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The Mental Representation of "If Only" Thoughts: Undoing the Exceptionality Effect.

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2009

Declaration

(a) The work contained in this thesis has not been submitted as an exercise for a degree at this or any other university.

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Summary

The aim of this thesis is to investigate the mental representations and cognitive processes that underlie counterfactual 'if only' thoughts. We examine the exceptionality effect, the tendency to undo exceptional antecedents to an outcome. We test whether manipulating the mental representation of *different possibilities* affects its occurrence. In Chapter 1, we review the literature on counterfactual thinking, conditional reasoning and decision-making. We outline different phenomena previously identified within counterfactual thinking, the function of these thoughts and theories about how counterfactual thoughts are constructed. We highlight that an understanding of counterfactual thoughts requires an account of the mental representations of counterfactual possibilities. We also review findings from decision-making research identifying principles about how people mentally represent choices when making decisions.

In Chapter 2, we test the occurrence of the exceptionality effect using versions of the everyday scenario used in the first identifications of the effect. We systematically modify the scenarios to test whether reasons for exceptional actions reduce their mutability. We also test if estimated regret is higher for unjustified actions than justified actions following negative outcomes. We show that participants judge overall regret to be greater for unjustified exceptional actions than justified exceptional actions, and find support for a theory of regret advocating that it comprises two aspects, process and outcome regret. However, the results show that justified exceptional actions are mutated as often as unjustified exceptional actions, in this everyday scenario.

In Chapter 3 we examine 'if only' thoughts about justified exceptional actions, employing a new card game scenario to test whether participants focus on antecedents that can bring about a better outcome. We show that participants change actions to exceptional actions or to unjustified actions if they lead to better outcomes. The experiments in this

series also show that people use a risk seeking simple gains strategy when deciding on the best bet.

In Chapter 4 we use the card game scenario to test the effects of unjustified actions on the exceptionality effect. We find that unjustified actions leads two groups of participants to create counterfactual thoughts that focus on different antecedents when undoing the outcome. We support our findings from Chapter 3 showing that participants use a simple gains risk seeking strategy to choose the best bet.

Chapter 5 investigates whether the underlying mental representations of three types of conditional, *indicative-if*, *subjunctive-if* and *subjunctive-if only* lead initially to participants keeping different explicit possibilities in mind. We find that differences in inferential arguments, consistency judgments and implication tasks support this hypothesis. We find support for the hypothesis that participants initially represent the conjecture for indicative-if conditionals, they represent the conjecture and the presupposed facts for the subjunctive-if conditional, and they appear to initially represent only the presupposed facts for subjunctive-if only conditionals.

In Chapter 6 we summarise the findings and discuss the importance of understanding the mental representation of conditionals and counterfactual thoughts. We consider alternative explanations for out results and we discuss the implications of our results for theories of counterfactual thinking, conditional reasoning and decision-making. We also propose some questions for future research.

Chapter 1 – Introduction

Most of us have experienced a course of events that did not turn out the way we hoped. We may have seen a chance to invest in a successful business opportunity go astray. Or we may think of a relationship that ended badly, or one that never got going in the first place. Often with these kinds of thoughts we think *if*. *If* primes us to imagine an alternative world where unrealised events exist. Our goal in this thesis is to investigate these different possibilities. We examine how people create counterfactual thoughts, why they are created, and we examine the principles that govern their creation. We also test some predictions regarding the alternative possibilities people will and will not think of.

Counterfactual thoughts have received a considerable amount of attention from philosophers (e.g.`, Lewis, 1973; Over, 2005; Stalnaker, 1970), linguists (Haser, 2005) and psychologists (see Byrne, 2005 for a review; Mandel, Hilton, & Catellani, 2005; Roese & Olson, 1995c). The comparison process of counterfactual thinking influences reasoning, mediates emotions, and impacts on decision-making, all of which will be illustrated and examined in this thesis.

Research into counterfactual thinking has produced insight into how people compare and contrast possibilities. In turn, this has led to numerous theories about the mechanisms and functions of these comparative processes. In this thesis we will test some of these theoretical aspects and aim to extend some of this insight to the field of decision-making. Within counterfactual thoughts, specifically we will examine whether people tend to imagine alternatives to exceptional actions by focusing on their usual actions, or whether they focus on exceptional events. For example, take the following scenario, Mr. Jones is 47 years old, the father of three and a successful banking executive. His wife has been ill at home for several months (Kahneman & Tversky, 1982):

> On the day of the accident, Mr. Jones left the office at the regular time. He

> sometimes left early to take care of home chores at his wife's request but this was not necessary on that day. Mr. Jones did not drive home by his regular route. The day was exceptionally clear and Mr. Jones told his friends at the office that he would drive along the shore to enjoy the view. The accident occurred at a major intersection. The light turned amber as Mr. Jones approached. Witnesses noticed that he braked hard to stop at the crossing, although he could easily have gone through. His family recognised this as a common occurrence in Mr. Jones' driving. As he began to cross after the light had changed, a truck charged into the intersection at top speed, and rammed Mr. Jones' car from the left. Mr. Jones was instantly killed. It was later ascertained that the truck was driven by a teenage boy, who was under the influence of drugs. As commonly happens in such situations, Mr. Jones family often thought and often said *if only* in the days that followed the accident.

Researchers have found that when people are asked to imagine how things could have been different, they undo the outcome. To test this, they gave people a scenario like the one above and asked them to complete 'if only' sentence stems. They then coded the completed sentences under one of four categories, undoing of route, undoing of departure time, undoing the crossing at the amber light and removing the drugged boy from the scene. In the above example, the most common form of undoing was having Mr. Jones take his usual route home (Gavanski & Wells, 1989; Kahneman & Tversky, 1982). Despite the originality of this finding, which went on to mobilise much of the counterfactual research, more recent research has shown that this finding can be mediated by other factors. Further to this, new methodologies have been employed to overcome some of the shortcoming of this original research, for example, the realisation that alternations to events do not fluctuate in the simple manner proposed by this original research, namely, an undoing of events by moving them towards greater normality In this thesis we will re-examine how people undo exceptional actions following negative outcomes, what happens when negative outcomes follow from exceptional or normal actions, and we examine whether justified actions are changed in the same way.

Throughout the thesis we will advocate that counterfactual thoughts are limited in their scope because of some basic principles limiting the alternatives that people imagine. We will examine some of the assertions and interpretations people reach from *if* and we look at how these differ from *if only* assertions. We will suggest that these differences arise because of different mental representations underlying the assertions. We illustrate with the following assertion, *if Mr. Jones wears his seatbelt, then he does not die.* From this assertion people initially think only about a factual possibility in which Mr Jones wears a seatbelt and does not die. Now take the conditional sentence; *if Mr. Jones had worn his seat belt, then he would not have died.* This assertion can imply that Mr Jones wore a seatbelt and did not die. It can also suggest the presupposed facts that Mr. Jones did not wear his seatbelt and that he was killed. We will put forward an explanation as to why these sentences produce different interpretations, and test the effects these differences have on the inferences people draw from them.

This chapter is divided into three main sections. The first section reviews the relevant literature on counterfactual thinking. We consider the theories about the functions and constraints of counterfactual thoughts, and the factors that lead to their generation. In the second section we review research on decision-making, the effect that uncertainty and risk have on choices and how people make decisions using the comparative process of counterfactual thinking, In the final section we try to tie together research from both fields, explaining counterfactual thinking by focusing on how counterfactual possibilities are mentally represented in people's minds.

Counterfactual Thinking

People commonly imagine how events or outcomes could have turned out differently (Byrne, 2002; Kahneman & Tversky, 1982). Take for instance, a situation where a person forgets to buy their weekly lottery ticket. Their numbers come up and they lose out on a

multi-million euro jackpot. A counterfactual thought, such as, *"if only they had bought their ticket, then they would be rich"*, comes quickly to mind. Counterfactual thoughts can occur in children from the age of two years (Harris & Leevers, 2000). Their ability to think counterfactually seems to grow with their developing capacity in working memory (Barrouillet & Lecas, 1999), and this in turn affects their emotional responses to judgments (Guttentag & Ferrell, 2004; Meehan, 2005). Counterfactual thoughts are also a cross-cultural phenomenon, appearing in different languages (Au, 1983), and research is beginning to identify that there are specific brain areas responsible for these thoughts. For example, individuals suffering from lesions to the dorsolateral prefrontal cortex have difficulties in imagining counterfactual thoughts and consequently, these individuals do not express emotions related to counterfactual thoughts such as regret or grief (Knight & Grabowecky, 1995). Together this research paints a picture of counterfactual thinking as an important aspect of daily thinking, permeating throughout human cognition from early development to late life, which ties it in with emotional reactions to certain outcomes. In this section we will introduce research explaining how counterfactual thoughts are triggered and how they are tied into emotions. We will also review explanations of some of the findings highlighting some rules and regularities of counterfactual thinking.

The Generation of Counterfactual Thoughts

There is a growing consensus that not only is our rationality bounded (Gigerenzer & Goldstein, 1996; Kahneman, 2003), but our imagination is as well (Byrne, 2005). Evidence for this idea comes from findings showing that counterfactual thought often exhibits regularities. These predictions provide insight into how human imagination works. For instance, Kahneman and Tversky (1982) suggested that the aspects that people change and the events that they focus on, indicate the 'joints of reality'. Their idea was that imagination was guided by a set of parameters. For example, people do not tend to imagine

all possible permutations following a given outcome. Byrne (1997) suggests that one of the general guiding parameters is that people do not stray too far from the facts of the scenario.

Markman, Sherman and McMullen (1993) suggested that counterfactual thoughts were classifiable by the direction of comparison, either upward or downward. To illustrate this process, recently the Irish boxer Kenny Egan gave an interview to a newspaper following his return from the 2008 Olympics clutching a silver medal. The headline of the article was a quote from the interview, "It will always haunt me." Ken also made the following comments in the interview, used as the final say of the piece:

> *"To win the silver medal it was the icing on the cake. But it's killing me today to have the silver medal because the gold was just there. It was on my fingertips. It just slipped for me"*
>
> *("'It will always haunt me'", 2008)*

Upward counterfactuals focus on a better possible world, normally when an outcome fails to reach the desired outcome (e.g. the gold medal). Downward counterfactual thoughts focus on a worse possible world, in which the outcome is better than the imagined alternative (e.g. no medal at all). Nevertheless, more recent research by Markman and McMullen (Markman & McMullen, 2003; McMullen & Markman, 2000) have suggested that this classification of counterfactual thinking does not completely capture their function. We shall discuss this literature in more detail later in the chapter.

