    .029 I                I
                   9.479 I                I
               (    .050)I                I
               (   5.420)I                I
                         I                I
E9  -  F32          .483*I                I
                    .054 I                I
                   8.880 I                I
               (    .074)I                I
               (   6.561)I                I
                         I                I
E10 -  F33          .262*I                I
                    .031 I                I
                   8.454 I                I
               (    .040)I                I
               (   6.505)I                I
                         I                I
E11 -  Q23          .202*I                I
                    .025 I                I
                   8.254 I                I
               (    .030)I                I
               (   6.676)I                I
                         I                I
E12 -  Q24          .280*I                I
                    .033 I                I
                   8.598 I                I
               (    .040)I                I
               (   6.949)I                I
                         I                I

E13 -  Q25          .149*I                I
                    .020 I                I
                   7.431 I                I
               (    .026)I                I
               (   5.743)I                I
                         I                I
E14 -  Q26          .086*I                I
                    .014 I                I
                   6.027 I                I
               (    .014)I                I
               (   6.009)I                I
                         I                I
```

```
COVARIANCES AMONG INDEPENDENT VARIABLES
---------------------------------------

                V                              F
               ---                            ---
                        I F2   -   F2                   .549*I
                        I F1   -   F1                   .062 I
                        I                              8.891 I
                        I                           (   .052)I
                        I                           ( 10.622)I
                        I                                    I
                        I F3   -   F3                   .459*I
                        I F1   -   F1                   .071 I
                        I                              6.432 I
                        I                           (   .087)I
                        I                           (  5.283)I
                        I                                    I
                        I F3   -   F3                   .772*I
                        I F2   -   F2                   .041 I
                        I                             18.733 I
                        I                           (   .052)I
                        I                           ( 14.889)I
                        I                                    I


STANDARDIZED SOLUTION:                                                     R-SQUARED


LOC1   =V1  =   .382*F1    + .924 E1                                         .146
LOC2   =V2  =   .733*F1    + .681 E2                                         .537
LOC3   =V3  =   .914*F1    + .405 E3                                         .836
F27    =V4  =   .765*F2    + .644 E4                                         .585
F28    =V5  =   .845*F2    + .535 E5                                         .714
F29    =V6  =   .764*F2    + .645 E6                                         .584
F30    =V7  =   .725*F2    + .689 E7                                         .526
F31    =V8  =   .487*F2    + .873 E8                                         .237
F32    =V9  =   .696*F2    + .718 E9                                         .484
F33    =V10 =   .762*F2    + .648 E10                                        .580
Q23    =V11 =   .707*F3    + .707 E11                                        .500
Q24    =V12 =   .373*F1    + .488*F3    + .676 E12                           .544
Q25    =V13 =   .776*F3    + .631 E13                                        .602
Q26    =V14 =   .842*F3    + .540 E14                                        .709


CORRELATIONS AMONG INDEPENDENT VARIABLES
---------------------------------------

                V                              F
               ---                            ---
                        I F2   -   F2                   .549*I
                        I F1   -   F1                        I
                        I                                    I
                        I F3   -   F3                   .459*I
                        I F1   -   F1                        I
                        I                                    I
                        I F3   -   F3                   .772*I
                        I F2   -   F2                        I
                        I                                    I

----------------------------------------------------------------------------
                     E N D   O F   M E T H O D
----------------------------------------------------------------------------
```

LAGRANGIAN MULTIPLIER TEST REQUIRES 13073 WORDS OF MEMORY.
PROGRAM ALLOCATES 2500000 WORDS.

LAGRANGE MULTIPLIER TEST (FOR ADDING PARAMETERS)

ORDERED UNIVARIATE TEST STATISTICS:

NO	CODE		PARAMETER	CHI-SQUARE	PROBABILITY	PARAMETER CHANGE
1	2	12	V4,F3	22.760	0.000	0.316
2	2	12	V1,F3	10.216	0.001	-0.175
3	2	12	V10,F3	8.811	0.003	-0.244
4	2	12	V12,F2	7.621	0.006	0.246
5	2	12	V8,F3	6.965	0.008	0.203
6	2	12	V7,F3	6.541	0.011	-0.221
7	2	12	V8,F1	5.898	0.015	-0.125
8	2	12	V9,F3	4.472	0.034	-0.228
9	2	12	V1,F2	3.499	0.061	-0.107
10	2	12	V3,F3	3.137	0.077	0.211
11	2	12	V6,F1	3.084	0.079	-0.104
12	2	12	V14,F2	3.001	0.083	-0.118
13	2	12	V6,F3	1.818	0.178	0.121
14	2	12	V14,F1	1.541	0.215	-0.049
15	2	12	V5,F1	1.429	0.232	0.049
16	2	12	V11,F2	1.354	0.245	0.088
17	2	12	V13,F2	1.219	0.270	-0.081
18	2	12	V10,F1	0.808	0.369	0.049
19	2	12	V13,F1	0.704	0.401	0.036
20	2	12	V3,F2	0.675	0.411	-0.105
21	2	12	V2,F2	0.488	0.485	0.033
22	2	12	V11,F1	0.312	0.576	0.026
23	2	12	V5,F3	0.111	0.739	-0.021
24	2	12	V9,F1	0.058	0.810	0.017
25	2	12	V4,F1	0.055	0.815	0.010
26	2	12	V7,F1	0.044	0.835	0.012
27	2	12	V2,F3	0.039	0.844	-0.009
28	2	0	F3,F3	0.000	1.000	0.000
29	2	0	F2,F2	0.000	1.000	0.000
30	2	0	F1,F1	0.000	1.000	0.000

MULTIVARIATE LAGRANGE MULTIPLIER TEST BY SIMULTANEOUS PROCESS IN STAGE 1

PARAMETER SETS (SUBMATRICES) ACTIVE AT THIS STAGE ARE:

PVV PFV PFF PDD GVV GVF GFV GFF BVF BFF

	CUMULATIVE MULTIVARIATE STATISTICS				UNIVARIATE INCREMENT	
STEP	PARAMETER	CHI-SQUARE	D.F.	PROBABILITY	CHI-SQUARE	PROBABILITY
1	V4,F3	22.760	1	0.000	22.760	0.000
2	V1,F3	32.976	2	0.000	10.216	0.001
3	V8,F3	42.266	3	0.000	9.291	0.002
4	V12,F2	49.545	4	0.000	7.278	0.007
5	V8,F1	55.883	5	0.000	6.338	0.012

5d. EQS output for F-D-LoC model.

```
EQS, A STRUCTURAL EQUATION PROGRAM              MULTIVARIATE SOFTWARE, INC.
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  PROGRAM CONTROL INFORMATION

     /TITLE
     Allsubs
     /SPECIFICATIONS
      DATA='C:\GAMBLING\ALLSUBS.ESS';
      VARIABLES= 14; CASES=  192;
      METHODS=ML, ROBUST;
      MATRIX=RAW;
     /LABELS
     V1=LOC1; V2=LOC2; V3=LOC3; V4=F27; V5=F28;
     V6=F29; V7=F30; V8=F31; V9=F32; V10=F33;
     V11=Q23; V12=Q24; V13=Q25; V14=Q26;
     /EQUATIONS
     V1 =  + F1  + E1;
     V2 =  + *F1  + E2;
     V3 =  + *F1  + E3;
     V4 =  + F2  + E4;
     V5 =  + *F2  + E5;
     V6 =  + *F2  + E6;
     V7 =  + *F2  + E7;
     V8 =  + *F2  + E8;
     V9 =  + *F2  + E9;
     V10 =  + *F2  + E10;
     V11 =  + F3  + E11;
     V12 =  + *F3 + *F1  + E12;
     V13 =  + *F3  + E13;
     V14 =  + *F3  + E14;
     F1= + *F3 + D1;
     F3=*F2 + D3;
     /VARIANCES
     F2 = *;
     E1 = *;
     E2 = *;
     E3 = *;
     E4 = *;
     E5 = *;
     E6 = *;
     E7 = *;
     E8 = *;
     E9 = *;
     E10 = *;
     E11 = *;
     E12 = *;
     E13 = *;
     E14 = *;
     /COVARIANCES
     /LMTEST
      PROCESS=SIMULTANEOUS;
      SET=PVV,PFV,PFF,PDD,GVV,GVF,GFV,GFF,BVF,BFF;
     /END