Another way of categorising was suggested by Dunning and Parpal (1989), who coined the terms additive and subtractive counterfactual thoughts. Antecedent events prior to an outcome could be either removed or added in order to change the outcome. In Kenny Egan's case, he could imagine that adding extra training would have won him the gold. Or he might remove an antecedent, for example the referee, who many felt impacted on his chances of winning. Roese and Olson (1993a) found that this strategy of undoing was

susceptible to the valence of the outcome, whether the end result was good or bad. Removal of antecedents (subtractive counterfactual thoughts) was elicited by success, while the inclusion of antecedents (additive counterfactual thoughts) was elicited by failure. So for Kenny Egan, his sense of achievement was greatly affected by the direction of the counterfactual comparison. He made an upward comparison because he focused on a better possible outcome. Whether he saw his silver medal as a success or failure depended on this comparison and this affected the use of additive or subtractive counterfactual thoughts. In Kenny's case, he would be more likely to add in antecedents, possibly extra training, in order to imagine winning the gold. However, this form of categorisation also has its limitations. For example, it is difficult to ascertain whether the inclusion of further training could be viewed as additive in all cases. Imagine Kenny did not train to the extent that he wished due to interruptions that reduced his training time. If Kenny thinks, "if only I had trained harder..." it becomes unclear whether to categorise his counterfactual thought as additive (increased training time) or as subtractive (the removal of interruption) if what he is implying is unclear.

We return later in the chapter to the difficulties of classifying counterfactual thoughts, in part due to their comparative nature, and for now address some of the commonalities discovered in counterfactual research.

Natural Laws, Plausibility and Availability

Counterfactual alternatives tend to be grounded on facts about the events, and on events that were once possible but are no longer so (Byrne, 1997). They rarely ignore natural laws such as gravity, for example people do not imagine avoiding injury from a fall by removing its existence (Seelau, Seelau, Wells, & Windschitl, 1995). Neither do people imagine alternatives to outcomes by constructing unbelievable or exceptionally unlikely

outcomes (Byrne, 2005), "*if the great white shark that attacked me had no teeth, then I would not have lost my leg*".

A counterfactual thought is an alterative thought about a known, actual series of events. The counterfactual thought remains connected to these events because the information and facts used to construct it are largely similar to the original scenario (Lewis, 1973). Seelau et al, have distinguished this as an availability constraint, in that certain events come to mind more easily than others, and these events can be mediated by contextual aspects such as saliency, recency or familiarity. To explain the availability constraint, consider an example about two men rushing to catch a flight (Kahneman & Miller, 1986):

> Mr. Crane and Mr. Tees were scheduled to leave the airport on different flights at the same time. They travelled from town in the same limousine, were caught in a traffic jam, and arrived at the airport 30 minutes after the scheduled departure time of their flights. Mr. Crane is told that his flight left on time. Mr. Tees is told that his flight was delayed, and just left five minutes ago. Who is more upset?

Kahneman and Miller (1986) explained that it is much easier for people to make up the 5 minutes that allow Mr. Tees to catch his flight, compared to making up 25 minutes for Mr. Crane. People judge that it is more plausible that Mr. Tees could have caught his plane, and this can also affect the estimations of probability. How easy it is to imagine a counterfactual acts as a heuristic in these calculations, in that the harder it is to imagine an alternative, the more certain an event appears to be (Kahneman & Varey, 1990; Medvec, Madey, & Gilovich, 1995; Medvec & Savitsky, 1997).

Exceptionality

Exceptional events that lead to negative outcomes are another situation conducive to counterfactual thinking. Reconsider the example we used earlier from Kahneman and Tversky (1982):

> On the day of the accident, Mr. Jones left his office at the regular time... Mr. Jones did not drive by his regular route. The day was exceptionally clear and Mr. Jones told his friends that he would drive along the shore to enjoy the view... As he began to cross after the light changed, a light truck charged into the intersection at top speed, and rammed Mr. Jones' car from the left. Mr. Jones was killed instantly.

People find it easy to imagine an alternative to these events. They change Mr. Jones' exceptional action by imagining, "*if only Mr. Jones took his usual route home*" (Kahneman & Miller, 1986; Kahneman & Tversky, 1982). Kahneman and Tversky (1982) and later extended by Kahneman and Miller (1986), suggested that people change exceptional actions because the normal actions come easily to mind. This explanation of available alternatives is distinct from Seelau et al. (1995) because Kahneman and Miller suggested that the mechanism underlying counterfactual thought was an automatic evoking of a norm. Norms were created by the retrieval of similar experiences stored in memory or from expectations of what could or should have happened. Events that evoked surprise were considered exceptional. Norm theory (Kahneman & Miller, 1986) was a novel hypothesis because it suggested that an event could be considered normal by post hoc judgments. If alternatives came easily to mind, this made the event exceptional, and if few alternatives came to mind, the event was judged as normal. This extended previous research on the availability heuristic, as it identified that people's reference point for normality was based not only on ad hoc representations, such as schemas and scripts (Kahneman & Varey, 1990; Sternberg, 1999), but also whether strong alternatives were evoked following an outcome (Spellman & Mandel, 1999; Zeelenberg & van Dijk, 2005).

However, later research began to indicate there were problems with norm theory. Gavanski and Wells (1989) suggested that the mechanism for counterfactual thinking could occur through a norm correspondence between outcomes and prior events. They supported the finding that exceptional outcomes were undone by changing the exceptional antecedents to be normal. They showed that normal events were undone by changing outcomes to be exceptional, changing an outcome to be normal only occurred when the outcome was exceptional. This showed that people could change antecedents to be normal or exceptional, but norm theory's proposed mechanisms failed to explain fully why this was (Roese & Hur, 1997; Roese & Olson, 1993b). Also, later research showed that spontaneous counterfactual thoughts created by participants outside laboratory settings, for example after sports games, did not show the presence of the exceptionality constraint to the same degree as was recorded in laboratory contexts (McEleney & Byrne, 2006). Norm theory's proposed mechanism for counterfactual thought also struggles with more recent findings showing that spontaneous counterfactual thoughts tend to focus on normal events as much as exceptional events (Girotto, Ferrante, Pighin, & Gonzalez, 2007; McEleney & Byrne, 2006). Therefore we re-examine the exceptionality effect in this thesis and intend to propose an explanation of this effect by understanding the underlying representations of possibilities that people keep in mind.

The Causal Order Effect

Research has also found that people tend to change the first event in a causal, dependent sequence more so than the following events (Girotto, Legrenzi, & Rizzo, 1991; Kahneman & Miller, 1986; Wells, Taylor, & Turtle, 1987). Wells, Taylor and Turtle (1987) suggested that when people attribute an event as a cause, what follows, namely its effects, are more mutable. They suggested that their findings supported the idea that in a causal chain the first event is changed most often because there are no prior events impacting on it. And

undoing these events leads people to believe that the following events fail to occur also (Roese, Sanna, & Galinsky, 2005). This causal order effect remains regardless of whether the causal sequence contains two events or four events (Segura, Fernandez-Berrocal, & Byrne, 2002).

Segura et al. have related this causal order effect to the possibilities people keep in mind. The first event is changed because causal relations are represented by keeping in mind the facts of the cause and its effect, *and* keeping in mind a second possibility where the cause and effect did not occur (Johnson-Laird & Byrne, 1991). They suggest that because causes elicit these counterfactual possibilities from the outset, people can easily think of ways in which they did not occur, and this makes them highly mutable. In this thesis we will look at the exceptionality effect in a similar way. We will examine whether the presence of a salient counterfactual alternative undoes the tendency to focus on the normal action when undoing outcomes stemming from exceptional actions.

The Controllability Effect

Another constraint to counterfactual thinking is whether or not an event is controllable. Girotto, Legrenzi and Rizzo (1991) showed that events deemed under the control of a protagonist are changed more often. Consider the example of Mr. Jones' car crash again. People imagined Mr Jones choosing an alternative route to undo the accident. Few imagined Mr. Jones' car breaking down or police arresting the drugged teenager before the accident. To test this, they ran an experiment using the following scenario:

> Mr. Bianchi was a bank employee, who worked in an agency situated in a village near to the one where he lived with his wife. The day of the accident he was going home after work but his progress toward home was delayed by a number of events: the manoeuvres of a lorry in the square where he parked, the passage of a flock of sheep, an impeding tree trunk, and his own decision of entering a bar to drink a beer. When he arrived home, Mr Bianchi found his wife on the floor. He realised

that she had a heart attack and was dying. He tried to help her, but his efforts were in vain.

They predicted that controllable events for Mr Bianchi (stopping to buy a beer) would be more mutable than events occurring in the surrounding background (getting stuck in traffic). Their results showed that the controllability effect even took precedence over the causal order effect. Controllable events were changed independent of their relative position in the scenario, i.e. whether they appeared first or last in the causal sequence. The controllability effect also took precedence over the exceptionality effect. Girotto et al. also tested the exceptionality effect using a modified version of their scenario, by stating that some events were exceptional for Mr. Bianchi and some were not. Changes were made to events regardless of whether they were normal or exceptional. A very robust constraint in counterfactual thinking had been discovered; events were more likely to be changed if they were within the control of a protagonist. Controllability has been shown to be more robust factor than both exceptionality and the action effect. Regardless of whether the counterfactual thoughts generated are spontaneous, as in from real world situations, or from laboratory-based contexts, controllability remains an important factor. Whether antecedents to outcomes can be controlled or not, greatly determines whether people mutate them. In contrast, the action effect tends to be a less robust phenomenon, as we discuss later and throughout the thesis, with the underlying intention to add to evidence suggesting the exceptionality effect can also be manipulated (Davis, Lehman, Wortman, & Silver, 1995).

In support of this, Markman, Gavanski, Sherman and McMullen (1995) tested participants using a wheel of fortune game. Participants had the choice of choosing one of two wheels to be spun by another player or either spinning one of the wheels themselves. Participants experienced either a near big win, with a loss by the other player, or a loss, with a big win by the other player. Participants required to produce counterfactual thoughts

following the game focused on the event they had controlled, either the choice of wheel or the spin. The counterfactual comparison process is affected by control also. Upward counterfactuals are more frequent following controllable events and failure, and downward counterfactuals are more frequent following uncontrollable outcomes and success (Roese & Olson, 1995b).

How easy it is to imagine an alternative to an outcome can also indirectly affect perceptions of control. Wohl and Enzl (2003) examined people's perception of personal luck on a wheel-of-fortune game. They tested whether a near big loss at a gambling game heightened perceptions of personal luck relative to a near big win. The closeness of the alternative outcome, how easy it was to imagine how the result could have been different, impacted on participants' feelings of control. Despite all winning the same amount, they showed that participants who narrowly avoided a big loss generated more downward counterfactuals, "*I won but I almost lost*", than participants who just missed out on a big win, "*I lost but I almost won*". These events mediated perceived self-luck and influenced future gambling behaviour. Participants who experienced a near big loss wagered significantly more on subsequent gambles, believing they were currently on a lucky run, compared to participants who missed out on the big win, who believed they were currently unlucky. As the case above shows, counterfactual possibilities that come easily to mind can influence estimates of control and probability, regardless of whether those estimates are fallacious (Branscombe, Wohl, Owen, Allison, & N'gbala, 2003; Teigen, 1996, 1998). Teigen et al. (1999) even suggest that knowing whether a person has suffered good or bad luck depends on the comparison drawn. For, example, knowing an experience was lucky requires a counterfactual thought that brings to mind how the outcome could have been worse.

Temporal Order

Another constraining factor in counterfactual thinking is temporal order[1]. Miller and Gunasegaram (1990) gave the following scenario to participants:

> Imagine two individuals (Jones and Cooper) who are offered the following very attractive proposition. Each individual is asked to toss a coin. If the two coins come up the same (both heads or both tails), each individual wins $1,000. However, if the two coins do not come up the same, neither individual wins anything. Jones goes first and tosses a head; Cooper goes next and tosses a tail. Thus the outcome is that neither individual wins anything.

The majority of participants created counterfactual thoughts that changed Cooper's toss to heads. Later events seemed to be changed more often than earlier events in a temporal sequence (Miller & Gunasegaram, 1990; Spellman, 1997). Segura et al. (2002) found that the temporal order effect held in cases where there were up to four events in a sequence. Miller and Gunasegaram also showed that these thoughts led to Cooper being blamed for the fact that neither character won £1,000, and predictions that Cooper would feel more guilt about the negative outcome.

However, this effect can be influenced by the context of a scenario (Byrne, Segura, Culhane, Tasso, & Berrocal, 2000). Byrne at al., tested the robustness of this effect by testing an example analogous to the coin toss:

> Imagine two individuals who take part in a television game show, on which they are offered the following very attractive proposition. Each individual is given a shuffled deck of cards and each one picks a card from his own deck. If the two cards they pick are the same colour (i.e. both from red suits or both from black suits) each individual wins £1,000. However, if the two cards are not the same colour, neither individual wins anything. Jones goes first and picks a black card from his deck. At this point, the game-show host has to stop the game because of a

[1] This must be a sequence providing no causal relation to events in the sequence, as discussed in previous sections.

technical difficulty. After a few minutes, the technical problem is solved and the game can be restarted. Jones goes first again, and this time the card that he draws is a red card. Brady goes next and the card that he draws is a black card. Thus, the outcome is that neither individual wins anything.

Their results showed that the temporal order effect could be undone. Changing the scenario in this way gave participants an explicit alternative to the first event; Jones picked a black card then later picks a red card. Participants now showed no preference for mutating one character's actions over another and showed no preference for assigning blame or guilt. Their conclusion was that the temporal order effect only occurred when the earlier event in the scenario was presupposed. In the temporal order effect the earlier event becomes the background against which other events are perceived and removing its immutability undoes the effect.

As shown above, providing an explicit counterfactual alternative is one way to undo the temporal order effect (Byrne et al., 2000; Segura et al., 2002). Yet another way to undo it is to describe the winning conditions in such a way that participants' focus on particular counterfactual alternatives. Walsh and Byrne (2004) tested whether the temporal order effect could be manipulated by altering possibilities that people kept in mind. They tested this by employing disjunctions to explain the winning conditions:

If one or the other but not both picks a card from a red suit, each individual wins £1,000.
Disjunctive (one but not both red)

If one or the other but not both picks a card from a black suit, each individual wins £1,000.
Disjunctive (one but not both black)

The two conditionals described the same state of affairs and the facts of the outcome were the same in both scenarios:

> John goes first and picks a black card from his deck; Michael goes next and also picks a black card from his deck. Thus the outcome is that neither individual wins anything.

In line with their predictions, they discovered that depending on the disjunction participants received, the temporal order effect was either produced (participants undid the last event most often with the black disjunction) or reversed (participants undid the first event most often with the red disjunction). How participants represented the winning outcome affected the possibilities they held in mind, affecting the temporal order effect. Once participants knew the first fact, they created their counterfactual thoughts of winning scenarios from this fact, reducing other possibilities.

In this thesis we manipulate the possibilities people keep in mind when an exceptional action is carried out and examine whether the exceptionality effect is affected by different representations of possibilities.

The Action Effect

The action effect is another constraint in counterfactual thinking. Kahneman and Tversky (1982) used the following investment scenario to highlight it:

> Mr. Paul owns shares in company A. During the past year, he considered switching to stock in company B, but he decided against it. He now finds that he would have been better off by $1,200 if he had switched to the stock of company B. Mr. George owned shares in company B. During the past year he switched to stock in company A. He now finds out he would have been better off by $1,200 if he kept his stock in company B. Who feels greater regret?

People focus on Mr. George and estimate that he would feel most regret. Regret is a counterfactual emotion because it is created from a comparison process (Anderson, 2003), comparing an outcome of a chosen option and the outcome of a once possible but foregone

option (Bell, 1982; Loomes & Sugden, 1982). This comparison process brings to mind anticipated feelings of regret, making people more cautious about actions rather than inaction (Byrne, 2002; Byrne & McEleney, 1997; Gleicher, Kost, Baker, & Strathman, 1990).

However, temporal aspects can influence whether an action or inaction produces most regret. Asked about life regrets, most people refer to things they failed to do rather than things they did, such as not travelling enough or spending enough time with family (see also Gilovich & Medvec, 1995; Gilovich, Medvec, & Chen, 1995). This has also been recorded in psychological laboratories too (Gilovich & Medvec, 1994):

> Dave and Jim do not know each other, but both are enrolled at the same elite East Coast University. Both are only moderately satisfied with where they are and both are considering transferring to another prestigious school. Each agonises over his decision, going back and forth between thinking he is going to stay and thinking he will leave. They ultimately make different decisions: Dave opts to stay where he is and Jim decides to transfer. Suppose their decisions turn out badly for both of them: Dave still doesn't like where he is and wishes he had transferred, and Jim doesn't like his new environment and wishes he had stayed.

Asking people who regretted their decision most in the sort term, Dave or Jim, results in the expected answer, that the one who acted (Jim) feels worse. However, if people estimate who feels worse in the long term, their answer changes to the non-actor (Dave). People can feel most regret from actions in the short term but regret inaction most when taking a long-term perspective (Gilovich & Medvec, 1994; Landman & Manis, 1992).

Yet this long-term shift in the action effect may be related only to certain types of inactions. In the film, *It's a Wonderful Life*, Jimmy Stewart's character is brought back through his life by his guardian angel Clarence as if he had never been born. He is shown an alternative world that reflects the full impact he has had in life. This scenario offers him the luxury of knowing the full set of consequences for his actions and inactions, which

results in a drastic change of perspective for Stewart's character. In psychological experiments this manipulation can be introduced too. When the counterfactual consequences of mentally undone actions and inactions are relayed to participants and shown to be similar, the temporal pattern to the action effect disappears (Byrne & McEleney, 2000). When the full facts about action and inaction are known, and counterfactual consequences are laid out, people return to regretting actions more than inactions for both the short and long term. Added to this, further research has also noted that the action effect always occurs when the decision scenario specifies certain counterfactual outcomes, thus allowing the representation of information to be more explicit (Feeney & Handley, 2006). However, some debate still remains as to the full effects of differences in how information is mentally represented and we return to this point later in the chapter.

Reasons, Obligations and Justifications for Actions

Actions can come with certain precursors such as reasons that focus people on them. Walsh and Byrne (2007) have tested whether reasons for actions are mutable in the same way that causes are for effects. People imagine alternatives to causes more than their effects, so they tested whether reasons were more mutable than actions. They asked participants to construct counterfactual thoughts after reading the following scenario:

> Sam is an avid tennis player. Recently, he took part in an important tournament in France. On Sunday he was due to take part in the semi-finals. Normally, Sam does some training the day before an important match. However, on Saturday he decided to rest instead. He wanted to be fresh for the following day. As a result he didn't do any training that day. The day of the match was very hot. Although Sam had often played in very hot conditions, he really didn't like it. That morning a draw was held to see which of the semi-finalists Sam would play. After the draw, Sam made a choice of two rackets, one made of synthetic material and one made of metal. He finally decided to use the metal racket because it is most suited to his

opponent's manner of play. That afternoon, Sam played the match and lost. He was very disappointed.

Walsh and Byrne tested a combination of events within the scenario, half of the scenarios contained an action and half contained an effect, but both had the same outcome. The scenario presented an action (...he decided to rest instead) and a reason (...he wanted to be fresh for the following day). However, they also gave a scenario where the reason and action were replaced by an effect (...the courts were closed) and a cause (...heavy rain the night before meant that the courts were waterlogged). Participants thought *if only* about actions (e.g. if only he had not decided to rest instead) more so than reasons (e.g. only he had not wanted to be fresh for the following day), showing that reasons and actions were not the same in mutability. In contrast, recall that causes (e.g. only there was no heavy rain the night before) or (e.g. only the courts were not waterlogged) tend to be mutated more than effects (e.g. only the courts were not closed) (Segura et al., 2002; Wells et al., 1987).

Walsh and Byrne attributed this finding to differences in how people understand the relationship between reasons and actions. This leads them to represent reasons and actions differently than causes and effects. People undo actions in a reason-action sequence but undo causes in a cause-effect sequence, because causes have a stronger influence on their effects than reasons have on actions. An example illustrates, a person might carry out an action for no reason but an effect does not happen without a cause. People may represent an action by thinking about two possibilities from the outset, the action and the counterfactual possibility (not acting). Similarly, causes bring to mind two possibilities, causes and no cause. Yet undoing causes means undoing the effects. Yet undoing reasons may not undo the action. Undoing an action may require imagining an alternative in which the reason occurs (wanting to be fresh) but the action does not (maybe Sam got an important phone call). This contrasts with effects because people undo effects by

imagining a possibility where neither the cause nor the effect occurs (it did not rain so the courts remained open) (Roese et al., 2005).

Regardless, reasons can still affect the mutability of an action. Walsh and Byrne, in the same study, investigated the effects obligations had on actions. Their results showed that people focused less on actions when a person was obliged to act, compared to no reason at all and even compared to actions followed by internal reasons (i.e. "...because I felt like it"). A similar case to obligations is a situation where an action is expected. In these cases the action effect can be reversed as people imagine *if only he acted...* (Zeelenberg, van den Bos, van Dijk, & Pieters, 2002). Zeelenberg and colleagues gave participants the following scenario:

> Steenland and Straathof are both coaches of a soccer team. Steenland is the coach of Blue-Black, and Straathof is the coach of E.D.O. Both coaches lost the prior game with a score of 4–0. This Sunday Steenland decides to do something: He fields three new players. Straathof decides not to change his team. This time both teams lose 3–0. Who feels more regret, coach Steenland or coach Straathof?

They induced an inaction effect because the prior negative outcomes within the scenario provided reasons to act and this made actions more normal and inactions more abnormal. The focus on an action could be mediated by how easy it is to imagine an alternative where the action did not occur.