     49 RECORDS OF INPUT MODEL FILE WERE READ

  DATA IS READ FROM C:\GAMBLING\ALLSUBS.ESS
  THERE ARE  14 VARIABLES AND   192 CASES
  IT IS A RAW DATA ESS FILE
```

SAMPLE STATISTICS BASED ON COMPLETE CASES

UNIVARIATE STATISTICS

VARIABLE	LOC1	LOC2	LOC3	F27	F28
MEAN	0.1458	0.2031	0.5313	1.5312	1.5729
SKEWNESS (G1)	5.1572	2.9758	2.6856	0.7913	0.7199
KURTOSIS (G2)	27.3362	9.5437	7.2697	-0.4110	-0.5492
STANDARD DEV.	0.6305	0.5272	1.1618	0.6383	0.6591

VARIABLE	F29	F30	F31	F32	F33
MEAN	1.9219	1.7031	1.4583	2.0365	1.7396
SKEWNESS (G1)	0.3965	0.7679	1.0573	0.4490	0.7510
KURTOSIS (G2)	-0.9678	-0.4528	0.8734	-0.9190	-0.2334
STANDARD DEV.	0.8617	0.7995	0.5952	0.9674	0.7893

VARIABLE	Q23	Q24	Q25	Q26
MEAN	1.6875	1.6563	1.4375	1.4115
SKEWNESS (G1)	0.3731	0.9463	1.0692	0.8448
KURTOSIS (G2)	-0.6913	0.0897	0.0986	-0.3832
STANDARD DEV.	0.6360	0.7837	0.6108	0.5439

MULTIVARIATE KURTOSIS

MARDIA'S COEFFICIENT (G2,P) = 130.1328
NORMALIZED ESTIMATE = 42.5959

ELLIPTICAL THEORY KURTOSIS ESTIMATES

MARDIA-BASED KAPPA = 0.5809 MEAN SCALED UNIVARIATE KURTOSIS = 0.9668

MARDIA-BASED KAPPA IS USED IN COMPUTATION. KAPPA= 0.5809

CASE NUMBERS WITH LARGEST CONTRIBUTION TO NORMALIZED MULTIVARIATE KURTOSIS:

CASE NUMBER	88	92	115	121	136
ESTIMATE	697.9184	697.9184	1331.0284	927.1008	717.7889

COVARIANCE MATRIX TO BE ANALYZED: 14 VARIABLES (SELECTED FROM 14 VARIABLES)
BASED ON 192 CASES.

		LOC1 V 1	LOC2 V 2	LOC3 V 3	F27 V 4	F28 V 5
LOC1	V 1	0.397				
LOC2	V 2	0.101	0.278			
LOC3	V 3	0.262	0.410	1.350		
F27	V 4	0.022	0.122	0.282	0.407	
F28	V 5	0.063	0.129	0.338	0.307	0.434
F29	V 6	0.001	0.126	0.319	0.324	0.354
F30	V 7	0.064	0.129	0.337	0.221	0.328
F31	V 8	-0.010	0.037	0.085	0.132	0.150
F32	V 9	0.068	0.165	0.389	0.274	0.340
F33	V 10	0.064	0.142	0.380	0.259	0.323
Q23	V 11	-0.022	0.100	0.230	0.193	0.196
Q24	V 12	0.071	0.170	0.503	0.267	0.318
Q25	V 13	-0.007	0.083	0.274	0.206	0.193
Q26	V 14	-0.008	0.068	0.220	0.231	0.182

		F29 V 6	F30 V 7	F31 V 8	F32 V 9	F33 V 10
F29	V 6	0.743				
F30	V 7	0.369	0.639			
F31	V 8	0.235	0.147	0.354		
F32	V 9	0.485	0.451	0.203	0.936	
F33	V 10	0.377	0.435	0.162	0.486	0.623
Q23	V 11	0.300	0.216	0.097	0.216	0.190
Q24	V 12	0.329	0.295	0.111	0.327	0.271
Q25	V 13	0.239	0.157	0.170	0.209	0.183
Q26	V 14	0.231	0.154	0.140	0.189	0.171

		Q23 V 11	Q24 V 12	Q25 V 13	Q26 V 14
Q23	V 11	0.404			
Q24	V 12	0.264	0.614		
Q25	V 13	0.205	0.214	0.373	
Q26	V 14	0.197	0.226	0.233	0.296

BENTLER-WEEKS STRUCTURAL REPRESENTATION:

NUMBER OF DEPENDENT VARIABLES = 16
DEPENDENT V'S : 1 2 3 4 5 6 7 8 9 10
DEPENDENT V'S : 11 12 13 14
DEPENDENT F'S : 1 3

NUMBER OF INDEPENDENT VARIABLES = 17
INDEPENDENT F'S : 2
INDEPENDENT E'S : 1 2 3 4 5 6 7 8 9 10
INDEPENDENT E'S : 11 12 13 14
INDEPENDENT D'S : 1 3

NUMBER OF FREE PARAMETERS = 31
NUMBER OF FIXED NONZERO PARAMETERS = 19

3RD STAGE OF COMPUTATION REQUIRED 25814 WORDS OF MEMORY.
PROGRAM ALLOCATED 2500000 WORDS

DETERMINANT OF INPUT MATRIX IS 0.30445E-07

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

CASE CONTRIBUTION TO PARAMETER VARIANCES (IN DESCENDING ORDER)

CASE	121=	11.215	53.40%	CASE	53=	1.279	6.09%
CASE	183=	0.935	4.45%	CASE	29=	0.908	4.32%
CASE	120=	0.803	3.82%	CASE	65=	0.686	3.27%
CASE	92=	0.554	2.64%	CASE	88=	0.554	2.64%
CASE	33=	0.542	2.58%	CASE	95=	0.496	2.36%
CASE	66=	0.444	2.12%	CASE	117=	0.402	1.91%
CASE	34=	0.218	1.04%	CASE	11=	0.182	0.86%
CASE	60=	0.172	0.82%	CASE	93=	0.133	0.64%
CASE	90=	0.126	0.60%	CASE	70=	0.094	0.45%
CASE	41=	0.083	0.40%	CASE	115=	0.073	0.35%
CASE	3=	0.069	0.33%	CASE	68=	0.056	0.27%
CASE	118=	0.053	0.25%	CASE	42=	0.050	0.24%
CASE	109=	0.043	0.20%	CASE	105=	0.039	0.18%
CASE	136=	0.036	0.17%	CASE	13=	0.035	0.17%
CASE	112=	0.029	0.14%	CASE	76=	0.026	0.12%
CASE	191=	0.021	0.10%	CASE	148=	0.020	0.09%
CASE	96=	0.019	0.09%	CASE	50=	0.019	0.09%
CASE	1=	0.017	0.08%	CASE	54=	0.017	0.08%
CASE	101=	0.015	0.07%	CASE	87=	0.014	0.07%
CASE	4=	0.014	0.07%	CASE	131=	0.014	0.07%
CASE	73=	0.013	0.06%	CASE	44=	0.013	0.06%
CASE	46=	0.013	0.06%	CASE	104=	0.013	0.06%
CASE	83=	0.012	0.06%	CASE	86=	0.012	0.06%
CASE	178=	0.012	0.06%	CASE	119=	0.012	0.06%
CASE	27=	0.011	0.05%	CASE	152=	0.011	0.05%
CASE	111=	0.011	0.05%	CASE	190=	0.010	0.05%
CASE	81=	0.010	0.05%	CASE	100=	0.010	0.05%
CASE	135=	0.010	0.05%	CASE	58=	0.010	0.05%
CASE	72=	0.009	0.04%	CASE	62=	0.009	0.04%
CASE	155=	0.009	0.04%	CASE	79=	0.008	0.04%
CASE	80=	0.008	0.04%	CASE	125=	0.008	0.04%
CASE	124=	0.008	0.04%	CASE	186=	0.008	0.04%
CASE	16=	0.007	0.03%	CASE	103=	0.007	0.03%
CASE	6=	0.007	0.03%	CASE	127=	0.007	0.03%
CASE	110=	0.006	0.03%	CASE	106=	0.006	0.03%
CASE	107=	0.006	0.03%	CASE	169=	0.006	0.03%
CASE	123=	0.006	0.03%	CASE	26=	0.006	0.03%
CASE	158=	0.006	0.03%	CASE	22=	0.006	0.03%
CASE	48=	0.005	0.03%	CASE	132=	0.004	0.02%
CASE	182=	0.004	0.02%	CASE	56=	0.004	0.02%
CASE	94=	0.004	0.02%	CASE	64=	0.004	0.02%
CASE	51=	0.004	0.02%	CASE	45=	0.004	0.02%
CASE	192=	0.004	0.02%	CASE	12=	0.004	0.02%
CASE	5=	0.003	0.02%	CASE	128=	0.003	0.01%
CASE	154=	0.003	0.01%	CASE	17=	0.003	0.01%
CASE	162=	0.003	0.01%	CASE	98=	0.003	0.01%
CASE	99=	0.003	0.01%	CASE	35=	0.003	0.01%
CASE	14=	0.003	0.01%	CASE	75=	0.003	0.01%
CASE	67=	0.003	0.01%	CASE	126=	0.003	0.01%
CASE	89=	0.003	0.01%	CASE	2=	0.002	0.01%
CASE	85=	0.002	0.01%	CASE	40=	0.002	0.01%
CASE	25=	0.002	0.01%	CASE	174=	0.002	0.01%
CASE	102=	0.002	0.01%	CASE	145=	0.002	0.01%
CASE	84=	0.002	0.01%	CASE	8=	0.002	0.01%
CASE	122=	0.002	0.01%	CASE	187=	0.002	0.01%
CASE	63=	0.002	0.01%	CASE	133=	0.002	0.01%
CASE	9=	0.002	0.01%	CASE	116=	0.002	0.01%
CASE	47=	0.001	0.01%	CASE	189=	0.001	0.01%
CASE	156=	0.001	0.01%	CASE	91=	0.001	0.01%
CASE	184=	0.001	0.01%	CASE	129=	0.001	0.01%

PARAMETER ESTIMATES APPEAR IN ORDER,
NO SPECIAL PROBLEMS WERE ENCOUNTERED DURING OPTIMIZATION.

RESIDUAL COVARIANCE MATRIX (S-SIGMA) :

		LOC1 V 1	LOC2 V 2	LOC3 V 3	F27 V 4	F28 V 5
LOC1	V 1	0.000				
LOC2	V 2	0.014	0.000			
LOC3	V 3	0.002	-0.002	0.000		
F27	V 4	-0.025	0.048	0.059	0.000	
F28	V 5	0.009	0.045	0.085	0.035	0.000
F29	V 6	-0.063	0.025	0.017	0.000	-0.015
F30	V 7	0.009	0.041	0.074	-0.061	0.007
F31	V 8	-0.038	-0.007	-0.049	-0.012	-0.014
F32	V 9	0.004	0.064	0.084	-0.055	-0.033
F33	V 10	0.007	0.052	0.108	-0.033	-0.009
Q23	V 11	-0.076	0.016	-0.025	0.015	-0.006
Q24	V 12	-0.034	0.003	0.002	0.054	0.077
Q25	V 13	-0.062	-0.004	0.011	0.022	-0.016
Q26	V 14	-0.061	-0.016	-0.032	0.055	-0.018

		F29 V 6	F30 V 7	F31 V 8	F32 V 9	F33 V 10
F29	V 6	0.000				
F30	V 7	-0.014	0.000			
F31	V 8	0.040	-0.023	0.000		
F32	V 9	0.039	0.063	0.005	0.000	
F33	V 10	-0.019	0.091	-0.014	0.085	0.000
Q23	V 11	0.059	0.006	-0.010	-0.028	-0.027
Q24	V 12	0.040	0.044	-0.017	0.035	0.011
Q25	V 13	-0.011	-0.060	0.059	-0.043	-0.042
Q26	V 14	-0.007	-0.053	0.034	-0.052	-0.044

		Q23 V 11	Q24 V 12	Q25 V 13	Q26 V 14
Q23	V 11	0.000			
Q24	V 12	0.020	0.000		
Q25	V 13	-0.005	-0.038	0.000	
Q26	V 14	-0.004	-0.015	0.024	0.000

AVERAGE ABSOLUTE COVARIANCE RESIDUALS = 0.0285
AVERAGE OFF-DIAGONAL ABSOLUTE COVARIANCE RESIDUALS = 0.0329

STANDARDIZED RESIDUAL MATRIX:

		LOC1 V 1	LOC2 V 2	LOC3 V 3	F27 V 4	F28 V 5
LOC1	V 1	0.000				
LOC2	V 2	0.043	0.000			
LOC3	V 3	0.003	-0.003	0.000		
F27	V 4	-0.063	0.142	0.080	0.000	
F28	V 5	0.022	0.129	0.111	0.083	0.000
F29	V 6	-0.115	0.056	0.017	0.000	-0.026
F30	V 7	0.018	0.098	0.080	-0.120	0.014
F31	V 8	-0.101	-0.023	-0.071	-0.031	-0.036
F32	V 9	0.006	0.125	0.074	-0.089	-0.051
F33	V 10	0.014	0.124	0.118	-0.065	-0.018
Q23	V 11	-0.189	0.046	-0.034	0.038	-0.015
Q24	V 12	-0.069	0.006	0.002	0.109	0.148
Q25	V 13	-0.161	-0.014	0.015	0.057	-0.039
Q26	V 14	-0.178	-0.056	-0.050	0.157	-0.050

		F29 V 6	F30 V 7	F31 V 8	F32 V 9	F33 V 10
F29	V 6	0.000				
F30	V 7	-0.020	0.000			
F31	V 8	0.077	-0.048	0.000		
F32	V 9	0.047	0.082	0.009	0.000	
F33	V 10	-0.028	0.143	-0.030	0.111	0.000
Q23	V 11	0.108	0.012	-0.027	-0.046	-0.053
Q24	V 12	0.060	0.070	-0.036	0.046	0.018
Q25	V 13	-0.021	-0.123	0.164	-0.073	-0.087
Q26	V 14	-0.015	-0.123	0.106	-0.099	-0.103

		Q23 V 11	Q24 V 12	Q25 V 13	Q26 V 14
Q23	V 11	0.000			
Q24	V 12	0.040	0.000		
Q25	V 13	-0.013	-0.080	0.000	
Q26	V 14	-0.011	-0.035	0.074	0.000

AVERAGE ABSOLUTE STANDARDIZED RESIDUALS = 0.0556
AVERAGE OFF-DIAGONAL ABSOLUTE STANDARDIZED RESIDUALS = 0.0642

LARGEST STANDARDIZED RESIDUALS:

V 11,V 1	V 14,V 1	V 13,V 8	V 13,V 1	V 14,V 4
-0.189	-0.178	0.164	-0.161	0.157
V 12,V 5	V 10,V 7	V 4,V 2	V 5,V 2	V 9,V 2
0.148	0.143	0.142	0.129	0.125
V 10,V 2	V 13,V 7	V 14,V 7	V 7,V 4	V 10,V 3
0.124	-0.123	-0.123	-0.120	0.118
V 6,V 1	V 5,V 3	V 10,V 9	V 12,V 4	V 11,V 6
-0.115	0.111	0.111	0.109	0.108

DISTRIBUTION OF STANDARDIZED RESIDUALS

```
   ----------------------------------------
   !                                      !
60-                                       -
   !                                      !
   !                                      !
   !                                      !
   !                                      !
45-                 *                     -
   !                *                     !
   !                *  *                  !
   !                *  *                  !
   !                *  *                  !
30-                 *  *                  -
   !                *  *                  !
   !                *  *                  !
   !                *  *                  !
   !                *  *                  !
15-                 *  *  *               -
   !                *  *  *               !
   !             *  *  *  *               !
   !             *  *  *  *               !
   !             *  *  *  *               !
   ----------------------------------------
      1  2  3  4  5  6  7  8  9  A  B  C
```

	RANGE			FREQ	PERCENT
1	-0.5	-	--	0	0.00%
2	-0.4	-	-0.5	0	0.00%
3	-0.3	-	-0.4	0	0.00%
4	-0.2	-	-0.3	0	0.00%
5	-0.1	-	-0.2	9	8.57%
6	0.0	-	-0.1	44	41.90%
7	0.1	-	0.0	38	36.19%
8	0.2	-	0.1	14	13.33%
9	0.3	-	0.2	0	0.00%
A	0.4	-	0.3	0	0.00%
B	0.5	-	0.4	0	0.00%
C	++	-	0.5	0	0.00%
	TOTAL			105	100.00%

EACH "*" REPRESENTS 3 RESIDUALS

GOODNESS OF FIT SUMMARY

INDEPENDENCE MODEL CHI-SQUARE = 1480.833 ON 91 DEGREES OF FREEDOM

INDEPENDENCE AIC = 1298.83295 INDEPENDENCE CAIC = 911.40087
MODEL AIC = 84.89250 MODEL CAIC = -230.16216

CHI-SQUARE = 232.892 BASED ON 74 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS LESS THAN 0.001
THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS 256.678.

SATORRA-BENTLER SCALED CHI-SQUARE = 160.4043
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS 0.00000

BENTLER-BONETT NORMED FIT INDEX= 0.843
BENTLER-BONETT NONNORMED FIT INDEX= 0.859
COMPARATIVE FIT INDEX (CFI) = 0.886
ROBUST COMPARATIVE FIT INDEX = 0.916

ITERATIVE SUMMARY

ITERATION	PARAMETER ABS CHANGE	ALPHA	FUNCTION
1	0.227608	1.00000	2.42034
2	0.103756	1.00000	1.59959
3	0.079674	1.00000	1.46459
4	0.104016	1.00000	1.28382
5	0.045304	1.00000	1.22043
6	0.007776	1.00000	1.21936
7	0.000965	1.00000	1.21933

```
MEASUREMENT EQUATIONS WITH STANDARD ERRORS AND TEST STATISTICS
(ROBUST STATISTICS IN PARENTHESES)


LOC1  =V1  =   1.000 F1    + 1.000 E1



LOC2  =V2  =   1.582*F1    + 1.000 E2
                 .322
                4.918
             (   .564)
             (  2.805)