Using a different approach, McCloy and Byrne (2000) examined the mutability of a series of events, including actions that lead to a negative outcome. They gave participants a story about a man who got home from work too late to save his wife from dying, similar to the scenario used by Girotto et al. (1991). Allowing for the controllability effect, they found that participants changed actions stemming from socially inappropriate reasons (e.g. stopping to have a pint of beer) more than appropriate reasons (e.g. stopping to visit elderly parents). Their results indicated that whether actions were deemed appropriate or

inappropriate affected the likelihood they would be changed, suggestive that inappropriate reasons generated alternatives more easily.

Actions that have bad reasons or good reasons may make it easier or harder to imagine alternatives in their place. Bonnefon, Zhang & Deng (2007) directly tested whether actions that have bad reasons or good reasons affect how hard it was to imagine alternatives. They modified the Mr. Jones scenario of Kahneman and Tversky (1982) by informing participants that Mr. Jones had taken a different route home because he had to buy some prescription drugs for his sick wife that could only have been bought at a specific pharmacist. The effect of this information reduced the focus on changing route from 54%, in what they termed the poorly justified action, to 28% under a good justification. They also found that estimated regret about the choice of route was significantly reduced when the action was deemed justified. They concluded that the justified action impacted on mutation, which in turn impacted on regret. However, their manipulation of counterfactual thinking by including reasons for actions appeared more akin to the inclusion of obligations for actions, an effect previously shown by Walsh and Byrne (2007). Nevertheless, this result suggested a direct association with counterfactual thinking and the level of regret felt after the decision, an assumption put to test in the empirical chapters of this thesis. Nevertheless, amplifying emotions is one function of counterfactual thinking, but we will review other theories of counterfactual functioning in the next section.

The Functions of Counterfactual Thinking

Counterfactual thoughts allow people to compare reality to an imagined alternative, what Hofstadter, (1985) calls "subjunctive instant replays". These replays can perform many functions and benefit the individual in numerous ways. One theory suggests that counterfactual thoughts amplify emotions (Kahneman & Miller, 1986), in turn providing

feedback about current situations (Markman & McMullen, 2003; Mellers, 2000; Mellers, Schwartz, Ho, & Ritov, 1997). For instance disappointment can inform us when an actual outcome differs from an expected desired outcome (Bell, 1985; Loomes & Sugden, 1986). However, no research has presented a completely satisfactory account of how such a feedback mechanism works.

Another function of counterfactual thinking relates to unexpected outcomes, people tend to produce counterfactual thoughts more readily from these outcomes (Kahneman & Miller, 1986; Sanna & Turley, 1996). Unexpected outcomes may produce feelings of discomfort because people may be uncertain about how to respond (Aronson, 1969; Read, Miller, Schank, & Langer, 1994). Perhaps counterfactual thinking offers a way of regaining a sense of personal control in the face of unexpected outcomes (Galinsky et al., 2005). Counterfactual thoughts also tend to follow bad outcomes (Boninger, Gleicher, & Strathman, 1994; Gleicher et al., 1990; Wells & Gavanski, 1989). This is a recognised pattern in adults (Gavanski & Wells, 1989; Gleicher et al., 1990; Roese et al., 2005), but also in children, despite early developmental limitations in how they construct counterfactual thoughts (Barrouillet & Lecas, 1999; German, 1999; Guttentag & Ferrell, 2004). And of course people can also imagine how things could have been better even when presented with positive outcomes (Landman, 1987; Markman et al., 1993; E. van Dijk & Zeelenberg, 2006).

Causal Judgments

Counterfactual thoughts can also help regain a sense of control or mastery over the environment by attributing ascriptions of cause or blame (Mandel & Lehman, 1996; N'gbala & Branscombe, 2003; Roese & Olson, 1993a, 1995c; Sanna, Chang, & Meier, 2001). For example, people tend to generate more causal explanations following unexpected events, and counterfactual thoughts may help people imagine how outcomes

following these events could have been prevented (McEleney & Byrne, 2006). Counterfactual simulation can help to infer the cause of an outcome, if the outcome can be easily undone by removing an antecedent, that antecedent will be attributed with a greater causal role in the outcome (Wells & Gavanski, 1989). Wells and Gavanski used an example based on the story of a taxi-driver to explain this point:

> Eugene and Tina were a young married couple who lived in the country. Both were partially paralyzed and confined to wheelchairs. They had met four years before when Tina was a counsellor with the Canadian Paraplegic Association, had fallen in love, and were married one year later.
>
> On this particular evening, Eugene had phoned to request a cab to take them downtown. When the taxi driver arrived, Eugene and Tina were waiting by the street. On seeing that they were both in wheelchairs, the taxi driver refused their fare because he thought it would be too crowded in the taxi with both of them and the wheelchairs. So the taxi driver headed back downtown without them. Because there was no time to call another cab, Eugene and Tina took Tina's car, which was equipped with special hand controls. In order to get downtown from their house, they had to travel across a bridge over Rupert River. A severe storm the night before had weakened the structure of the bridge. About 5 minutes before Eugene and Tina reached it, a section of the bridge collapsed. The taxi driver had reached the bridge about 15 minutes before them, and made it safely across. In the dark, Eugene and Tina drove off the collapsed bridge and their car plummeted into the river below. They both drowned. Their bodies were retrieved from the car the next morning.

Participants asked to construct counterfactual thoughts about how the outcome could have been avoided, undid the taxi driver refusing the fare, which led to them rating his actions as more causal to the outcome. The process of representing an alternative to events, in this case the counterfactual possibility, acts as a moderator for causal attributions (Johnson-Laird & Byrne, 1991). Thus a strong relation exists between how people connect causes and effects and the changes they can imagine between antecedents and outcomes,

suggestive of a reliance on some similar mental apparatuses. This we discuss in more detail later in the chapter.

Counterfactual thinking provides insight into how or why unexpected outcomes occurred (Roese & Olson, 1995a; Sanna & Turley, 1996). This has led some theorists to suggest that causal thinking depends on prior counterfactual thinking (Wells & Gavanski, 1989; Wells et al., 1987). However, Byrne and McEleney suggest that understanding the possibilities people must keep in mind when working out causal and counterfactual assertions undermines this view that causal assertions rely on counterfactual assertions. They suggest that counterfactual thoughts require two possibilities to be kept in mind whereas causal assertions only require one possibility to be kept in mind. Roese (1997) has provided support for this view, because people answer a causal question faster after having answered a related counterfactual question. However, the effect does not work the other way around. Mandel and Lehman (1996) have also shown that counterfactual thoughts focus on specific prevention relations, or how the outcome could have been avoided, and this restricts the generation of counterfactual thoughts. In comparison, people can generate causal thoughts more easily, as causal assertions focus on antecedents that simply co-vary with the outcome. Driving while on drugs co-varies with traffic accidents for example. Further, Mandel and Lehman found that counterfactual content was unrelated to causal assertions. Taking the example of Mr. Jones' unfortunate choice of route home, people thinking counterfactually focus on how Mr. Jones could have prevented the crash. However, attributions about what caused Mr. Jones crash focus on co-varying antecedents with the crash, namely the drugged teenage boy. Assuming causal assertions were drawn from counterfactual assertions, counterfactual assertions should be made as easily as causal assertions, and contain similar content.

One explanation that promises some resolution in explaining the relation between counterfactual thinking and attributions of cause is that of McEleney and Byrne (2006).

They suggest similarities exist between the mental representations of causes and counterfactual thoughts, and they propose that differences emerge because the two diverge in the number of possibilities people initially keep in mind when representing them. People understand causal relations by keeping in mind only the facts as they happened (Goldvarg & Johnson-Laird, 2001), whereas counterfactual assertions require people to represent the facts and the counterfactual possibilities. This gives an explanation as to why causal assertions are easier to make compared to counterfactual assertions, because counterfactual thoughts require people to explicitly represent more information. Nevertheless questions remain as to the complete relation between counterfactual thinking and causal judgments. For example, unrealistic counterfactual thinking reduces causal attribution strength and the affective consequences attributed to such thoughts versus that of realistic counterfactual thinking (Sevdalis & Kokkinaki, 2006). Such distinctions have not been completely explained by any one theory in the field to date.

The Preparative Function of Counterfactual Thoughts

The context in which counterfactual thinking is activated has indicated to some researchers that they serve a preparative function (Roese, 1994; Sanna, Meier, & Wegner, 2001). Remember the comments of the Irish boxer Kenny Egan, who returned from the 2008 Olympics with a silver medal:

> *"To win the silver medal it was the icing on the cake. But it's killing me today to have the silver medal because the gold was just there. It was on my fingertips. It just slipped for me"*
>
> *("'It will always haunt me'", 2008)*

Markman and colleagues (1993) suggested that upward or downward counterfactual thoughts could serve a preparative function. Kenny Egan may think, "*if only I had trained*

harder, then I would have won gold". This thought may motivate him to improve his training before the next Olympics. Now imagine Kenny had won a bronze medal. He then might imagine missing out on a medal altogether, a downward counterfactual thought. In comparison to upward counterfactual thoughts, a downward counterfactual can have an ameliorative effect on mood. This has been tested with real Olympic medal winners and results support this idea (Medvec et al., 1995).

Markman and colleagues used a game of Blackjack ('21') to show why this is so. They designed their experiments so that participants would draw with the dealer and only leave with a small win of $5. They found that when participants believed they were playing the first in a series of Blackjack card games (all participants only played one game), upward-preparative counterfactuals were constructed. However, when participants knew the game was a one-off, they constructed downward-ameliorative counterfactuals. Participants believing they were going to play a series of games were performance orientated, wanting to learn from each game, so they employed upward counterfactual thinking, "*if I had gotten a 2, I would have beaten the dealer*". In comparison, those playing only one game were emotion orientated. They focused on deriving as much satisfaction from the event as possible and employed downward counterfactual thoughts, "*if I had gotten the King, I would have lost to the dealer*". Counterfactual thinking helped either prepare behaviour for the future or mediate emotions. Comparing reality with once possible alternatives can motivate a person to change behaviour in order to achieve better outcomes, or improve the affective state following an outcome by thinking about worse possibilities.

Counterfactual Thinking and Goals

Theorists advocating a functional approach have sought to explain the generation of counterfactual thoughts by understanding them as a function of goal setting (Epstude & Roese, 2008; Roese et al., 2005). This idea proposes that counterfactual thinking functions

to motivate and aid in the performance of goals, suggesting that counterfactual thoughts are activated when a failure to meet goals produces negative affect. Counterfactual thoughts either improve on future performance by imagining how things could have been better or worse, repair or maintain mood or prepare for future threats of negative mood. This primes the activation of higher order goal states, infusing counterfactual thoughts with ways and means of achieving these goals. For example, Kenny Egan feels disappointment with his silver medal, and creates the counterfactual thought, "*if I had trained harder, then I would have won the gold medal*". This motivates him to train harder so in the future he can attain the goal of winning a gold medal. Epstude and Roese (2008) showed a connection between counterfactual thinking and goal setting by getting participants to complete 'if' sentence stem completion tasks with a focus on "how things might have been different" and then compared them to causal attributions stems ("because of") made by the same participants who were asked to focus on "how certain events in the past brought about other events. They found that personal actions accounted for a greater proportion of counterfactual statements than causal statements and that goals accounted for a greater proportion of counterfactual statements than causal statements.