LOC3  =V3  =   4.744*F1    + 1.000 E3
                 .975
                4.866
             (  1.670)
             (  2.841)

F27   =V4  =   1.000 F2    + 1.000 E4



F28   =V5  =   1.136*F2    + 1.000 E5
                 .093
               12.218
             (   .075)
             ( 15.166)

F29   =V6  =   1.356*F2    + 1.000 E6
                 .123
               11.005
             (   .117)
             ( 11.590)

F30   =V7  =   1.180*F2    + 1.000 E7
                 .115
               10.219
             (   .131)
             (  9.039)

F31   =V8  =    .602*F2    + 1.000 E8
                 .089
                6.741
             (   .090)
             (  6.666)

F32   =V9  =   1.372*F2    + 1.000 E9
                 .140
                9.766
             (   .156)
             (  8.812)

F33   =V10 =   1.221*F2    + 1.000 E10
                 .113
               10.790
             (   .120)
             ( 10.191)
 Q23   =V11 =   1.000 F3    + 1.000 E11


 Q24   =V12 =   1.017*F1    +  .929*F3    + 1.000 E12
                  .291           .139
                 3.492          6.705
             (    .329)     (    .149)
```

```
           (  3.093)       ( . 6.217)
 Q25   =V13 =   1.035*F3    + 1.000 E13
                  .108
                 9.580
           (      .097)
           ( 10.635)

 Q26   =V14 =     .989*F3   + 1.000 E14
                  .097
                10.168
           (      .092)
           ( 10.733)
```

```
CONSTRUCT EQUATIONS WITH STANDARD ERRORS AND TEST STATISTICS
(ROBUST STATISTICS IN PARENTHESES)


  F1    =F1   =     .264*F3    + 1.000 D1
                    .068
                   3.891
             (      .092)
             (     2.874)

  F3    =F3   =     .743*F2    + 1.000 D3
                    .088
                   8.398
             (      .079)
             (     9.434)
```

```
VARIANCES OF INDEPENDENT VARIABLES
----------------------------------

               V                             F
              ---                           ---
                          I F2  -   F2                  .239*I
                          I                             .039 I
                          I                            6.086 I
                          I                         (   .032)I
                          I                         (  7.402)I
                          I                                  I


VARIANCES OF INDEPENDENT VARIABLES
----------------------------------

               E                             D
              ---                           ---
E1  -  LOC1               .343*I D1  -  F1              .041*I
                          .036 I                        .016 I
                         9.592 I                       2.531 I
                      (   .145)I                    (   .033)I
                      (  2.358)I                    (  1.251)I
                               I                             I
E2  -  LOC2               .141*I D3  -  F3              .071*I
                          .019 I                        .016 I
                         7.376 I                       4.367 I
                      (   .031)I                    (   .019)I
                      (  4.485)I                    (  3.757)I
                               I                             I
E3  -  LOC3               .116*I                             I
                          .112 I                             I
                         1.033 I                             I
                      (   .119)I                             I
                      (   .967)I                             I
                               I                             I
E4  -  F27                .168*I                             I
                          .020 I                             I
                         8.393 I                             I
```

```
                        (    .026)I                               I
                        (   6.537)I                               I
                                  I                               I
 E5   -   F28                .126*I                               I
                             .017 I                               I
                            7.388 I                               I
                        (    .020)I                               I
                        (   6.283)I                               I
                                  I                               I
 E6   -   F29                .302*I                               I
                             .036 I                               I
                            8.362 I                               I
                        (    .042)I                               I
                        (   7.274)I                               I
                                  I                               I
 E7   -   F30                .306*I                               I
                             .035 I                               I
                            8.721 I                               I
                        (    .040)I                               I
                        (   7.621)I                               I
                                  I                               I
 E8   -   F31                .268*I                               I
                             .028 I                               I
                            9.462 I                               I
                        (    .050)I                               I
                        (   5.345)I                               I
                                  I                               I
 E9   -   F32                .485*I                               I
                             .055 I                               I
                            8.878 I                               I
                        (    .073)I                               I
                        (   6.620)I                               I
                                  I                               I
 E10 -    F33                .266*I                               I
                             .031 I                               I
                            8.474 I                               I
                        (    .040)I                               I
                        (   6.619)I                               I
                                  I                               I
 E11 -    Q23                .201*I                               I
                             .024 I                               I
                            8.291 I                               I
                        (    .030)I                               I
                        (   6.649)I                               I
                                  I                               I
 E12 -    Q24                .280*I                               I
                             .033 I                               I
                            8.610 I                               I
                        (    .041)I                               I
                        (   6.818)I                               I
                                  I                               I
```

```
VARIANCES OF INDEPENDENT VARIABLES (CONTINUED)
----------------------------------------------

E13 -  Q25                 .155*I                                I
                           .020 I                                I
                          7.701 I                                I
                        (  .025)I                                I
                        ( 6.101)I                                I
                                I                                I
E14 -  Q26                 .097*I                                I
                           .014 I                                I
                          6.727 I                                I
                        (  .015)I                                I
                        ( 6.643)I                                I
                                I                                I


STANDARDIZED SOLUTION:                                                      R-SQUARED


 LOC1   =V1   =   .371 F1    + .928 E1                                        .138
 LOC2   =V2   =   .703*F1    + .712 E2                                        .494
 LOC3   =V3   =   .956*F1    + .293 E3                                        .914
 F27    =V4   =   .767 F2    + .642 E4                                        .588
 F28    =V5   =   .843*F2    + .538 E5                                        .711
 F29    =V6   =   .770*F2    + .638 E6                                        .593
 F30    =V7   =   .722*F2    + .692 E7                                        .521
 F31    =V8   =   .495*F2    + .869 E8                                        .245
 F32    =V9   =   .694*F2    + .720 E9                                        .481
 F33    =V10  =   .757*F2    + .653 E10                                       .573
 Q23    =V11  =   .709 F3    + .705 E11                                       .503
 Q24    =V12  =   .304*F1    + .535*F3    + .676 E12                          .543
 Q25    =V13  =   .764*F3    + .645 E13                                       .584
 Q26    =V14  =   .820*F3    + .572 E14                                       .673
  F1    =F1   =   .508*F3    + .861 D1                                        .258
  F3    =F3   =   .806*F2    + .593 D3                                        .649



------------------------------------------------------------------------------------
                          E N D    O F    M E T H O D
------------------------------------------------------------------------------------
```

```
LAGRANGIAN MULTIPLIER TEST REQUIRES     14561 WORDS OF MEMORY.
PROGRAM ALLOCATES  2500000 WORDS.


LAGRANGE MULTIPLIER TEST (FOR ADDING PARAMETERS)

             ORDERED UNIVARIATE TEST STATISTICS:

 NO     CODE     PARAMETER    CHI-SQUARE    PROBABILITY  PARAMETER CHANGE
 --     ----     ---------    ----------    -----------  ----------------

  1     2  20      V4,F3        20.861         0.000            0.747
  2     2  10      D3,D1         9.068         0.003           -0.021
  3     2  22      F3,F1         9.068         0.003           -0.521
  4     2  16      F1,F2         9.068         0.003            0.220
  5     2  20      V1,F3         8.538         0.003           -0.368
  6     2  20     V10,F3         7.548         0.006           -0.561
  7     2  12     V12,F2         7.408         0.006            0.523
  8     2  20      V7,F3         5.666         0.017           -0.510
  9     2  20     V14,F1         4.663         0.031           -0.334
 10     2  12     V14,F2         4.196         0.041           -0.305
 11     2  20      V9,F3         4.166         0.041           -0.543
 12     2  20      V8,F3         4.090         0.043            0.381
 13     2  12     V13,F2         3.753         0.053           -0.317
 14     2  20      V8,F1         3.749         0.053           -0.365
 15     2  20      V5,F1         2.918         0.088            0.250
 16     2  12      V2,F2         2.424         0.120            0.123
 17     2  12      V1,F2         2.035         0.154           -0.148
 18     2  20     V10,F1         1.985         0.159            0.280
 19     2  20      V6,F1         1.131         0.287           -0.227
 20     2  20      V6,F3         0.986         0.321            0.218
 21     2  20      V3,F3         0.831         0.362            0.296
 22     2  20     V11,F1         0.580         0.446           -0.148
 23     2  20      V4,F1         0.571         0.450            0.120
 24     2  20      V2,F3         0.456         0.500            0.073
 25     2  20      V7,F1         0.352         0.553            0.125
 26     2  20      V9,F1         0.295         0.587            0.142
 27     2  12      V3,F2         0.139         0.709            0.071
 28     2  12     V11,F2         0.096         0.757            0.053
 29     2  20      V5,F3         0.004         0.948           -0.010
 30     2  20     V13,F1         0.003         0.954            0.010
 31     2   0      V4,F2         0.000         1.000            0.000
 32     2   0      F1,D1         0.000         1.000            0.000
 33     2   0     V11,F3         0.000         1.000            0.000
 34     2   0      V1,F1         0.000         1.000            0.000
 35     2   0      F3,D3         0.000         1.000            0.000

MULTIVARIATE LAGRANGE MULTIPLIER TEST BY SIMULTANEOUS PROCESS IN STAGE  1

PARAMETER SETS (SUBMATRICES) ACTIVE AT THIS STAGE ARE:

   PVV PFV PFF PDD GVV GVF GFV GFF BVF BFF


       CUMULATIVE MULTIVARIATE STATISTICS                 UNIVARIATE INCREMENT
       ----------------------------------                 --------------------

STEP  PARAMETER    CHI-SQUARE  D.F.   PROBABILITY        CHI-SQUARE  PROBABILITY
---- -----------   ----------  ----   -----------        ----------  -----------

  1      V4,F3       20.861      1       0.000             20.861       0.000
  2      F3,F1       29.929      2       0.000              9.068       0.003
  3     V12,F2       39.045      3       0.000              9.116       0.003
  4      V1,F3       47.583      4       0.000              8.538       0.003
  5      V8,F3       53.476      5       0.000              5.893       0.015
```

5e. EQS output for D-F-LoC model.

```
EQS, A STRUCTURAL EQUATION PROGRAM              MULTIVARIATE SOFTWARE, INC.
COPYRIGHT BY P.M. BENTLER                       VERSION 5.7b (C) 1985 - 1998.

  PROGRAM CONTROL INFORMATION

  /TITLE
  Allsubs
  /SPECIFICATIONS
   DATA='C:\GAMBLING\ALLSUBS.ESS';
   VARIABLES= 14; CASES=  192;
   METHODS=ML, ROBUST;
   MATRIX=RAW;
  /LABELS
  V1=LOC1; V2=LOC2; V3=LOC3; V4=F27; V5=F28;
  V6=F29; V7=F30; V8=F31; V9=F32; V10=F33;
  V11=Q23; V12=Q24; V13=Q25; V14=Q26;
  /EQUATIONS
  V1 =  + F1  + E1;
  V2 =  + *F1  + E2;
  V3 =  + *F1  + E3;
  V4 =  + F2  + E4;
  V5 =  + *F2  + E5;
  V6 =  + *F2  + E6;
  V7 =  + *F2  + E7;
  V8 =  + *F2  + E8;
  V9 =  + *F2  + E9;
  V10 =  + *F2  + E10;
  V11 =  + F3  + E11;
  V12 =  + *F3 + *F1  + E12;
  V13 =  + *F3  + E13;
  V14 =  + *F3  + E14;
  F1= + *F2 + D1;
  F2=*F3 + D3;
  /VARIANCES
  F3 = *;
  E1 = *;
  E2 = *;
  E3 = *;
  E4 = *;
  E5 = *;
  E6 = *;
  E7 = *;
  E8 = *;
  E9 = *;
  E10 = *;
  E11 = *;
  E12 = *;
  E13 = *;
  E14 = *;
  /COVARIANCES
  /LMTEST
   PROCESS=SIMULTANEOUS;
   SET=PVV,PFV,PFF,PDD,GVV,GVF,GFV,GFF,BVF,BFF;
  /END

     49 RECORDS OF INPUT MODEL FILE WERE READ

  DATA IS READ FROM C:\GAMBLING\ALLSUBS.ESS
  THERE ARE  14 VARIABLES AND   192 CASES
  IT IS A RAW DATA ESS FILE
```

SAMPLE STATISTICS BASED ON COMPLETE CASES

UNIVARIATE STATISTICS

VARIABLE	LOC1	LOC2	LOC3	F27	F28
MEAN	0.1458	0.2031	0.5313	1.5312	1.5729
SKEWNESS (G1)	5.1572	2.9758	2.6856	0.7913	0.7199
KURTOSIS (G2)	27.3362	9.5437	7.2697	-0.4110	-0.5492
STANDARD DEV.	0.6305	0.5272	1.1618	0.6383	0.6591

VARIABLE	F29	F30	F31	F32	F33
MEAN	1.9219	1.7031	1.4583	2.0365	1.7396
SKEWNESS (G1)	0.3965	0.7679	1.0573	0.4490	0.7510
KURTOSIS (G2)	-0.9678	-0.4528	0.8734	-0.9190	-0.2334
STANDARD DEV.	0.8617	0.7995	0.5952	0.9674	0.7893

VARIABLE	Q23	Q24	Q25	Q26
MEAN	1.6875	1.6563	1.4375	1.4115
SKEWNESS (G1)	0.3731	0.9463	1.0692	0.8448
KURTOSIS (G2)	-0.6913	0.0897	0.0986	-0.3832
STANDARD DEV.	0.6360	0.7837	0.6108	0.5439

MULTIVARIATE KURTOSIS

MARDIA'S COEFFICIENT (G2,P) = 130.1328
NORMALIZED ESTIMATE = 42.5959

ELLIPTICAL THEORY KURTOSIS ESTIMATES

MARDIA-BASED KAPPA = 0.5809 MEAN SCALED UNIVARIATE KURTOSIS = 0.9668

MARDIA-BASED KAPPA IS USED IN COMPUTATION. KAPPA= 0.5809

CASE NUMBERS WITH LARGEST CONTRIBUTION TO NORMALIZED MULTIVARIATE KURTOSIS:

CASE NUMBER	88	92	115	121	136
ESTIMATE	697.9184	697.9184	1331.0284	927.1008	717.7889

COVARIANCE MATRIX TO BE ANALYZED: 14 VARIABLES (SELECTED FROM 14 VARIABLES)
BASED ON 192 CASES.

		LOC1 V 1	LOC2 V 2	LOC3 V 3	F27 V 4	F28 V 5
LOC1	V 1	0.397				
LOC2	V 2	0.101	0.278			
LOC3	V 3	0.262	0.410	1.350		
F27	V 4	0.022	0.122	0.282	0.407	
F28	V 5	0.063	0.129	0.338	0.307	0.434
F29	V 6	0.001	0.126	0.319	0.324	0.354
F30	V 7	0.064	0.129	0.337	0.221	0.328
F31	V 8	-0.010	0.037	0.085	0.132	0.150
F32	V 9	0.068	0.165	0.389	0.274	0.340
F33	V 10	0.064	0.142	0.380	0.259	0.323
Q23	V 11	-0.022	0.100	0.230	0.193	0.196
Q24	V 12	0.071	0.170	0.503	0.267	0.318
Q25	V 13	-0.007	0.083	0.274	0.206	0.193
Q26	V 14	-0.008	0.068	0.220	0.231	0.182

		F29 V 6	F30 V 7	F31 V 8	F32 V 9	F33 V 10
F29	V 6	0.743				
F30	V 7	0.369	0.639			
F31	V 8	0.235	0.147	0.354		
F32	V 9	0.485	0.451	0.203	0.936	
F33	V 10	0.377	0.435	0.162	0.486	0.623
Q23	V 11	0.300	0.216	0.097	0.216	0.190
Q24	V 12	0.329	0.295	0.111	0.327	0.271
Q25	V 13	0.239	0.157	0.170	0.209	0.183
Q26	V 14	0.231	0.154	0.140	0.189	0.171

		Q23 V 11	Q24 V 12	Q25 V 13	Q26 V 14
Q23	V 11	0.404			
Q24	V 12	0.264	0.614		
Q25	V 13	0.205	0.214	0.373	
Q26	V 14	0.197	0.226	0.233	0.296

BENTLER-WEEKS STRUCTURAL REPRESENTATION:

NUMBER OF DEPENDENT VARIABLES = 16
DEPENDENT V'S : 1 2 3 4 5 6 7 8 9 10
DEPENDENT V'S : 11 12 13 14
DEPENDENT F'S : 1 2

NUMBER OF INDEPENDENT VARIABLES = 17
INDEPENDENT F'S : 3
INDEPENDENT E'S : 1 2 3 4 5 6 7 8 9 10
INDEPENDENT E'S : 11 12 13 14
INDEPENDENT D'S : 1 3

NUMBER OF FREE PARAMETERS = 31
NUMBER OF FIXED NONZERO PARAMETERS = 19

3RD STAGE OF COMPUTATION REQUIRED 25811 WORDS OF MEMORY.
PROGRAM ALLOCATED 2500000 WORDS

DETERMINANT OF INPUT MATRIX IS 0.30445E-07

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

CASE CONTRIBUTION TO PARAMETER VARIANCES (IN DESCENDING ORDER)

CASE	121=	9.382	53.25%	CASE	53=	0.986	5.59%
CASE	183=	0.829	4.71%	CASE	29=	0.783	4.44%
CASE	120=	0.685	3.89%	CASE	33=	0.602	3.42%
CASE	92=	0.538	3.05%	CASE	88=	0.538	3.05%
CASE	95=	0.419	2.38%	CASE	65=	0.343	1.95%
CASE	60=	0.237	1.35%	CASE	34=	0.231	1.31%
CASE	66=	0.227	1.29%	CASE	136=	0.188	1.07%
CASE	117=	0.166	0.94%	CASE	11=	0.137	0.78%
CASE	70=	0.089	0.50%	CASE	90=	0.079	0.45%
CASE	3=	0.078	0.45%	CASE	115=	0.073	0.42%
CASE	93=	0.070	0.40%	CASE	42=	0.049	0.28%
CASE	105=	0.049	0.28%	CASE	118=	0.045	0.25%
CASE	68=	0.039	0.22%	CASE	41=	0.037	0.21%
CASE	109=	0.036	0.21%	CASE	13=	0.030	0.17%
CASE	112=	0.025	0.14%	CASE	76=	0.025	0.14%
CASE	191=	0.024	0.14%	CASE	1=	0.020	0.11%
CASE	96=	0.017	0.10%	CASE	50=	0.017	0.10%
CASE	54=	0.016	0.09%	CASE	16=	0.016	0.09%
CASE	73=	0.015	0.09%	CASE	4=	0.014	0.08%
CASE	111=	0.014	0.08%	CASE	104=	0.013	0.07%
CASE	178=	0.013	0.07%	CASE	44=	0.012	0.07%
CASE	148=	0.012	0.07%	CASE	46=	0.012	0.07%
CASE	101=	0.012	0.07%	CASE	83=	0.011	0.06%
CASE	131=	0.011	0.06%	CASE	135=	0.010	0.06%
CASE	87=	0.009	0.05%	CASE	190=	0.009	0.05%
CASE	72=	0.009	0.05%	CASE	86=	0.009	0.05%
CASE	110=	0.009	0.05%	CASE	58=	0.009	0.05%
CASE	119=	0.009	0.05%	CASE	62=	0.009	0.05%
CASE	100=	0.008	0.05%	CASE	152=	0.008	0.05%
CASE	27=	0.008	0.04%	CASE	124=	0.007	0.04%
CASE	155=	0.007	0.04%	CASE	6=	0.007	0.04%
CASE	186=	0.006	0.04%	CASE	169=	0.006	0.03%
CASE	79=	0.006	0.03%	CASE	123=	0.006	0.03%
CASE	81=	0.006	0.03%	CASE	48=	0.005	0.03%
CASE	158=	0.005	0.03%	CASE	26=	0.005	0.03%
CASE	182=	0.005	0.03%	CASE	132=	0.005	0.03%
CASE	107=	0.005	0.03%	CASE	45=	0.005	0.03%
CASE	80=	0.004	0.03%	CASE	51=	0.004	0.02%
CASE	192=	0.004	0.02%	CASE	94=	0.004	0.02%
CASE	154=	0.004	0.02%	CASE	12=	0.004	0.02%
CASE	64=	0.004	0.02%	CASE	84=	0.004	0.02%
CASE	125=	0.003	0.02%	CASE	128=	0.003	0.02%
CASE	106=	0.003	0.02%	CASE	162=	0.003	0.02%
CASE	17=	0.003	0.02%	CASE	103=	0.003	0.02%
CASE	67=	0.003	0.02%	CASE	98=	0.003	0.02%
CASE	126=	0.003	0.02%	CASE	40=	0.003	0.02%
CASE	14=	0.003	0.02%	CASE	35=	0.003	0.02%
CASE	99=	0.003	0.02%	CASE	5=	0.003	0.01%
CASE	85=	0.003	0.01%	CASE	75=	0.002	0.01%
CASE	25=	0.002	0.01%	CASE	56=	0.002	0.01%
CASE	127=	0.002	0.01%	CASE	145=	0.002	0.01%
CASE	122=	0.002	0.01%	CASE	89=	0.002	0.01%
CASE	9=	0.002	0.01%	CASE	116=	0.002	0.01%
CASE	133=	0.002	0.01%	CASE	63=	0.002	0.01%
CASE	187=	0.002	0.01%	CASE	8=	0.002	0.01%
CASE	2=	0.002	0.01%	CASE	129=	0.001	0.01%
CASE	69=	0.001	0.01%	CASE	189=	0.001	0.01%
CASE	22=	0.001	0.01%	CASE	71=	0.001	0.01%
CASE	78=	0.001	0.01%	CASE	47=	0.001	0.01%
CASE	74=	0.001	0.01%	CASE	157=	0.001	0.01%

PARAMETER ESTIMATES APPEAR IN ORDER,
NO SPECIAL PROBLEMS WERE ENCOUNTERED DURING OPTIMIZATION.

RESIDUAL COVARIANCE MATRIX (S-SIGMA) :

		LOC1 V 1	LOC2 V 2	LOC3 V 3	F27 V 4	F28 V 5
LOC1	V 1	0.000				
LOC2	V 2	0.007	0.000			
LOC3	V 3	0.006	0.000	0.000		
F27	V 4	-0.044	0.016	-0.005	0.000	
F28	V 5	-0.013	0.009	0.011	0.034	0.000
F29	V 6	-0.088	-0.016	-0.067	0.003	-0.013
F30	V 7	-0.014	0.004	-0.003	-0.062	0.006
F31	V 8	-0.049	-0.025	-0.085	-0.009	-0.012
F32	V 9	-0.023	0.020	-0.006	-0.055	-0.034
F33	V 10	-0.017	0.013	0.028	-0.034	-0.012
Q23	V 11	-0.069	0.025	0.025	0.023	0.002
Q24	V 12	-0.041	-0.010	0.015	0.042	0.062
Q25	V 13	-0.056	0.004	0.059	0.027	-0.011
Q26	V 14	-0.056	-0.009	0.012	0.057	-0.016

		F29 V 6	F30 V 7	F31 V 8	F32 V 9	F33 V 10
F29	V 6	0.000				
F30	V 7	-0.011	0.000			
F31	V 8	0.044	-0.020	0.000		
F32	V 9	0.042	0.062	0.008	0.000	
F33	V 10	-0.018	0.088	-0.012	0.083	0.000
Q23	V 11	0.071	0.014	-0.004	-0.018	-0.018
Q24	V 12	0.026	0.029	-0.022	0.017	-0.005
Q25	V 13	-0.003	-0.055	0.064	-0.037	-0.037
Q26	V 14	-0.002	-0.051	0.037	-0.049	-0.042

		Q23 V 11	Q24 V 12	Q25 V 13	Q26 V 14
Q23	V 11	0.000			
Q24	V 12	0.035	0.003		
Q25	V 13	-0.007	-0.027	0.000	
Q26	V 14	-0.009	-0.007	0.016	0.000

AVERAGE ABSOLUTE COVARIANCE RESIDUALS = 0.0244
AVERAGE OFF-DIAGONAL ABSOLUTE COVARIANCE RESIDUALS = 0.0281

STANDARDIZED RESIDUAL MATRIX:

		LOC1 V 1	LOC2 V 2	LOC3 V 3	F27 V 4	F28 V 5
LOC1	V 1	0.000				
LOC2	V 2	0.021	0.000			
LOC3	V 3	0.009	0.000	0.000		
F27	V 4	-0.110	0.049	-0.007	0.000	
F28	V 5	-0.030	0.025	0.014	0.081	0.000
F29	V 6	-0.162	-0.036	-0.067	0.005	-0.023
F30	V 7	-0.027	0.009	-0.003	-0.121	0.011
F31	V 8	-0.130	-0.080	-0.123	-0.025	-0.030
F32	V 9	-0.037	0.040	-0.005	-0.089	-0.054
F33	V 10	-0.033	0.030	0.030	-0.068	-0.022
Q23	V 11	-0.172	0.076	0.035	0.056	0.004
Q24	V 12	-0.082	-0.023	0.017	0.084	0.120
Q25	V 13	-0.145	0.014	0.083	0.069	-0.028
Q26	V 14	-0.163	-0.031	0.019	0.164	-0.044

		F29 V 6	F30 V 7	F31 V 8	F32 V 9	F33 V 10
F29	V 6	0.000				
F30	V 7	-0.017	0.000			
F31	V 8	0.086	-0.043	0.000		
F32	V 9	0.051	0.080	0.015	0.000	
F33	V 10	-0.026	0.140	-0.026	0.108	0.000
Q23	V 11	0.130	0.028	-0.010	-0.030	-0.037
Q24	V 12	0.038	0.046	-0.047	0.023	-0.008
Q25	V 13	-0.005	-0.113	0.176	-0.063	-0.077
Q26	V 14	-0.005	-0.118	0.116	-0.094	-0.099

		Q23 V 11	Q24 V 12	Q25 V 13	Q26 V 14
Q23	V 11	0.000			
Q24	V 12	0.070	0.006		
Q25	V 13	-0.019	-0.056	0.000	
Q26	V 14	-0.025	-0.017	0.047	0.000

AVERAGE ABSOLUTE STANDARDIZED RESIDUALS = 0.0488
AVERAGE OFF-DIAGONAL ABSOLUTE STANDARDIZED RESIDUALS = 0.0563

LARGEST STANDARDIZED RESIDUALS:

V 13,V 8	V 11,V 1	V 14,V 4	V 14,V 1	V 6,V 1
0.176	-0.172	0.164	-0.163	-0.162
V 13,V 1	V 10,V 7	V 11,V 6	V 8,V 1	V 8,V 3
-0.145	0.140	0.130	-0.130	-0.123
V 7,V 4	V 12,V 5	V 14,V 7	V 14,V 8	V 13,V 7
-0.121	0.120	-0.118	0.116	-0.113
V 4,V 1	V 10,V 9	V 14,V 10	V 14,V 9	V 9,V 4
-0.110	0.108	-0.099	-0.094	-0.089

DISTRIBUTION OF STANDARDIZED RESIDUALS