The functional explanation relies on a two-stage model of counterfactual thinking, asserting that upward counterfactual thoughts focus specifically on performance goals and are the default in counterfactual thinking. Downward counterfactual goals are rare and effortful and generally mediate emotion, serving a preventative function. Thus, the dichotomy between these two goals requires a regulatory focus, with this model proposing that this focus is automatic, or becomes so through a well-learned mind-set. We will examine this goal function hypothesis throughout this thesis.

The Comparative Nature of Counterfactual Thinking

The comparative nature of counterfactual thinking allows it to play a strong role in mediating emotion (Boninger et al., 1994; Bonnefon et al., 2007). Imagine someone involved in a bad car accident in which they were injured, but because of a seatbelt, their injuries were not life threatening. On the one hand they could think, "*if only I had taken the bus, then I would not have been injured*," or they could imagine, "*if I had not been wearing my seatbelt, then I would be dead*". Both thoughts arouse contrasting emotions (Landman, 1987; Markman et al., 1993; Roese & Olson, 1997). Counterfactual thinking has the ability to amplify these emotions by imagining alternatives to the facts (Kahneman & Miller, 1986). Researchers have examined the effect of these contrasts on feelings of guilt and shame (Niedenthal, Tangney, & Gavanski, 1994), regret (Gilovich & Medvec, 1995; Hetts, Boninger, Armor, Gleicher, & Nathanson, 2000), disappointment (W. W. van Dijk & Zeelenberg, 2002; Zeelenberg & van Dijk, 2005), as well as positive emotions (Landman, 1987; Teigen, 1997). It is largely through this comparison process that counterfactual thoughts affect emotions and behaviour.

We have explained how upward counterfactuals can influence behaviour by motivating people to work towards a better outcome (Markman et al., 1993; Roese, 1994). However, counterfactual thoughts can have a more direct influence on behaviour. McMullen and Markman (2000) have shown this by manipulating downward counterfactuals. Imagine a young driver who has a near miss in his car while driving too fast. He might imagine a worse outcome, serious injury for example, and become motivated to change his behaviour for fear of suffering such consequences (i.e. drive more slowly). Yet if the downward counterfactual produces positive affect for the young driver (i.e. if I had not swerved at the last minute, then I would have crashed), this can diminish the motivation to change or improve behaviour in the future (i.e. I am a great driver and capable of driving at these speeds).

Research has also identified cases where counterfactual thinking results in failure to carry out actions. Take the following story (Ritov & Baron, 1990):

> Imagine that there have been several outbreaks of a certain kind of flu, which can cause severe illness in children under three. Only a small number of children exposed actually catch this flu, but for those who do it's quite severe. The children get very sick with high fevers, a lot of pain, and generally feel horrible for several weeks. A vaccine for this kind of flu has been developed and tested. The vaccine eliminates any possibility of the child getting the flu. The vaccine, however, can sometimes cause side effects that are very similar to the severe flu symptoms: high fever, pain, feeling horrible. Fortunately, these unpleasant effects are rare. In fact, the risk of a vaccinated child getting the unpleasant side effects is about as low as the chance of a non-vaccinated child getting severe flu symptoms.
>
> Imagine that you are married and have one child, a one-year old. You have spent a lot of time trying to decide whether or not to have the child vaccinated against this flu. After talking to several doctors, reading medical journals and consulting with friends its now time decide whether to have your child vaccinated or not.
>
> Suppose you did decide to vaccinate. Unfortunately, your child is one of those who have the bad vaccine side effects: high fever, a lot of pain, and several weeks of feeling very sick.

When a parent chooses not to vaccinate his or her child for fear of the child having an adverse reaction to the vaccine, it is an example of omission bias (Baron & Ritov, 1994; Ritov & Baron, 1990). Despite the risk of the child catching the illness, the parent's choice is based on his or her estimation of how much regret they would experience if the child reacted negatively to the vaccine. The effect of simulating, through counterfactual thinking, the regret felt if the worse outcome should occur, leads to the parent avoiding the vaccination. People are able to go beyond temporal constraints when imagining alternative outcomes, allowing them to either put themselves in that moment in time and imagine how they would feel given the 'then' facts. Alternatively, people can imagine prefactual outcomes (Byrne & Egan, 2004; Sanna, 1998), taking an objective view from a different

point in time and constructing an estimate of how they think they would feel. Regardless of what way they imagine alternatives; people prove capable of this form of mental representation and often use this in everyday life (Byrne, 2005).

Because of counterfactual simulations, inaction can occur even in the face of good reasons to act. If a person misses a good opportunity, but is faced with a similar but lesser opportunity later, they can fail to act. Known as inaction inertia, it occurs in cases that begin with the missing of an attractive action. The person avoids regret derived from the initial miss (Tykocinski & Pittman, 1998).

> Imagine the following scenario: You are in the supermarket at the local mall doing your weekend shopping when you hear over the mall's loudspeaker system an announcement declaring that the mall's clothing store is now holding a special sale. During the next half hour all merchandise will be sold with a 50% price reduction. The timing is good because in the past few days you were thinking about purchasing a suit for your friend's wedding that will take place two days from now. You hurry to the checkout line, but because of the typical Thursday evening long queues, you are held up, and by the time you reach the store, the salesperson tells you that the sale has just finished. Maybe out of kindness she lets you know discreetly that the store will hold another sale all day tomorrow: 10% off of all merchandise in the store.

This tendency to decline a substantially less attractive current opportunity in the same action domain (10% sale), even when a positive value remains, is called inaction inertia. The diminished positives of the current outcome (10% off) only emphasises the missed opportunity and what could have been gained (50% off). This can result in greater negative consequences. Therefore it becomes beneficial to avoid the new opportunity in order to avoid the negative affective consequences stemming from the missed opportunity (Tykocinski & Pittman, 1998).

Counterfactual Thinking and Decision-making

In decision-making, people are also required to compare and contrast possibilities. Hence, an examination of these processes in counterfactual thinking has enlightened understanding of similar processes in this domain, and directly implicated counterfactual thinking in decision-making (Bonnefon et al., 2007; Landman & Manis, 1992; Roese, 1999; Zeelenberg, van Dijk, Manstead, & van der Pligt, 2000). This research has largely focused on the relation of counterfactual thinking to negative affective consequences stemming from decisions (Bonnefon et al., 2007; Byrne & McEleney, 1997; Markman et al., 1993; Markman & Tetlock, 2000; N'gbala & Branscombe, 1997; Roese & Olson, 1995c). For example, people often examine their choices and once possible outcomes through counterfactual thought (Roese, 1999). Nevertheless, no theory has yet clearly drawn together the necessary mechanisms that must exist for the mental representation of real or imagined possibilities that lead to affective consequences nor completely explained how they lead to future behaviours. Therefore in this thesis, we examine how the possibilities people represent influence the decisions they make and the counterfactual thoughts that follow from the decisions.

Counterfactual Thinking, Affective Consequences & Decisions

Both the influence of emotional states and anticipated emotions are factors in decision-making (Janis & Mann, 1977; McMullen & Markman, 2000; Mellers, Chang, Birnbaum, & Ordóñez, 1992; Mellers et al., 1997; Mellers, Schwartz, & Ritov, 1999). Imagine you are in a nice restaurant looking at the menu. You order the fish and the waiter takes your order. Then the waiter turns to your partner and takes their order, which is steak. You think for a moment, call the waiter back and change your order to the steak. Why? Is it possible that you imagined tucking into your fish, while across from you, your partner cuts into their steak? You might even imagine what the mouthfuls of the different types of food are like.

These mental simulations may prompt you to change your order. Now think whether this would have happened had you been alone in the restaurant and ordered the fish? The comparison process that we can engage in, prior to and during decision-making, helps us realise how we might feel after the event, and this can affect the decisions we make.

Decision-affect theory accounts for this by proposing that decisions are not simply made by the heuristic of avoiding negative affect (Mellers, 2000; Mellers et al., 1997). Instead, this theory proposes that choices are picked on the basis that one will lead to a more pleasant feeling than another, feeling either better or not as bad as what could have been (Mellers et al., 1997). Mellers and colleagues tested whether a correlation existed between choices and this best-expected feeling by presenting participants with a choice between two gambles, displayed in the form of a pie chart. Participants were informed that all outcomes were real losses or gains and that each region of the pie chart represented the chance of receiving the outcome associated with that region. The chart was presented twenty times on a computer screen and each presentation displayed two possibilities, $0 and a potential gain (e.g. S5.40, $9.70, S17.50, S31.50. or $56.70). The risk was that each gamble had different probabilities of winning (e.g. .09, .17. .29, .52, and .94), as represented by the space it accounted for on the pie chart. Measuring participants' surprise, disappointment and elation with outcomes, they found that unattained outcomes served as reference points for evaluating the obtained outcomes. Where expectation about receiving $0 was high, disappointment was reduced, in comparison to a case where expectation about receiving $56.70 was high but the result was $0. People felt better or worse depending on the counterfactual outcome and the perceived probability of the outcome. Although not being able to illustrate completely the exact dynamics involved across these mechanisms, they did identified an overlap in the relationship between the expected utility (usefulness) of an outcome and the expected emotions following the outcome, showing that both utility and emotions could differ markedly.

To use another example, your boss offers you an unexpected bonus in your job and this produces considerable satisfaction. Now imagine that you were expecting a promotion and instead received this offer of a bonus. With economic models of choice, the expected utility of the bonus is assumed to be independent of expectations and beliefs. Mellers et al. showed that the subjective utility of the bonus was greater in the former scenario than in the latter. These hedonic experiences rely heavily on counterfactual alternatives, derived from expectancies and beliefs.

We have already discussed how expectations of negative affective consequences can influence many decisions (Baron & Ritov, 1994; Roese & Olson, 1995c). For instance, regret avoidance can also lead to greater risk seeking or risk aversion, depending on the context of the outcome (Zeelenberg & Beattie, 1997; Zeelenberg, Beattie, van der Plight, & de Vries, 1996). Zeelenberg and colleagues found that a key factor for this effect was the expectation of feedback following the decisions outcome. Recall again the restaurant example, a key factor for the decision maker here is that the alternative (the steak) will be right across from them on a plate. Counterfactual thinking can function by providing this feedback by simulating the presence of an alternative. In cases where there is an expected outcome, and the actual outcome deviates from this, the ease in which an alternative can be imagined mediates the experienced emotion (Kahneman & Miller, 1986; Mellers et al., 1999; Miller, Turnbull, & McFarland, 1990). The type of comparative process can also affect the emotion experienced. For example, disappointment occurs when a different state of the world would have produced a better outcome in comparison to the actual state. Regret comes when an actual outcome is compared to a better outcome that would have been obtained had a different choice been made (Bell, 1982, 1985; Gilovich & Medvec, 1995; Loomes & Sugden, 1982, 1986). Despite these findings, as yet no one theory has been successful in explaining how these affective consequences become represented within

imagined possibilities and in what way these emotive additions to thee possibilities affects the resulting behaviour, we will attempt to address this issue through this thesis.