```
   ----------------------------------------
   !                                      !
 60-                                      -
   !                                      !
   !                                      !
   !                                      !
   !                                      !            RANGE      FREQ PERCENT
 45-                    *                 -
   !                 *  *                 !    1   -0.5  -  --        0   0.00%
   !                 *  *                 !    2   -0.4  -  -0.5      0   0.00%
   !                 *  *                 !    3   -0.3  -  -0.4      0   0.00%
   !                 *  *                 !    4   -0.2  -  -0.3      0   0.00%
 30-                 *  *                 -    5   -0.1  -  -0.2     10   9.52%
   !                 *  *                 !    6    0.0  -  -0.1     42  40.00%
   !                 *  *                 !    7    0.1  -   0.0     46  43.81%
   !                 *  *                 !    8    0.2  -   0.1      7   6.67%
   !                 *  *                 !    9    0.3  -   0.2      0   0.00%
 15-                 *  *                 -    A    0.4  -   0.3      0   0.00%
   !                 *  *                 !    B    0.5  -   0.4      0   0.00%
   !              *  *  *                 !    C     ++  -   0.5      0   0.00%
   !              *  *  *  *              !    --------------------------------
   !              *  *  *  *              !            TOTAL       105 100.00%
   ----------------------------------------
      1  2  3  4  5  6  7  8  9  A  B  C      EACH "*" REPRESENTS  3 RESIDUALS
```

GOODNESS OF FIT SUMMARY

INDEPENDENCE MODEL CHI-SQUARE = 1480.833 ON 91 DEGREES OF FREEDOM

INDEPENDENCE AIC = 1298.83295 INDEPENDENCE CAIC = 911.40087
MODEL AIC = 74.89792 MODEL CAIC = -240.15674

CHI-SQUARE = 222.898 BASED ON 74 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS LESS THAN 0.001
THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS 235.393.

SATORRA-BENTLER SCALED CHI-SQUARE = 156.0937
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS 0.00000

BENTLER-BONETT NORMED FIT INDEX= 0.849
BENTLER-BONETT NONNORMED FIT INDEX= 0.868
COMPARATIVE FIT INDEX (CFI) = 0.893
ROBUST COMPARATIVE FIT INDEX = 0.920

ITERATIVE SUMMARY

ITERATION	PARAMETER ABS CHANGE	ALPHA	FUNCTION
1	0.222968	1.00000	2.25410
2	0.111388	1.00000	1.48116
3	0.084031	1.00000	1.39333
4	0.081677	1.00000	1.20594
5	0.038574	1.00000	1.16739
6	0.003156	1.00000	1.16701
7	0.000564	1.00000	1.16700

MEASUREMENT EQUATIONS WITH STANDARD ERRORS AND TEST STATISTICS
(ROBUST STATISTICS IN PARENTHESES)

```
LOC1   =V1  =    1.000 F1     + 1.000 E1


LOC2   =V2  =    1.601*F1     + 1.000 E2
                  .322
                 4.979
              (   .572)
              (  2.797)

LOC3   =V3  =    4.354*F1     + 1.000 E3
                  .868
                 5.018
              (  1.485)
              (  2.932)

F27    =V4  =    1.000 F2     + 1.000 E4


F28    =V5  =    1.139*F2     + 1.000 E5
                  .093
                12.277
              (   .076)
              ( 15.033)

F29    =V6  =    1.346*F2     + 1.000 E6
                  .123
                10.915
              (   .119)
              ( 11.303)

F30    =V7  =    1.183*F2     + 1.000 E7
                  .115
                10.255
              (   .133)
              (  8.877)

F31    =V8  =     .592*F2     + 1.000 E8
                  .089
                 6.631
              (   .090)
              (  6.595)

F32    =V9  =    1.374*F2     + 1.000 E9
                  .140
                 9.791
              (   .157)
              (  8.738)

F33    =V10 =    1.227*F2     + 1.000 E10
                  .113
                10.858
              (   .122)
              ( 10.034)

Q23    =V11 =    1.000 F3     + 1.000 E11


Q24    =V12 =    1.230*F1     +   .847*F3     + 1.000 E12
                  .309              .131
                 3.985             6.477
              (   .359)       (    .139)
              (  3.421)       (   6.082)
```

```
 Q25    =V13 =    1.053*F3    + 1.000 E13
                   .109
                  9.619
                (   .102)
                ( 10.324)

 Q26    =V14 =    1.020*F3    + 1.000 E14
                   .100
                 10.242
                (   .096)
                ( 10.600)


CONSTRUCT EQUATIONS WITH STANDARD ERRORS AND TEST STATISTICS
  (ROBUST STATISTICS IN PARENTHESES)


  F1    =F1  =     .276*F2    + 1.000 D1
                   .065
                  4.228
                (   .101)
                (  2.741)

  F2    =F2  =     .842*F3    + 1.000 D3
                   .105
                  8.053
                (   .094)
                (  8.917)


 VARIANCES OF INDEPENDENT VARIABLES
 ----------------------------------

                V                                 F
               ---                               ---
                             I F3  -    F3                .202*I
                             I                            .038 I
                             I                           5.294 I
                             I                         (   .036)I
                             I                         (  5.686)I
                             I                                  I


 VARIANCES OF INDEPENDENT VARIABLES
 ----------------------------------

                E                                 D
               ---                               ---
 E1  -  LOC1              .339*I D1  -   F1               .041*I
                          .036 I                          .016 I
                         9.501 I                         2.556 I
                       (   .145)I                      (   .031)I
                       (  2.330)I                      (  1.300)I
                               I                                I
 E2  -  LOC2              .127*I D3  -   F2               .096*I
                          .018 I                          .019 I
                         7.008 I                         5.010 I
                       (   .028)I                      (   .023)I
                       (  4.600)I                      (  4.251)I
                               I                                I
 E3  -  LOC3              .235*I                                I
                          .094 I                                I
                         2.495 I                                I
                       (   .106)I                               I
                       (  2.228)I                               I
                               I                                I
 E4  -  F27               .168*I                                I
                          .020 I                                I
                         8.426 I                                I
                       (   .026)I                               I
                       (  6.473)I                               I
                               I                                I
```

```
E5  -  F28                 .124*I                                    I
                           .017 I                                    I
                          7.393 I                                    I
                      (    .020)I                                    I
                      (   6.267)I                                    I
                                I                                    I
E6  -  F29                 .309*I                                    I
                           .037 I                                    I
                          8.446 I                                    I
                      (    .042)I                                    I
                      (   7.362)I                                    I
                                I                                    I
E7  -  F30                 .305*I                                    I
                           .035 I                                    I
                          8.735 I                                    I
                      (    .040)I                                    I
                      (   7.626)I                                    I
                                I                                    I
E8  -  F31                 .270*I                                    I
                           .029 I                                    I
                          9.481 I                                    I
                      (    .050)I                                    I
                      (   5.425)I                                    I
                                I                                    I
E9  -  F32                 .484*I                                    I
                           .054 I                                    I
                          8.893 I                                    I
                      (    .074)I                                    I
                      (   6.568)I                                    I
                                I                                    I
E10 -  F33                 .263*I                                    I
                           .031 I                                    I
                          8.475 I                                    I
                      (    .040)I                                    I
                      (   6.503)I                                    I
                                I                                    I
E11 -  Q23                 .202*I                                    I
                           .025 I                                    I
                          8.253 I                                    I
                      (    .030)I                                    I
                      (   6.673)I                                    I
                                I                                    I
E12 -  Q24                 .279*I                                    I
                           .033 I                                    I
                          8.585 I                                    I
                      (    .040)I                                    I
                      (   6.962)I                                    I
                                I                                    I

E13 -  Q25                 .149*I                                    I
                           .020 I                                    I
                          7.439 I                                    I
                      (    .026)I                                    I
                      (   5.755)I                                    I
                                I                                    I
E14 -  Q26                 .086*I                                    I
                           .014 I                                    I
                          5.986 I                                    I
                      (    .014)I                                    I
                      (   5.976)I                                    I
                                I                                    I
```

STANDARDIZED SOLUTION: R-SQUARED

```
LOC1  =V1  =   .385 F1    + .923 E1                  .148
LOC2  =V2  =   .736*F1    + .677 E2                  .542
LOC3  =V3  =   .909*F1    + .418 E3                  .826
F27   =V4  =   .766 F2    + .643 E4                  .587
F28   =V5  =   .845*F2    + .534 E5                  .715
F29   =V6  =   .764*F2    + .645 E6                  .583
F30   =V7  =   .724*F2    + .690 E7                  .524
F31   =V8  =   .487*F2    + .874 E8                  .237
F32   =V9  =   .695*F2    + .719 E9                  .483
F33   =V10 =   .760*F2    + .649 E10                 .578
Q23   =V11 =   .707 F3    + .707 E11                 .499
Q24   =V12 =   .381*F1    + .487*F3   + .676 E12     .543
Q25   =V13 =   .775*F3    + .632 E13                 .600
Q26   =V14 =   .843*F3    + .538 E14                 .711
 F1   =F1  =   .556*F2    + .831 D1                  .309
 F2   =F2  =   .774*F3    + .633 D3                  .599
```

E N D   O F   M E T H O D

```
LAGRANGIAN MULTIPLIER TEST REQUIRES     14558 WORDS OF MEMORY.
  PROGRAM ALLOCATES  2500000 WORDS.
```

LAGRANGE MULTIPLIER TEST (FOR ADDING PARAMETERS)

ORDERED UNIVARIATE TEST STATISTICS:

NO	CODE		PARAMETER	CHI-SQUARE	PROBABILITY	PARAMETER CHANGE
1	2	12	V4,F3	22.080	0.000	0.692
2	2	12	V1,F3	9.884	0.002	-0.374
3	2	12	V10,F3	9.151	0.002	-0.555
4	2	12	V8,F3	7.230	0.007	0.462
5	2	20	V12,F2	7.146	0.008	0.500
6	2	12	V7,F3	6.740	0.009	-0.501
7	2	20	V8,F1	6.277	0.012	-0.537
8	2	12	V9,F3	4.646	0.031	-0.518
9	2	20	V1,F2	3.734	0.053	-0.228
10	2	12	V3,F3	3.416	0.065	0.399
11	2	20	V6,F1	3.396	0.065	-0.451
12	2	20	V14,F2	3.074	0.080	-0.248
13	2	12	V6,F3	1.786	0.181	0.266
14	2	20	V11,F2	1.448	0.229	0.188
15	2	20	V5,F1	1.149	0.284	0.179
16	2	20	V13,F2	1.054	0.305	-0.155
17	2	20	V13,F1	0.895	0.344	0.157
18	2	20	V10,F1	0.700	0.403	0.188
19	2	20	V14,F1	0.700	0.403	-0.118
20	2	20	V11,F1	0.543	0.461	0.135
21	2	20	V3,F2	0.406	0.524	-0.167
22	2	10	D3,D1	0.344	0.557	-0.005
23	2	16	F1,F3	0.344	0.557	0.044
24	2	22	F2,F1	0.344	0.557	-0.123
25	2	20	V2,F2	0.334	0.563	0.057
26	2	12	V5,F3	0.226	0.635	-0.066
27	2	20	V9,F1	0.047	0.829	0.064
28	2	20	V7,F1	0.032	0.858	0.043
29	2	12	V2,F3	0.031	0.861	-0.016
30	2	20	V4,F1	0.008	0.930	0.016
31	2	0	F2,D3	0.000	1.000	0.000
32	2	0	F1,D1	0.000	1.000	0.000
33	2	0	V11,F3	0.000	1.000	0.000
34	2	0	V4,F2	0.000	1.000	0.000
35	2	0	V1,F1	0.000	1.000	0.000

MULTIVARIATE LAGRANGE MULTIPLIER TEST BY SIMULTANEOUS PROCESS IN STAGE 1

PARAMETER SETS (SUBMATRICES) ACTIVE AT THIS STAGE ARE:

PVV PFV PFF PDD GVV GVF GFV GFF BVF BFF

	CUMULATIVE MULTIVARIATE STATISTICS				UNIVARIATE INCREMENT	
STEP	PARAMETER	CHI-SQUARE	D.F.	PROBABILITY	CHI-SQUARE	PROBABILITY
1	V4,F3	22.080	1	0.000	22.080	0.000
2	V1,F3	31.842	2	0.000	9.762	0.002
3	V8,F3	41.260	3	0.000	9.419	0.002
4	V12,F2	47.599	4	0.000	6.338	0.012
5	V8,F1	53.496	5	0.000	5.897	0.015
6	V10,F3	57.442	6	0.000	3.946	0.047
7	V7,F3	61.846	7	0.000	4.404	0.036
8	V9,F3	66.442	8	0.000	4.596	0.032

7.6. Appendix 6

6a. Complete Questionnaire for Study 3.

1a. A friend takes a coin out of a pocket and is about to flip it into the air. Would you go for Heads or Tails?

....

b. How confident would you be?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

2. You have been observing the outcomes at a Roulette table. The outcomes so far on the table you've been looking at have been:

Black, Red, Black, Black, Black, Black, Black, Red,.....

a. What do you think the next outcome will be? Please Circle: Red Black

b. How confident are you that your choice is correct?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

------------------------PAGE BREAK-------------------------

3. A taxi cab was involved in a hit and run accident at night. Two cab companies, the Green and the Blue, operate in the city.
150 of the cabs in the city are Green, 100 are Blue. A witness identified the cab as Blue. The Court tested the reliability of the witness under the same circumstances that existed on the night of the accident, and concluded that the witness correctly identified each one of the two colours 80% of the time, and failed 20% of the time.

a. What is the likelihood that the cab involved in the accident was Blue rather than Green?

Please Indicate from 0 (Completely Unlikely) to 100 (Completely Likely) ....

b. How confident are you that your response is correct?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

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4. A new Wheel of Fortune has 50 segments that you can bet on. Half of the numbers are even (E), half are odd (O), and they are distributed around the wheel equally.

a. How random do you think the sequence below is as arising from the spinning of the Wheel?

O O E E E E E O E O O O E E E E O O E E E O O E O O

Please Indicate from 0 (Not at all Random) to 100 (Completely Random)

....

b. How confident are you of your rating?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

c. How random do you think the sequence below is as arising from the spinning of the Wheel?

O O E O E E O E E E E E O O O E E O E O E O O E O E

Please Indicate from 0 (Not at all Random) to 100 (Completely Random)

....

d. How confident are you of your rating?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

e. How random do you think the sequence below is as arising from the spinning of the Wheel?

E E O E O E E O E O E O E O E E O E O E O O E E O E

Please Indicate from 0 (Not at all Random) to 100 (Completely Random)

....

f. How confident are you of your rating?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

g.. How random do you think the sequence below is as arising from the spinning of the Wheel?

O O O O O O O O O E E O O O O O E E E E E E E O E E

Please Indicate from 0 (Not at all Random) to 100 (Completely Random) ....

h. How confident are you of your rating?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

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5a. Suppose you sample a word at random from an English text. Is it more likely that the word starts with the letter "k" or that "k" is its third letter?

....

b. How confident are you that your judgement is correct?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

6a. In four pages of a novel (about 2000 words), how many words would you expect to find have the form _ _ _ _ i n g (seven letter words that end in "ing")?

....

b. How confident are you that your judgement is correct?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

7a. You turn up at a Casino to play Roulette. You arrive at the table and place a bet. What would you choose to go for first? Red or Black?

Please Circle: Red Black

b. How confident would you be?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

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8. Imagine everybody in every city in the world was photographed. From studying the photos, it appears that 50% of the photos show people with their heads facing to the left, whilst the other 50% of the people are looking to the right.
You are presented with a series of these photos in which the direction of gaze, in the order that you receive them, is as follows:

Left, Left, Right, Left, Right, Right, Left, Left, Right, Left, Right, Right, Right, Left, Left, Right, ..

a. If presented with another photo, which direction do you think the person's head will be facing?

Please Circle: Right Left

b. How confident are you that your judgement is correct?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

9. Two countries were at battle against each other. Country A had only 1000 soldiers to start with, but had a much stronger technological weapons backing, compared to the much stronger army of 2000 soldiers in Country B with a much weaker technological backing. Although the battle was fierce and a close-call for both countries, one country did finally win the battle.

a. Which one do you think it was? ....

b. How confident are you that your decision is the correct one?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident) ....

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10. You decide to go to a Casino for the evening. You arrive and watch some of the players playing the various games, before making your way to one of the roulette tables. You decide to play yourself, and have won the last few trials. You decide to stick to betting on Red or Black for the time being.

a. How confident are you that you will win the next round?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

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11. You have been observing the outcomes at a Roulette table. The outcomes so far on the table you've been looking at have been:

Red, Red, Black, Red, Black, Black, Red, Red, Black, Red, Black, Black, Black, Red, Red, Black, .

a. What do you think the next outcome will be? Please Circle: Red Black

b. How confident are you that your choice is correct?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

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12. The outcomes of the spin of the Roulette wheel are clearly displayed for you to look at. Out of the last 8 outcomes, there was a sequence of four red in a row, followed by four black numbers.

a. What do you think the following outcome was? Please Circle: Red Black

b. How confident are you that your choice is the correct one?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

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13. Imagine everybody in every city in the world was photographed. From studying the photos, it appears that 50% of the photos show people with their heads facing to the left, whilst the other 50% of the people are looking to the right.
You are presented with a series of these photos in which the direction of gaze, in the order that you receive them, is as follows:

Left, Right, Right, Left, Right, Left, Left, Right, ...

a. If presented with another photo, which direction do you think the person's head will be facing?

Please Circle: Right Left

b. How confident are you that your judgement is correct?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

14a. In four pages of a novel (about 2000 words), how many words would you expect to find have the form _ _ _ _ _ n _ (seven letter words with "n" as the sixth letter) ?

....

b. How confident are you that your judgement is correct?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

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15. How likely do you think the sequence of outcomes below is to occur from flipping a coin:
(0.6)

16

Please Indicate from 0 (Completely Unlikely) to 100 (Completely Likely)

17. How likely do you think the sequence of outcomes below is to occur from flipping a coin:
(0.4)

18.

Please Indicate from 0 (Completely Unlikely) to 100 (Completely Likely)

19. How likely do you think the sequence of outcomes below is to occur from flipping a coin:
(0.2)

20.

Please Indicate from 0 (Completely Unlikely) to 100 (Completely Likely)

21. How likely do you think the sequence of outcomes below is to occur from flipping a coin:
(0.8)

22.

Please Indicate from 0 (Completely Unlikely) to 100 (Completely Likely)

22. Imagine everybody in every city in the world was photographed. From studying the photos, it appears that 50% of the photos show people with their heads facing to the left, whilst the other 50% of the people are looking to the right.
You are presented with a series of these photos in which the direction of gaze, in the order that you receive them, is as follows:

Right, Left, Right, Right, Right, Right, Right, Left, ...

a. If presented with another photo, which direction do you think the person's head will be facing?

Please Circle: Right Left

b. How confident are you that your judgement is correct?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

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23. You have been observing the outcomes at a Roulette table. The outcomes so far on the table you've been looking at have been:

Red, Black, Black, Red, Black, Red, Red, Black

a. What do you think the next outcome will be? Please Circle: Red Black

b. How confident are you that your choice is correct?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

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24. Two countries were at battle against each other. Country A had only 1000 soldiers to start with, but had a much stronger technological weapons backing, compared to the much stronger army of 2000 soldiers in Country B with a much weaker technological backing. Although the battle was fierce and a close-call for both countries, Country A country did finally win the battle.

a. How confident would you have been in predicting this?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

25. Imagine everybody in every city in the world was photographed. From studying the photos, it appears that 50% of the photos show people with their heads facing to the left, whilst the other 50% of the people are looking to the right.
You are presented with a series of these photos in which the direction of gaze, in the order that you receive them, is as follows:

Left, Left, Right, Left, Left, Left, Right, Left, Right, Left, Left, Left, Left, Left, Left, Right,......

a. If presented with another photo, which direction do you think the person's head will be facing?

Please Circle: Right Left

b. How confident are you that your judgement is correct?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident) ....

26. Trainer A enters 15 horses and Trainer B enter 10 horses into the season's races. Before entering the paddock before a particular race, a punter points to a horse and reports that it comes from Trainer B. It is known that even from a distance, the punter can correctly report which Trainer the horse belongs to 80% of the time, and fails 20% of the time.

a. What is the likelihood that the horse that the punter points to, comes from Trainer B?

Please Indicate from 0 (Completely Unlikely) to 100 (Completely Likely) ....

27. The outcomes of the spin of the Roulette wheel are clearly displayed for you to look at. Out of the last 8 outcomes, there was a sequence of four red in a row, followed by four black numbers.

a. Given that the next outcome that you've just seen was in fact Red, how confident would you have been in predicting it?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

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28. You have been observing the outcomes at a Roulette table. The outcomes so far on the table you've been looking at have been:

Red, Red, Black, Red, Red, Red, Black, Red, Black, Red, Red, Red, Red, Red, Red, Black,

a. What do you think the next outcome will be? Please Circle: Red Black

b. How confident are you that your choice is correct?
Please Indicate from 0 (Completely Unconfident) to 100 (Completely Confident)

....

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1. Do you currently gamble? YES NO

2. When was the last time you gambled? (Days, Weeks, Months, ago) ....

<u>Please answer the following questions about the gambling you have done over the last 12 months,</u> (or throughout your previous episode of gambling)

3. Which of the following activities have you wagered money on? (please circle)

Horse/Dog racing (Off course)	The National Lottery	Bingo
Horse/Dog racing (On course)	Scratch Cards	Pools
Gaming machines (fruit machines etc.)	Casino games	Other:......................