Mechanisms in Choice

Choices can be difficult to mentally represent, and representing all the choices and their consequences can go beyond the capacities of working memory (Feeney, Scrafton, Duckworth, & Handley, 2004; García-Madruga, Gutiérrez, Carriedo, Luzón, & Vila, 2007). Research into decision-making began to show that people's rationality was bounded (Eisenstadt & Simon, 1997; Gigerenzer & Goldstein, 1996; Kahneman, 2003; Tversky, 1972a, 1972b). People could be rational when making decisions but in certain contexts were 'irrational'. For example, people sometimes employed heuristics or strategies to help them make decisions, and this could produce conclusions that were not entirely rational. Decision-makers might focus on distinguishing components of gambles, and overlook similarities in order to simplify choice. Tversky called this heuristic *elimination by aspects* (Tversky, 1972a, 1972b). He used the example of a television commercial to illustrate this method of reaching a conclusion in action:

> "There are more than two dozen companies in the San Francisco area which offer training in computer programming." The announcer puts some two-dozen eggs and one walnut on the table to represent the alternatives, and continues: "Let us examine the facts. How many of these schools have on-line computer facilities for training?" The announcer removes several eggs. "How many of these schools have placement services that would help find you a job?" The announcer removes some more eggs. "How many of these schools are approved for veterans' benefits?" This continues until the walnut alone remains. The announcer cracks the nutshell, which reveals the name of the company and concludes: "This is all you need to know in a nutshell."

The decision-maker creates a context, in which to assess the choices, induces a comparison process that makes salient aspects that correspond to a desired end goal. This allows the

decision maker to ignore some choices and focus on other choices that are closest to satisfying a target goal. Kahneman and Tversky (1979) elaborated this finding to explain the *isolation effect,* a phenomenon they recorded within people's decision-making preferences. There aim was to highlight problems with earlier decision-making theories that suggested people made choices by assessing the utility of choices. Instead they believed and showed that in fact people could make choices based on subjective interpretations of similarities and differences between the choices. They gave participants a problem in the form of a game played in two stages, and asked them to make a decision before knowing any outcomes:

First stage:	75% chance of elimination and winning nothing
	25% chance of proceeding to second stage

In the second stage they will be faced with another choice,

Second stage:	80% chance of winning €4,000
	100% chance of winning €3,000

Kahneman and Tversky found that people ignored the first stage of the game, and *isolated* the second stage when working out which option they would prefer, despite the first stage affecting the overall probabilities (.25 X .80 = .20 chance to win €4,000 versus .25 X 1.0 = .25 to win €3,000).

Kahneman and Tversky suggested that the difficulty in estimating people's preferences, especially with risky choices, was because of the many subjective steps people used in order to edit down their choices. They posited that decision-makers initially examine the choices on offer, and then edit these down, isolating what choices they deemed important. It was on this simpler representation of the choices that decision-makers made their evaluation of which prospect was best. We will apply the principles of

choice reduction alongside similar principles originating from the reasoning literature, namely those proposed by mental model theory, when understanding the comparative processes of counterfactual thoughts following decisions.

The Peanuts Effect: How Affect Ties into Decisions

The predilection for decision-makers is to avoid risk in cases of gains, and be risk seeking in the context of losses (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981, 1986). If offered a choice between the options below, people choose B:

Positive Prospect	Option A	80% probability of winning €4,000
	Option B	100% probability of winning €3,000

Yet if offered two choices within a loss context they choose option Y:

Negative Prospect	Option Y:	80% probability of losing €4,000
	Option Z:	100% probability of losing €3,000

People do not want to lose out on certain winnings and want the chance to avoid certain losses. Risk seeking has also been shown in other domains. Markowitz and Dunlap (1956) proposed that for each person there comes a point where the general preference for risk aversion will be reversed. In most cases, a preference will be shown for a 10% chance of winning €100 over €10 for certain. Yet increase the monetary level by the power of 10, and the certain €100 may very well be taken over a 10% chance of winning €1000, despite the ratio remaining constant (Weber & Chapman, 2005). The effect of decreasing risk aversion with decreasing monetary amounts is termed the 'peanuts effect' (Prelec & Loewenstein, 1991). 'Playing for peanuts' deceases risk aversion, inducing greater risk seeking behaviour. This effect is also seen where a delayed positive monetary outcome needs to be offset by greater monetary value (Weber & Chapman, 2005). The anticipated

counterfactual thought plays an important role in mediating this effect. People can imagine the feeling of losing out on €100, despite the 10% chance of €1,000, motivating people to chose the €100. In other words, the anticipated negative affect leads to the avoidance of behaviour that could bring this about. What adds to this effect is that losses have been shown to hurt more than equally proportionate gains please (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981). However, small stakes gambles may not elicit anticipated negative emotions to the same degree that larger gambles do, as the peanuts effect has been shown to appear when disappointment is low (Weber & Chapman, 2005). Regardless, it remains unclear how these differences in stakes are represented in a way that includes such affective information so as to lead to such a result, as these findings are presented without such an explanation. We will therefore attempt to examine whether the context of small stakes gambles removes the necessity for people to anticipate negative affective consequences from counterfactual alternatives, therefore allowing them to keep possibilities in mind that would otherwise be ignored, or to mentally represent such possibilities without the need to encode such information.

Framing Decisions

Earlier assumptions about decision makers posited that people's choices were rational, in other words their choices satisfied consistency and coherence (Tversky & Kahneman, 1981). However, as explained in the previous section, people were capable of conceiving outcomes and contingencies from their own individual point of reference, identified as their decision frame (Tversky & Kahneman, 1981). An example employed by Tversky and Kahneman (1981) was of a person at a horse race. The individual has already lost €140 on bets, yet is considering a final bet of €10 on a 15:1 'long shot'. The issue of reference point becomes salient if the individual's actions are viewed from two different angles:

Angle 1:	Loss	€10
	Potential gain	€140
Angle 2:	Loss	€150
	Drawing even	€0

Tversky and Kahneman posited that viewing the bet from Angle 2 would induce more risk seeking behaviour because losses hurt more than gains please (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981). Underlying this hypothesis was that people generally evaluated actions minimally, using shortcuts to reduce cognitive effort, for instance accepting a gamble based simply on the money won or lost (Kahneman & Tversky, 1984; Tversky & Kahneman, 1981). We will test the conditions in which people simplify their decisions and the conditions that lead them, if required, to incorporate more detail into their decisions, by changing the reference point from which their choices are being evaluated.

Further simplifications can occur when people are dealing with choices and risk, as research has shown that the two can be kept independent of each other (Lopes & Oden, 1999; Mellers et al., 1999; Payne, 2005; Payne & Braunstein, 1971; Sokolowska, 2006). For instance, aspiration levels (or goals) affect preferences between choices, as people will make choices that satisfy the goals they set (Sokolowska, 2006). Yet evidence suggests that aspiration levels may not affect people's assessment of risk within these choices (Sokolowska, 2006). Decision-making that involves risky choices can mean that decisions are made under risk avoidance or goal attainment. If no conflict arises between minimising the risk and attaining goals, risk-aversion is the general default, as the previously referenced literature suggests (Kahneman & Tversky, 1979). However, if the risk-averse choices cannot achieve the set goals, people pursue the goals and behave in a way that suggests a lack of risk awareness (Sokolowska, 2006). For example, a young driver might aspire to impress his girlfriend or friends who are passengers in his car. This goal may lead

him to increase the speed at which he drives beyond his usual perceptions of risk, not thinking about the consequences of his actions in terms of driving but within the consequences of social approval. Despite the fact that most decisions usually incorporate a combination of goals and risk awareness, one or the other can lead decision makers if the context dictates (Sokolowska, 2006). Despite this research bringing to light such distinctions, the conclusions reached fail to explain a clear process in which these distinctions are decided on from an individual basis.

Placing a decision within a context reduces the need to incorporate all the available information because people focus on certain aspects and information (Kahneman & Tversky, 1979; Tversky, 1972b). On the other hand, this can limit the construction of possibilities because only the information that is being focused on and explicitly represented is available (Byrne & McEleney, 1997; Johnson-Laird & Byrne, 2002; Legrenzi & Girotto, 1996). This can then have a large effect on the alternative possibilities people think counterfactually about. Girotto et al. (2007) highlighted that different roles for individuals, for example actors versus readers, affected the type of counterfactual thoughts participants constructed after an outcome. Girotto and colleagues (2007) had participants either read about or act as a protagonist in the following story:

> Anna, an undergraduate at your university, was asked to participate in a game. A research assistant told her, ''In order to win two chocolates, you have to mentally multiply either two one-digit numbers or two two-digit numbers, in 30 seconds. If you fail, you do not receive the chocolates. The two multiplication problems are contained in two sealed envelopes. Let us call them envelope A and envelope B. Of course, we do not know which envelope contains the one-digit multiplication problem and which one contains the two digit multiplication problem.'' Anna accepted the offer to participate. She chose envelope A, and the research assistant opened it. Unfortunately, it contained the two-digit multiplication problem. She failed. Things would have been better for Anna, if...

They found that actors and readers created different counterfactual thoughts and concluded that this was due to the differences in the information both groups were explicitly representing. Participants explicitly represented different information depending on the requirements of the role they were situated in. In contrast to readers, actors altered normal events in the direction of exceptionality, and altered uncontrollable events as much as controllable ones. Actors also preferred to make large modifications by introducing elements not present in the real experience. This research identifies a weakness in the field, in that the present knowledge and previous methodologies employed failed to recognise these role distinctions. This casts some doubt as to the ability to generalise some findings to all contexts. We intend to test whether the perspective of participants' affects their counterfactual thinking by manipulating the information provided to them about counterfactual alternatives and their outcomes.

Evidence provided by Markman and Tetlock (2000) suggests that counterfactual thoughts are dependent on these different perspectives. They found that depending on whether people accounted for the decision process and the outcome stemming from the decision process, or whether they accounted for simply the outcome, differences in counterfactual thinking was observed. They gave participants an investment scenario with some general information about a stock performance simulation and asked them to role-play at investing money. Unbeknownst to them, they were assigned either to a process-accountable group or an outcome-accountable group. The outcome-accountable group were informed that:

> When you are done with the first phase of the experiment (choosing the four stocks and filling out the four questionnaires), the experimenter will then be conducting a 5- to 10-minute interview with you to discuss your performance on this stock investment decision-making task. The experimenter has brought with him a computer printout of how well other students have performed on this task. Thus, you will be given an opportunity to see how your performance "sizes up" with

other college students who have participated in this experiment. Good performance on this task is highly correlated with general decision-making abilities!

The process-accountable group were informed that:

> When you are done with the first phase of the experiment (choosing the four stocks and filling out the four questionnaires), the experimenter will then be conducting a 5- to 10-minute interview with you to explore the types of information you used to arrive at your investment decisions. During your interview, you will be asked to justify how and why you made the decisions that you did. On the basis of your responses, the experimenter will compute a Quality of Reasoning Score (QR) for you. The experimenter has brought with him a computer printout of the QR scores that other students have received. Thus, you will be given an opportunity to see how your QR score "sizes up" with other college students who have participated in this experiment. A high QR score on this task is highly correlated with general decision-making abilities!

Participants later saw one of four outcomes corresponding to end share value:

Clear Win Outcome:	Their Stock $50	Other Stock $20
Clear Loss Outcome:	Their Stock $50	Other Stock $80
Near Win Outcome:	Their Stock $50	Other Stock $50.50
Clear Win Outcome:	Their Stock $50	Other Stock $49.50

Compared to outcome-accountable participants, process-accountable participants had more negative emotional reactions to nearly losing (compared to clearly winning) and had more positive emotional reactions to nearly winning (compared to clearly losing). They also thought that their performance was poorer compared to the outcome-accountable group when they nearly lost and their performance was better compared to the outcome-accountable group when they nearly won. The manipulation affected the groups' counterfactual thoughts in different ways. The process-accountable group created counterfactual thoughts that gave self-evaluations; for example, *"I'm feeling pretty good*

right now because I came close to winning". Whereas the outcome-accountable group created more thoughts that gave performance evaluations, *"I'm fairly happy about how the stock performed, it could have lost to the other two."*

To better explain these differences, Markman and McMullen (2003; , 2005) composed a model, which they call the Reflective-Evaluative Model (REM) of counterfactual thought. To explain the difference between reflective versus evaluation contrasts, they used a real news story about flight attendant Kim Stroka. She had claimed she was too distraught to return to work after her co-worker died on United Airlines Flight 93, which had been high jacked after taking off from Newark International Airport on route to San Francisco on 11 September 2001. Stroka had apparently traded shifts with her co-worker and would have died instead of her colleague if she had worked a normal shift.

This example shows a downward counterfactual in action, Kim Stroka imagined dying in the plane crash. However, imagining a worse outcome than actually happened did not make her feel better but worse. Downward counterfactual thoughts have been considered to be contrastive in nature, as people imagine the worse possible outcomes, their feelings are improved as they realise what the actual outcome was better. In Stroka's case, her affective experience is drawn to the worse and more upsetting outcome (Markman & McMullen, 2003). This subtle distinction challenges some suppositions of other theories of counterfactual thought. It has been suggested that the trigger of counterfactual thought is negative affect derived from goal blockage (Epstude & Roese, 2008; Roese et al., 2005). Markman and McMullen (2005 p.88) instead suggest that counterfactual thoughts are activated when there is a *behavioural interruption.* Similar to Kahneman and Miller's (1986) idea of violations to normality, they suggest this interruption can occur in the representation of the perceived world *or* the counterfactual possibility. They illustrate as follows:

"A student who typically gets A grades on exams gets a B. For the student a B is

an interruption to the typical event sequence and therefore draws attentional focus. The grade in this case is automatically contrasted with the grade that could have been, the A."

(Markman & McMullen, 2005, p.89)

They compare the above example to the Stroka case, suggesting that her counterfactual thought, where a last minute change removed her from certain death, draws attention to the *counterfactual thought* about what could have been (i.e. killed in a plane crash), an interruption to the typical event sequence (i.e. surviving a flight). Here affective assimilation is the default as it is the counterfactual alternative that is reflected on, and this reflection is done in the absence of an explicit comparison to reality.

The aim of this thesis is to examine counterfactual thoughts in the light of these distinctions, the perspectives from which participants will create their counterfactual thoughts, and the comparisons they make.

The Representation of Counterfactual Thoughts

We suggest in this thesis that it is important to understand how counterfactual thoughts are mentally represented in the mind. Much research has examined counterfactual thinking and causal attributions because many believe that causal relationships are the foundation on which counterfactual thoughts are based (Mandel & Lehman, 1996; N'gbala & Branscombe, 2003; Wells et al., 1987). An *if-then* relationship is therefore advocated as embodying a causal proposition. For example, *if A happens, then B happens* (in which A is an antecedent an B is a consequent). Some theorists have suggested that causal inference is the glue that binds the functioning of counterfactual thinking together (Epstude & Roese, 2008; Roese et al. 2005). Examine the following model used to understand the possibilities kept in mind when thinking of a cause and its effect:

Possibility:	*cause*	*effect*
Possibility:	*not-cause*	*not-effect*

The relationships between causes and effects can vary from implausible to strong (Goldvarg & Johnson-Laird, 2001). An example of a strong cause is as follows, *if the water is boiled, then it is heated to 100°C* (Byrne, 2005; Frosch, 2007). Implausible can mean a cause-effect mismatch, or a conflict between other cause-effect possibilities, or it could mean that a relationship between two clauses was not considered causal and therefore not represented. To give some examples of conditional sentences that may or mat not be considered strong, "*if George W. Bush had not been president, then the Iraq war would not have happened*", or "*if George W. Bush had not been president, then Barak Obama would not have become president.*" These two sentences, though similar, can be interpreted to have different causal strengths because the relationship between the antecedent and consequent differs. For a strong cause, the antecedent must be necessary and sufficient for the consequent (i.e. the antecedent must be present when the consequent is present, and the consequent must be present when the antecedent is present). By its nature, this relationship limits the possibilities people keep in mind. Now compare the relationship between other antecedent-consequent relationships that are not as strongly connected, for example reasons and actions. With this relationship, an antecedent can be sufficient but not necessary for the consequent, and the consequent necessary but not sufficient for the antecedent. This weakens the relationship between the antecedent and consequent and as this relationship is far less constrained, it becomes much easier to imagine other possibilities (Goldvarg & Johnson-Laird, 2001):

Possibility:	*reason*	*action*
Possibility:	*reason*	*not-action*
Possibility:	*not-reason*	*not-action*
Possibility:	*not-reason*	*action*

Causal inferences and counterfactual thoughts are indirectly linked because counterfactual thoughts can be created from different relationships between antecedents and consequents when undoing outcomes (Byrne & McEleney, 2006).

We now illustrate how the exceptionality effect can be better understood if we understand how people represent exceptional actions. Recall the Kahneman and Tversky (1982) scenario of Mr. Jones who took an exceptional route home and died in a car accident. The following are a full set of possibilities:

(A)	Factual Possibility:	*takes route*	*dies in accident*
(B)	Possibility:	*does not take route*	*does not die*
(C)	Possibility:	*takes route*	*does not die*
(D)	Possibility:	*does not take route*	*dies in accident*

The counterfactual thoughts that people generate suggests they are thinking about the first possibility, which corresponds to the facts, and to the second possibility; the data suggest people are not thinking about possibility C or D (Byrne & Johnson-Laird, In submission; Espino, Santamaría, & Byrne, In press; Santamaria, Espino, & Byrne, 2005).

To use another illustration, let us propose how participants might represent possibilities within a card game scenario. Take the following sentence, *if Peter places an exceptional medium bet, then he wins €60*. This could be interpreted to be consistent with a full set of possibilities:

(1)	Possibility:	*places exceptional medium*	*wins €60*
(2)	Possibility:	*does not place exceptional medium*	*does not win €60*
(3)	Possibility:	*places exceptional medium*	*does not win €60*
(4)	Possibility:	*does not place exceptional medium*	*wins €60*

For example, perhaps Peter bets medium but another player beats him. Or perhaps he bets small but still wins €60. We know that the many intricacies of a card game allow for many possibilities.

To explain further we will use another example involving obligation. For instance imagine Peter was *obliged* to bet medium:

(i)	Possibility:	*bets medium*	*wins €60*
(ii)	Possibility:	*does not bet medium*	*does not win €60*
(iii)	Possibility:	*bets medium*	*does not win €60*
(iv)	Possibility:	*does not bet medium*	*wins €60*

Now possibilities ii and iv do not seem probable because we are told that Peter was obliged to bet medium, and this constrains the possibilities we hold in mind.

At the heart of every counterfactual scenario there is a core conditional (e.g. if he had taken a different route home he would have lived, or if he had bet medium he would have won). To understand counterfactual thoughts it is necessary to understand how people think about, '*if A then B*' conditionals. For this reason we examine how people make inferences from conditional sentence (i.e. if A then B), how they make judgments about what possibilities remain consistent within them and what possibilities they imply. We will look to explain this by illustrating that difference in inferences, judgments and implications are identified because different forms of conditionals lead to different mental representations. We will also explain how some different interpretations of these core meanings lead to different perspectives about how conditionals are mentally represented.

Conditional Reasoning

Insight into how people represent and reason from counterfactual possibilities has been collected from research into conditional reasoning. Counterfactual thoughts are generally phrased as conditionals in the subjunctive mood (Byrne & Tasso, 1999; Johnson-Laird &

Byrne, 2002; Thompson & Byrne, 2002). Conditionals can take the form of an antecedent, *if A*... followed by a consequent, *...then B. If-then* conditional propositions can also be seen in such a way that, *if* corresponds to an action (antecedent) and *then* refers to a goal (consequent), such as, "*if only she had practiced harder, then she would have passed the audition*" (Roese et al., 2005).

Conditional reasoning has been used to investigate how people reason about possibilities, and how people draw inferences from these possibilities. Examining people's reasoning from conditionals helps probe how people use information to construct relevant possibilities, make inferences about what could have happened, or ignore irrelevant possibilities. Previous research (Byrne & Tasso, 1999; Thompson & Byrne, 2002) has employed the use of conditional argument tasks (*given A, what follows...*), consistency judgment tasks (whether an event conjunction, *antecedent-consequent*, equates to the interpretation of a conditional) and implications tasks (examining what is *implied* following a reading of a conditional). In the next section we will review how differences in the way information is represented impacts on the possibilities and inferences people make and we describe how people draw inferences from subjunctive (counterfactual) conditionals such as, *if Sarah had gone to Moose Jaw then Tom would have gone to Medicine Hat*, and conditionals in the indicative mood, *if Sarah went to Moose Jaw then Tom went to Medicine Hat.* We also examine the effect *only* has on subjunctive conditionals, *if only Sarah had gone to Moose Jaw, then Tom would have gone to Medicine Hat.* Using examples of basic conditionals, that is conditionals that are not placed within a particular pragmatic or linguistic context, our aim is to review evidence that people represent different possibilities from different types of conditionals (Johnson-Laird & Byrne, 1991, 2002; Thompson & Byrne, 2002).