Sports betting (Motor sports, Football etc.)		

4. Which is the form of gambling you take part in most often? ....

4a. Which is the form that you have spent the most money on? ....

5. Over the last 12 months, on average, how often have you gambled?
(e.g. 2 per week, every day, once a month ...etc) ....

5a. Over the last 12 months, approximately how much money have you spent gambling? ....

6. How long is your typical gambling episode? (please circle)
(e.g. 10 minutes, 1 hour, 6 hours, ...etc) ....

7. On average, how much do you spend per session? (please circle) ....

8. Do you see your gambling activities as ever having lead to a problem? NO YES

9. Have you sought or thought of seeking help for your gambling behaviour? YES NO

10. Was there any time when the amount you were gambling made you nervous? YES NO

11. After winning, do you feel you ought to gamble more to increase your winnings? NO YES

12. Do you gamble until all your spare cash has gone? YES NO

13. After losing, do you spend more money to try to make up for your losses? NO YES

14. Do you ever get into debt as a result of your gambling? NO YES

15. Have you borrowed money to gamble or pay gambling debts? YES NO

16. Do you find you gamble for longer than you intended? NO YES

17. Do you need to gamble with more and more money to achieve the desired excitement? YES NO

18. Do you ever have unsuccessful attempts to control, cut back, or stop gambling? NO YES

19. When you gamble, do you go back another day to win back the money you lost? NO YES

20. Do you ever gamble more money than you intended to? YES NO

21. Have you felt guilty about the way you gamble or about what happens when you gamble?
YES NO

22. Have you hidden betting slips, lottery tickets, gambling money, or other signs of gambling form your spouse, children, or other important people in you life? NO YES

<u>Please respond to the following items by circling the option that best describes the way you feel.</u>(Please only circle one option)

23. Gambling makes me feel really alive.

Strongly Agree Agree Disagree Strongly Disagree

24. Sometimes I forget about the time when I am gambling.

Strongly Disagree Disagree Agree Strongly Agree

25. I get a real buzz that lifts me when I gamble.

Strongly Disagree Disagree Agree Strongly Agree

26. Whilst gambling I feel I'm free, able to do and choose what I like.

Strongly Disagree Disagree Agree Strongly Agree

27. I feel less stressed when I gamble.

Strongly Disagree	Disagree	Agree	Strongly Agree

28. Whilst I'm in the gambling environment, I usually don't notice what other people are up to.

Strongly Disagree	Disagree	Agree	Strongly Agree

29. As soon as I start gambling I feel different to how I did before.

Strongly Disagree	Disagree	Agree	Strongly Agree

30. If I were feeling down, gambling would probably pick me up.

Strongly Agree	Agree	Disagree	Strongly Disagree

31. I like gambling because it helps me to forget my everyday problems.

Strongly Disagree	Disagree	Agree	Strongly Agree

32. If I have not won any bets for a while, I am probably due for a big win.

Strongly Disagree	Disagree	Agree	Strongly Agree

33. I know when I'm on a streak.

Strongly Agree	Agree	Disagree	Strongly Disagree

34. It is important to feel confident when I'm gambling.

Strongly Disagree	Disagree	Agree	Strongly Agree

35. No matter what the game is, there are betting strategies that can help you to win.

Strongly Disagree	Disagree	Agree	Strongly Agree

36. I have carried a lucky charm when I gambled.

Strongly Agree	Agree	Disagree	Strongly Disagree

37. I must be familiar with a gambling game if I am going to win.

Strongly Agree	Agree	Disagree	Strongly Disagree

38. To be successful at gambling, I must be able to identify streaks.

Strongly Disagree	Disagree	Agree	Strongly Agree

39. I sometimes find myself saying or thinking "I feel that I'm going to win this time".

Strongly Disagree	Disagree	Agree	Strongly Agree

40. I sometimes find myself saying or thinking "I knew it was going to be that, I said so".

Strongly Agree	Agree	Disagree	Strongly Disagree

41. I sometimes find myself saying or thinking "How come I didn't win?"

Strongly Disagree	Disagree	Agree	Strongly Agree

42. I sometimes find myself saying or thinking "This time wasn't very good, I could have played better."

Strongly Agree	Agree	Disagree	Strongly Disagree

Please indicate by circling a response as to how much you agree that each item is relevant to you.

43. Some people have the experience of driving a car and suddenly realising that they don't remember what has happened during all or part of the trip.

Strongly Agree Agree Disagree Strongly Disagree

44. Some people have the experience of finding themselves in a place and having no idea how they got there.

Strongly Disagree Disagree Agree Strongly Agree

45. Some people have the experience of feeling as though they are standing next to themselves or watching themselves do something and they actually see themselves as if they were looking at another person.

Strongly Agree Agree Disagree Strongly Disagree

46. Some people find that they have no memory for some important events in their lives.

Strongly Disagree Disagree Agree Strongly Agree

47. Some people have the experience of not being sure whether things that they remember happening really did happen or whether they just dreamed them.

Strongly Disagree Disagree Agree Strongly Agree

48. Some people have the experience of being in a familiar place but finding it strange and unfamiliar.

Strongly Agree Agree Disagree Strongly Disagree

49. Some people find that when they are watching television or a movie they become so absorbed in the story that they are unaware of other events happening around them.

Strongly Disagree Disagree Agree Strongly Agree

50. Some people sometimes find that they become so involved in a fantasy or daydream that it feels as though it were really happening to them.

Strongly Agree Agree Disagree Strongly Disagree

51. Some people find that in one situation they may act so differently compared with another situation that they feel almost as if they were two different people.

Strongly Agree Agree Disagree Strongly Disagree

52. Some people sometimes find that they hear voices that tell them to do things or comment on things that they are doing.

Strongly Disagree Disagree Agree Strongly Agree

8. References

Allcock, C. C., and Grace, D. M., (1988). Pathological gamblers are neither impulsive nor sensation-seekers. *Australian and New Zealand Journal of Psychiatry*, **22(3)**, 307-311.

American Psychiatric Association (1980). *Diagnostic and statistical manual, third edition, revised.* Washington, D.C., Author.

American Psychiatric Association (1994). *Diagnostic and statistical manual, fourth edition.* Washington, D.C., Author.

Anderson G, & Brown, R. I. F., (1984). Real and Laboratory gambling, sensation-seeking and arousal. *British Journal of Psychology*, **75**, 401-410.

Arkes, H. R., Wortmann, R. L., Saville, P. D., & Harkness, A. R. (1981). Hindsight bias among physicians weighing the likelihood of diagnoses. *Journal of Applied Psychology.* **66(2)**, 252-254.

Arrow, K. J., (1970). Essays in the theory of risk-bearing. North Holland, Amsterdam. In Walker, M. B., (1992). *The Psychology of Gambling.* Oxford: Pergamon Press.

Bar-Hillel, M. (1980). The base-rate fallacy in probability judgements. *Acta Psychologica,* **44**, 211-233.

Baron, J. (1985). *Rationality and Intelligence.* Cambridge, England: Cambridge University Press.

Baumeister, R. F. (1991). *Escaping the self: Alcoholisim, spirituality, masochism and other flights from the burden of selfhood.* New York: Guilford Press.

Bergler, E. (1957) *The Psychology of Gambling.* New York: Hill & Wang.

Bernstein, E.M, and Putman, F.W. (1986). Development, reliability and validity of a dissociation scale. *The Journal of Nervous and Mental Disease*, **174**, 727-735.

Birnbaum M. H. (1983). *American Journal of Psychology*, **96(1)**.1, pp83-94.

Blascovitch, J., Veach, T. L. & Ginsburg, G. P. (1973). Blackjack and the risky shift. *Sociometry*, **36**, 42-55.

Blaszczynski, A. P., Wilson, A. C., and McConaghy, N. (1986). Sensation seeking and pathological gambling. *British Journal of Addiction*. **81(1)**, 113-117.

Breen, R, B., & Frank, M. L., (1993). The effects of statistical fluctuations and perceived status of a competitor on the illusion of control in experienced gamblers. *Journal of Gambling Studies*. **9(3)**, 265-276.

Breen, R, B. & Zuckerman, M. (1999). "Chasing" in gambling behavior: Personality and cognitive determinants. *Personality and Individual Differences*, **27(6)**, 1097-1111.

Brenner, G. A. & Brenner, R. A., (1987). A profile of Gamblers. Centre de Recherche et Developpement en Economique. Montreal (Quebec). In Walker, M. B., (1992). *The Psychology of Gambling*. Oxford: Pergamon Press.

Brown, R.I.F., (1986). Arousal and sensation seeking components in the general explanation of gambling and gambling addictions. *International Journal of Addictions*, **21**, 1001-1016.

Buhringer, G. and Konstanty, R. (1992). Intensive gamblers on German-style slot machines, *Journal of Gambling Studies*, **8**, 21-38.

Caldwell, G. T., Young, S., Dickerson, M. G., & McMillen, J., (1988). Casino development for Canberra, Social Impact Report. Commonwealth of Australia, Canberra. In Walker, M. B., (1992). *The Psychology of Gambling*. Oxford: Pergamon Press.

Carlton, P.L. and Manowitz, P. (1987). Physiological factors in determinants of pathological gambling. *Journal of Gambling Behavior*, **3**, 274-285.

Caverni, J. P., Fabre, J. M., and Gonzalez, M. (eds.) (1990). Cognitive Biases. *Advances in Psychology*, **68**. Elsevier Science Publishing Company, Oxford.

Ceci, S. J., & Liker, J. K., (1986). A day at the races: A study of IQ, expertise, and cognitive complexity. *Journal of Experimental Psychology:-General*. **115(3)**, 255-266.

Christiansen, E.M. (1993). Income 1992 gross annual wager of the U.S. Part 1: Handle. *Gaming and Wagering Business,* **14(7)**, 12-35.

Cohen, L. J., (1979). On the psychology of prediction: whose is the fallacy? *Cognition,* **7**, 385-407.

Cornish, D.B. (1978). Gambling: a review of the literature and its implications for policy and research. *Home Office Research Study*, 42. London, HMSO.

Coulombe, A., Ladouceur, R., Desharnais, R., and Jobin, J., (1992). Erroneous perceptions and arousal among regular and occasional video poker players. *Journal of Gambling Studies,* **8(3)**, 235-244.

Coventry, K. R. (in press). Rationality and Decision Making: The case of gambling and the development of gambling addiction. Gambling Research: Proceedings of the Ninth International Conference on Gambling and Risk Taking, Las Vegas.

Coventry, K.R. and Brown, R.I.F, (1993). Sensation seeking, gambling and gambling addictions. *Addiction*, **88**, 541-554.

Coventry K. C., and Constable, B. (1999). Physiological arousal and sensation-seeking in female fruit machine players. *Addiction,* **94(3)**, 425-430.

Coventry , K. R., and Norman, A. C., (1997). Arousal, Sensation seeking and frequency of gambling in off-course horse racing bettors. *British Journal of Psychology*, **88**, 671-681.

Coventry , K. R., and Norman, A. C., (1998). Arousal, erroneous verbalisations and the illusion of control during a computer-generated gambling task. *British Journal of Psychology*, **89**, 629-645.

Custer, R.L. and Milt, H. (1985). *When luck runs out.* New York: Facts on File Publications.

Delfabbro, P.H., and Winefield, A.H., (1998). Poker machine gambling: An analysis of within session characteristics. *British Journal of Psychology*, **90(3)**, 425-439.

Dennis, I., Newstead, S. E., and Wright, D. E. (1996). A new approach to exploring biases in educational assessment. *British Journal of Psychology,* **87**, 515-534.

Devereaux, E. C. Jr. (1968). Gambling in psychological and sociological perspective. International Encyclopedia of the Social Sciences, 6, 53-62. IN Wagenaar, W. A. (1988) *Paradoxes of Gambling Behaviour*. Lawrence Erlbaum Associates. London.

Diagnostic and Statistical Manual of Mental Disorders, 10th ed. rev. Washington DC, American Psychiatric Association, 1987.

Dickerson, M. (1977). The role of the betting shop environment in the training of compulsive gamblers. *B.A.B.P. Bulletin.* **5(1)**: 3-8.

Dickerson, M. G. (1979). FI schedules and persistence at gambling in the U.K. betting office. *Journal of Applied Behavior Analysis.* **12(3),** 315-323.

Dickerson, M. G. (1984). *Compulsive Gamblers*. London, Longman.

Dickerson, M. G. (1989) Gambling: A dependence without a drug. *International Review of Psychiatry*. **1(1-2)**, 157-171.

Dickerson, M. G. (1993). A preliminery exploration of a two-stage methodology in the assessment of the extent and degree of gambling related problems in the Australian population. IN Eadington, W.R. and Cornelius, J.A. (eds.) *Gambling Behavior and Problems*.

Dickerson, M. G. (1993). Internal and external determinants of persistent gambling: Problems in generalising from one form of gambling to another. *Journal of Gambling Studies,* **9**, 225-245.

Dickerson, M. G. and Adcock, S.G. (1987). Mood arousal and cognitions in persistent gambling: Preliminary investigation of a theoretical model. *Journal of Gambling Behaviour,* **82**, 673-680.

Dickerson, M. G., Cunningham, R., England, S-L., & Hinchy, J., (1991). On the determinants of persistent gambling: III. Personality, prior mood, and poker machine play. *International Journal of the Addictions*. **26(5)**, 531-548.

Dickerson, M. G., Hinchy, J., and Fabre, J., (1987). Chasing, arousal and sensation seeking in off-course gamblers. *British Journal of Addiction*, **82**, 673-680.

Dickerson, M. G. & Hinchy, J. (1988). The prevalence of excessive and pathological gambling in Australia. *Journal of Gambling Behaviour*, **4**, 135-151.

Dickerson, M., Hinchy, J., England, S. L. ,Fabre, J., & Cunningham, R., (1992). On the determinants of persistant gambling behaviour: I. High-frequency poker machine players. *British Journal of Psychology*. **83(2)**, 237-248.

Dickerson, M., Walker, M., England, S-L., and Hinchy, J., (1990) Demographic, personality, cognitive and behavioural correlates of off-course betting involvement. *Journal of Gambling Studies*, **6(2)**, 165-182.

Dumont, M., & Ladouceur, R. (1990). Evaluation of motivation among video-poker players. *Psychological Reports*. **66(1)**, 95-98.

Epstein, S. (1990). Cognitive-experiential self-theory. IN Pervin, L. (Ed.) Handbook of personality theory and research (pp. 165-192).

Epstein, S., Pacini, R., Dennes-Raj, V., Heier, H., (1996). Individual differences in intuitive-experiential and analytical-rational thinking styles. *Journal of Personality and Social Psychology*, **71(2)**, 390-405.

Evans, J. St.B. T. (1989). Bias in Human Reasoning: Causes and Consequences. *Essays in Cognitive Psychology*. Lawrence Erlbaum Associates. London UK.

Evans, J. St.B. T., and Over, D. E., (1996). Rationality and Reasoning. *Essays in Cognitive Psychology*. Psychology Press, Hove, UK.

Evans, J. St.B. T., Over, D. E. & Manktelow, K. I. (1993). Reasoning, decision making and rationality. *Cognition*, **49 (1-2)**, 165-187.

Fahrenberg, J., Foerster, F., and Wilmers, F. (1993). Cardiovascular response to mental and physical tasks as predictors of ambulatory measurements. *Journal of Psychophysiology*, **7**, 275-289.

Ferster, C. B. & Skinner, B. F. (1957). *Schedules of reinforcement.* Appleton Century Crofts. New York.

Fischhoff, B. (1975). Hindsight /= Foresight: the effect of outcome knowledge on judgement under uncertainty. *Journal of Experimental Psychology: Human Perception and Performance*, **1**, 288-299.

Fischhoff, B., & Beyth, R. (1975) "I knew it would happen" - Remembered probabilities of once-future things. *Organisational Behaviour and Human Performance*, **13**, 1-16.

Fitzgerald, S., (1997). Lotteries: Considering consideration. *Society for the Study of Gambling Newsletter,* **29**, Spring, 5-10.

Freud, S. (1917). Mourning and melancholia, in J. Strachey (ed.) (1957). Standard Edition, 14, 237-258.

Freud, S. (1928). Dosteovsky and parracide. In Collected Works, (1950) **5**., 222-242.

Gaboury, A., and Ladouceur, R., (1989). Erroneous perceptions and gambling. *Journal of Social Behavior and Personality,* **4**, 411-420.

Gaboury, A. & Ladouceur, R. (1993). Evaluation of a prevention program for pathological gambling among adolescents. *Journal of Primary Prevention.* **14(1)**, 21-28.

Gaboury, A., Ladouceur, R., Beauvais, G., Marchand, L., and Martineau, Y. (1988). Dimensions cognitives et comportementales chez les jouers réguliers et occasionnels au blackjack. *International Journal of Psychology*, **23**, 283-291.

Hess, H. F. and Diller, J.V. (1969). Motivation for gambling as revealed in the marketing methods of the legitimate gambling industry. *Psychological Reports*, **25**, 19-27.

Hill, E. and Williamson, J. (1998). Choose six numbers, any numbers. *The Psychologist: Bulletin of the British Psychological Society*, **11(1)**, 17-21.

Hogarth, R.M., and Einhorn, H.J., (1992). Order effects in belief updating: the belief adjustment model. *Cognitive Psychology*, **24**, 1-55.

Hraba, J., Lee, G., (1996). Gender, gambling and problem gambling. *Journal of Gambling Studies.* **12(1)**, 83-101.

Kahneman, D. & Tversky, A. (1972). Subjective Probability : a judgement of representativeness. *Cognitive Psychology*, **3**, 430-454.

Kahneman, D. & Tversky, A. (1973). On the psychology of prediction. *Psychological Review*, **80**, 237-251.

Kahneman, D. & Tversky, A. (1979). Prospect Theory: an analysis of decision under risk. *Econometrica*, **47**, 263-291.

Kahneman D., Slovic, P. & Tversky, A., (1982). *Judgement Under Uncertainty: Heuristics and Biases.* Cambridge: Cambridge University Press.

Kihlstrom, J. F., Glisky, M. L., and Anguilo, M. J., (1994). Dissociative tendencies and dissociative disorders. *Journal of Abnormal Psychology*, **103**, 117-124.

Kuley, N. B., and Jacobs, D. F., (1988) The relationship between dissociative-like experiences and sensation seeking among social and problem gamblers. *Journal of Gambling Behavior* , **4(3)**, 197-207.

Ladouceur, R. (1991). Prevalence estimates of pathological gamblers in Quebec, Canada, *Canadian Journal of Psychiatry*, **36**, 732-734.

Ladouceur, R. & Dube, D. (1997). Erroneous perceptions in generating random sequences: Identification and strength of a basic misconception in gambling behavior. *Swiss Journal of Psychology*. **56(4)**, 256-259.

Ladouceur, R., Dube, D., Giroux, I., Legendre, N. & Gaudet, N., (1995). Cognitive biases in gambling: American roulette and 6/49 lottery. *Journal of Social Behavior and Personality.* **10(2)**,473-479.

Ladouceur, R., Gaboury, A. (1988). Effects of limited and unlimited stakes on gambling behavior. *Journal of Gambling Behavior*, **4(2)**, 119-126.

Ladouceur, R., Gaboury, A. (1988). Risk-taking behavior in gamblers and non-gamblers during prolonged exposure. *Journal of Gambling Behavior*.

Ladouceur, R., Gaboury, A., Bujold, A., Lachance, N., & Tremblay, S., (1991). Ecological validity of laboratory studies of videopoker Gaming. *Journal of Gambling Studies*, **7(2)**, 109-116.

Ladouceur, R., Gaboury, A., Dumont, M., and Rochette, P., (1988). Gambling: Relationship between the frequency of sins and irrational thinking. *Journal of Psychology,* **122**, 409-414.

Ladouceur, R., & Mayrand, M., (1984). Evaluation of the "Illusion of Control": Type of feedback, outcome sequence, and number of trials among regular and occasional gamblers. *The Journal of Psychology*, **117**, 37-46.

Ladouceur, R., & Mayrand, M., (1987). The level of involvement and the timing of betting in roulette. *The Journal of Psychology*, **121**, 169-176.

Ladouceur, R., Mayrand, M., Dussault, R., Letarte, A., & Tremblay, J., (1984). Illusion of control: The effects of participation and involvement. *The Journal of Psychology*, **117**, 47-52.

Ladouceur, R., Mayrand, M., & Tourigny, Y., (1987). Risk-taking behavior in gamblers and non-gamblers during prolonged exposure. *Journal of Gambling Behavior*. **3(2)**, 115-122.

Ladouceur, R., Paquet, C., & Dube, D., (1996) Erroneous perceptions in generating sequences of random events. *Journal of Applied Social Psychology.* **26(24),** 2157-2166.

Ladouceur, R., Paquet, C., Lachance, N., & Dube, D., (1996). Examen d'une erreur fondamentale dans la perception du hasard. *International Journal of Psychology.* **31(2),** 93-99.

Ladouceur, R., Sylvain, C., Duval, C., Gaboury, A., and Dumont, M., (1989). Correction des verbalisations irrationnelles chez les jouers de poker-vidéo. *International Journal of Psychology,* **24,** 43-56.

Ladouceur, R., Tourigny, M., & Mayrand, M., (1985). Familiarity, group exposure, and risk-taking behaviour in gambling. *The Journal of Psychology,* **120(1),** 45-49.

Ladouceur, R. & Walker, M. (1996) A Cognitive Perspective on Gambling. IN Salkovskis, P. M. (ed) (1996), *Trends in Cognitive and Behavioural Therapies.* John Wiley & Sons Ltd.

Langer, E. J., (1975). The Illusion of Control. *Journal of Personality and Social Psychology.* **32(2),** 311-328.

Langer, E. J., (1983). *The Psychology of Control.* Beverly Hills, CA. Sage.

Langer, E. J. & Roth, J., (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(6),** 951-955.

Leary, K. & Dickerson, M. G. (1985). Levels of arousal in high and low frequency gamblers. *Behavior Research and Therapy,* **23,** 197-207.

Lefcourt, H. M. (1973). The function of the illusions of control and freedom. *American Psychologist,* **28,** 417-425.

Lesieur, H. R. and Blume, S. B. (1991). When lady luck loses: Women and compulsive gambling. IN Van Den Burgh, N. (1991). *Feminist perspectives on addictions.* New York, Springer Publishing Co.

Letarte, A., Ladouceur, R., & Mayrand, M., (1986). Primary and secondary illusory control and risk-taking in gambling (roulette). *Psychological Reports,* **58**, 299-302.

Lynch, W. C., Schuri, U, & D'Anna, J. (1976) Effects of isometric muscle tension on vasomotor activity and heart rate. *Psychophysiology*, **13**, 222-230.

Maze, J. R., (1987). Lady Luck is gambler's mother. IN Walker, M. b., (Ed.) *Faces of Gambling*. Sydney: National Association for Gambling Studies.

McGlothin, W. H., (1956). Stability of choices among uncertain alternatives. *American Journal of Psychology*, **69**, 604-615.

Nisbet, R. E., & Wilson, T. D., (1977). "Telling more than we can know:verbal reports on mental processes. *Psychological Review*, **84**, 231-259.

Obrist, P. A. (1981) Cardiovascular Psychophysiology. A Perspective. New York/London: Plenum.

Pacini, R. and Epstein, S., (1999). The relation of Rational and Experiential processing styles to personality, basic beliefs, and the ratio-bias phenomenon. *Journal of Personality and Social Psychology*. **76(6)**, 972-987.

Pennington, D. C., Rutter, D.R., McKenna, K. & Morley, I. E. (1980). Estimating the outcome of a pregnancy test: Women's judgements in foresight and hindsight. *British Journal of Social and Clinical Psychology*. **19(4)**, 317-324.

Peterson, D. K., & Pitz, G., (1988). Confidence, uncertainty and the use of information. *Journal of Experimental Psychology: Learning, Memory and Cognition*, **14(1)**, 85-92.

Putman, F. W. (1991b). Dissociative phenomena. In A. Tasman & S. M. Goldfinger (Eds.), American psychiatric press review of psychiatry (pp. 145 - 160). Washington, D.C. American Psychiatric Press.

Putman F. W., Carlson, E.B., Ross, C.A., Anderson, G., Clark, P., Torem, M., Bowman, E.S., Coons, P., Chu, J.A., Dill, D.L., Loewenstein, R. J., and Braun, B.G., (1996). Patterns of dissociation in clinical and nonclinical samples. *Journal of Nervous and Mental Disease,* **184**, 673-679.

Reber, A. S. (1986). Implicit learning and tacit knowlegde. *Journal of Experimental Psychology: General,* **118**, 219-235.

Reid, R.L., (1986) The Psychology of the near miss. *Journal of Gambling Behavior,* **2**, 32-39.

Rosenthal, R. J., (1992). *Pathological gambling.* Psychiatric Annuals. **22(2)**, 72-78.

Satorra, A. and Bentler, P.M.(1988) Scaling corrections for chi-square in covariance structure analysis. *Proceedings of the American Statistical Association,* **4**, 308-313.

Satorra, A. and Bentler, P.M.(1994) Corrections to test statistics and standard errors in covariance structure analysis. In A von Eye and C.C.Clogg (eds.) *Latent variable analysis: Applications for developmental research.* Thousand Oaks, CA: Sage.

Saunders, D. M. (1981). The late betting phenomenon in relation to type of bet and type of race. *Behavioural Psychotherapy,* **9**, 330-337.

Savoie, D., & Ladouceur, R. (1995) Evaluation et modification de conceptions erronees au sujet des loteries. *Canadian Journal of Behavioural Science.* **27(2)**, 199-213.

Scolaris, D. & Brown, R.I.F. (1988). A classification of gambling superstitions. Unpublished manuscript, Department of Psychology, University of Glasgow.

Shubin, S. (1977) The compulsive gambler. *Today in Psychiatry.* **3**, 1-3.

Skinner, B. F. (1953). *Science and Human Behaviour.* New York, Free Press.

Smith, E. E., Guyton, A. C., Manning, R. D. & White, R. J. (1976). Integrating mechanisms of cardiovascular response and control during exercise in the normal human. *Progress in Cardiovascular Disease*, **18**, 421-443.

Stanovich, K. E., (1999). *Who is Rational? Studies of Individual Differences in Reasoning.* Lawrence Erlbaum Associates, London.

Stanovich, K. E. and West, R. F., (1998). Individual Differences in Reasoning and the Heuristic and Bias Debate. IN Learning and Individual Differences: Process, Trait and Content Determinants. P. L. Ackerman, P. C. Kyllomen and R. D. Roberts (Eds.). American Psychiatric Association, Washington D.C.

Steinberg, M. A., Kosten, T. A., and Rounsaville B. J., (1992) Cocaine abuse and pathological gambling. *American Journal on Addictions*, **1(2)**, 121-132.

Sullivan, G., (1972). *By chance a winner, the history of lotteries*. New York: Dodd, Mead and Co.

Sylvain, C. & Ladouceur, R., (1992). Correction cognitive et habitudes de jeu chez les jouers de poker-vidéo. *Canadian Journal of Behavioural Science*, **24(4)**, 479-489.

Sylvain, C., Ladouceur, R., & Boisvert (1997). Cognitive and behavioral treatment of pathological gambling: A controlled study. *Journal of Consulting and Clinical Psychology*. **65(5)**, 727-732.

Thomas, W. I. (1901). The gambling instinct. American Journal of Sociology, 6, 750-763. IN Wagenaar, W. A. (1988). *Paradoxes of Gambling Behaviour*. Lawrence Erlbaum Associates. London.

Tversky, A., and Kahneman, D., (1971). Belief in the law of small numbers. *Psychological Bulletin*, **76**, 105-110.

Tversky, A. and Kahneman D. (1983). Extensional vs. Intuitive reasoning: the conjunction fallacy in probability judgement. *Psychological Review*, **90**, 293-315.

Vickrey, W., (1945). Measuring marginal utility of reactions to risk. Econometrica, 13, 319-333. In Wagenaar, W. A., (1988). *Paradoxes of Gambling Behaviour*. Hove: Lawrence Erlbaum Associates. Essays in Cognitive Psychology Series.

Volberg, R. A., & Steadman, H. J. (1988). Refining prevalence estimates of pathological gambling. *American Journal of Psychiatry*, **145**, 502-505.

Wagenaar, W. A., (1988). *Paradoxes of Gambling Behaviour*. Hove: Lawrence Erlbaum Associates. Essays in Cognitive Psychology Series.

Walker, M. B., (1985). Explanations for Gambling. In Caldwell, G. T., Dickerson, M. G., Haig, B., & Sylvan, L. (Eds), (1985). *Gambling in Australia*. Sydney: Crook Helm.

Walker, M. B., (1992). *The Psychology of Gambling.* Oxford: Pergamon Press.

Waters, L. K., and Kirk, W. E., (1968). Stimulus-seeking motivation and risk-taking behavior in a gambling situation. *Educational and Psychological Measurement*, **28(2)**, 549-550.

Wolfgang, A. K., (1988). Gambling as a function of gender and sensation seeking. *Journal of Gambling Behavior,* **4(2)**, 71-77.

Wolfgang, A. K., Zenker, S. I., & Viscusi, T., (1984). Control motivation and the illusion of control in betting on dice. *The Journal of Psychology*, **116**, 67-72.

Wong, A., and Carducci, B. J., (1991). Sensation seeking and financial risk taking in everyday money matters. *Journal of Business and Psychology*, **5(4)**, 525-530

Zola, I. K., (1963). Observations on gambling in a lower-class setting. Social Problems, 10, 353-361. IN Wagenaar, W. A. (1988). *Paradoxes of Gambling Behaviour*. Lawrence Erlbaum Associates. London.

Zuckerman, M., (1979) *Sensation seeking: Beyond the Optimal Level of Arousal*. Hillsdale, NJ: Erlbaum.

Zuckerman, M., (1994). *Behavioral expressions and biosocial bases of sensation seeking.* New York: Cambridge University Press.