The Mental Model Theory

Counterfactual thinking requires people to represent different states of affairs in the world around them and alternatives to that world. People may construct mental models to represent this structure of their world (Johnson-Laird, 1983; Johnson-Laird & Byrne, 1991, 2002). Within these models, certain principles have been advocated as important in controlling what possibilities are represented (Johnson-Laird & Byrne, 1991; 2002). For example, situations considered untrue tend not to be represented (Espino et al., In press; Johnson-Laird & Byrne, 2002). Espino and colleagues used priming experiments to test this principle. They found that following reading affirmative conjunctions (i.e. *A, B*), participants read conditional and a bi-conditional (i.e. *'if and only if A then B'*) equally fast. They then had participants read a negated antecedent conjunction (i.e. *not-A, B*); participants read a conditional as easily as with the previous conjunction but they slowed when reading a bi-conditional. In support of the truth principle of the mental model theory, conditionals primed reading affirmative and negated-antecedent conjunctions but bi-conditionals primed reading only affirmative conjunctions but not negated-antecedent conjunctions. This concluded that people think about the true possibilities of *'A and B'*, and *'not-A and B'*, when understanding a conditional *'if A then B'*. In contrast, when they think about possibilities derived from a bi-conditional, they can imagine *'A and B'* but not the false possibility of *'not-A and B'*.

Another example of a proposed principle of the mental model theory is related to the constraints of working memory. People initially keep in mind only a few possibilities necessary for making an inference (García-Madruga et al., 2007; Johnson-Laird & Byrne, 2002). Previous research has identified that increases to the central executive's load, a working memory component, results in poorer conditional reasoning (Toms, Morris, & Ward, 1993). Nevertheless, García-Madruga and colleagues (2007) tested this specific to the principle of parsimony advocated by mental model theory, by giving participants two

working memory tests and then giving all participants a paper and pencil reasoning test. They found that the introduction of simple inference tasks significantly increased the difficulty of the working memory tests. However, inferences that required the representation of multiple possibilities were further taxing to working memory, resulting in poorer performance in the working memory tests.

To illustrate how these principles mediate what possibilities are represented, we will use an example derived from an indicative conditional:

If Sarah went to Moose Jaw then Tom went to Medicine Hat

With this form of conditional people imagine possibilities related to the conjecture (Byrne, 2002; Byrne & Tasso, 1999; Santamaria et al., 2005). For example:

Moose Jaw *Medicine Hat*

...

The diagram uses *Moose Jaw* to represent *Sarah went to Moose Jaw* and *Medicine Hat* to represent *Tom went to Medicine Hat*. Separate models are displayed on separate lines, and the three dots represent implicit possibilities that are not yet explicitly represented (Johnson-Laird & Byrne, 2002). Implicit possibilities can be 'fleshed out' later and made explicit if required by the reasoner. A fully fleshed out set of models containing all the possibilities consistent with the conditional are as follows:

Moose Jaw	*Medicine Hat*
not-Moose Jaw	*not-Medicine Hat*
not-Moose Jaw	*Medicine Hat*

Where 'not' is the propositional-like tag that denotes negation (Johnson-Laird, 1983).

A key tenet of the mental model theory is that the core meaning for basic conditionals of the *if-then* form, is defined by these three true possibilities (Johnson-Laird & Byrne, 2002). This distinction removes the final possibility:

Moose Jaw *not-Medicine Hat*

because the *if-then* form of the conditional suggests that this is false, and the mental model theory suggests that people only represent true possibilities.

The three possibilities represent the relation between the antecedent (Sarah went to Moose Jaw) and the consequent (Tom went to medicine Hat). The *if-then* form of the conditional suggests that the antecedent is sufficient for the consequent to occur but not necessary, while the consequent is necessary but not sufficient for the antecedent to occur. Using the model above to explain, the antecedent appears only when the consequent is present, *Moose Jaw and Medicine Hat*, however the consequent can be present with or without the antecedent, *not-Moose Jaw and Medicine Hat* and *Moose Jaw and Medicine Hat*. Therefore the *if-then* form of conditional is a conjunction of the following two sentences, *if antecedent then consequent*, and *if not-antecedent then the consequent may or may not be the case*. We will explain later that this has a great bearing on what people can validly conclude if given either the consequent or the antecedent as a premise.

Mental Models of Counterfactual Thoughts

The conditional we used as an example in the previous section was a conditional in the indicative mood. We now explain how the mental model theory has provided evidence that an indicative conditional is represented differently than a subjunctive conditional. Counterfactual thoughts generally are conditionals in the subjunctive mood; such as, "*if Sarah had gone to Moose Jaw then Tom would have gone to Medicine Hat*" (Byrne & Tasso, 1999; Thompson & Byrne, 2002). A counterfactual interpretation of a subjunctive

conditional keeps two possibilities in mind. The possibilities related to the conjecture, *Sarah went to Moose Jaw (A) and Tom went to Medicine Hat (B)*, and the presupposed facts that *Sarah did not go to Moose Jaw (not-A) and Tom did not go to Medicine Hat (not-B)* (Thompson & Byrne, 2002):

Moose Jaw *Medicine Hat*
not-Moose Jaw *not-Medicine Hat*
...

With indicative conditionals, people think about just a single possibility, the conjecture, from the outset. Although other possibilities may exist (as represented by the three dots):

Moose Jaw *Medicine Hat*
...

The mental model theory suggests that certain inferences are more easily made from subjunctive than from indicative conditionals because of this distinction. Take again the following conditional:

If Sarah went to Moose Jaw then Tom went to Medicine Hat

The mental model theory predicts that a *modus tollens* inference, reaching a conclusion from the premise, *Tom did not go to Medicine Hat* (not-B), is harder to reach from an indicative conditional compared to a counterfactual conditional because the reasoner's rudimentary initial model only contains the possibilities related to the conjecture:

Moose Jaw *Medicine Hat*
...

In this case, the conclusion, *Sarah did not go to Moose Jaw (not-A),* is not represented among the imagined possibilities. Thus the common error that follows when only the conjecture is represented explicitly, from an indicative conditional for example, is a conclusion that nothing follows (Johnson-Laird & Byrne, 1991). Yet if a reasoner 'fleshes out' their models with all the possibilities:

Moose Jaw	*Medicine Hat*
not-Moose Jaw	*not-Medicine Hat*
not-Moose Jaw	*Medicine Hat*

a conclusion can be reached. The presence of the explicit alternative (*not-Medicine Hat)* in the model allows the reasoner to combine a represented possibility with the premise (Johnson-Laird & Byrne, 1991). However, making a *modus tollens* inference is difficult because the models have to be fleshed out and reasoners have to keep several possibilities in mind (Byrne & Tasso, 1999).

In contrast, it is easier to make a *modus tollens* inference from a counterfactual interpretation. For a counterfactual conditional:

If Sarah had gone to Moose Jaw then Tom would have gone to Medicine Hat

A reasoner's initial set of models contains two possibilities, the conjecture and the presupposed facts:

Moose Jaw	*Medicine Hat*
not-Moose Jaw	*not-Medicine Hat*
...	

A conclusion can be reached from the second premise, *Tom did not go to Medicine Hat,* and it does not require further fleshing out.

The *modus tollens* premise, *not-Medicine Hat,* is represented in the model from the outset; reasoners can use the counterfactual possibility that is explicitly represented in order to make the valid conclusion, *not-Moose Jaw*. The error that 'nothing follows' is not made as easily as compared to a factual interpretation, as a conclusion can be reached without having to flesh out the full set of alternatives. The mental model theory suggests that from the outset, a counterfactual interpretation requires a more explicit representation than a factual interpretation. This prediction of the mental model theory has been corroborated. Inferences based on initial representations are easier than inferences that require reasoners to flesh out models (Byrne & Tasso, 1999; Johnson-Laird, 1983, 2001; Johnson-Laird & Byrne, 2002; Johnson-Laird, Byrne, & Schaeken, 1992; Legrenzi & Girotto, 1996; Walsh & Byrne, 2005).

The mental model can therefore make the following predictions. With a *modus ponens* inference, reaching a conclusion from the premise, *Sarah went to Moose Jaw* (A), no reliable differences will occur from factual or counterfactual interpretations. With both interpretations the premise is explicit in the reasoner's initial model, and so a conclusion can be reached without the reasoner having to flesh out other possibilities. The initial model from a factual interpretation is:

Moose Jaw *Medicine Hat*

...

Reasoners can easily conclude, *Medicine Hat* (B). The models for a counterfactual interpretation are:

Moose Jaw *Medicine Hat*
not-Moose Jaw *not-Medicine Hat*

...

This also allows the second premise to combine so as to reach a valid conclusion. Therefore there is no difference in the ease of the inferential process.

Recall earlier that we explained that the antecedent was sufficient but not necessary for the consequent to occur, and that the consequent was necessary but not sufficient for the antecedent. This allows valid conclusions to be reached from the premises of *modus ponens* and *modus tollens* inferences. We know that the consequent must be present if the antecedent is present, as this is stated by the conditional, *if A then B*. However, we do not know if the antecedent is present when the consequent is present because the consequent can occur either way. Therefore, given the premises, only the *modus ponens* and *modus tollens* inferences are valid.

In contrast, the *affirmation of the consequent* inference, reaching a conclusion from the premise, *Tom went to Medicine Hat* (B) is invalid. We know that the antecedent may or may not be present when the consequent occurs. Likewise, trying to reach a conclusion about the consequent given the premise, *Sarah did not go to Medicine Hat* (not-A), the *denial of the antecedent* inference, is also invalid. The consequent can be present whether or not the antecedent is present. Hence *denial of the antecedent* inferences and *affirmation of the consequent* inferences are fallacies[2]. The mental model theory also maps out how these arguments are represented and makes predictions about the inferences people will make from them. We discuss this in the next section.

Prediction of Inferences by the Mental Model Theory

Making a *denial of the antecedent* inference means reaching a conclusion from the premise:

---

[2] Any conclusions drawn from these arguments are valid only under a bi-conditional interpretation, *if and only if A, then B*. With a bi-conditional both antecedent and consequent are necessary and sufficient conditions for each other. Without a bi-conditional interpretation, no valid conclusion can be reached.

Sarah did not go to Moose Jaw. (not-A)

Making an *affirmation of the consequent* inference means reaching a conclusion from the premise:

Tom went to Medicine Hat. (B)

Once again, any conclusions reached from these premises are invalid. Thus, the *if-then* form of the conditional only allows valid inferences to be made from *modus tollens* and *modus ponens* premises (Evans, Newstead, & Byrne, 1993; Johnson-Laird & Byrne, 1991; Thompson & Byrne, 2002).

Regardless of whether the inferences reach valid or invalid conclusions, people still find it easier or harder to reach conclusions depending on the possibilities they keep in mind. To explain, recall that the mental model theory predicts that people keep two possibilities in mind when making a counterfactual interpretation, the conjecture and the presupposed facts. This is in comparison to a factual interpretation where only the possibility of the conjecture is represented. We explained previously that the effect of keeping different possibilities in mind is that when compared to conditionals given a factual interpretation, *modus tollens* inferences are made more frequently from conditionals given a counterfactual interpretation. However, no difference arises in frequencies of *modus ponens* inferences across interpretations because possibilities allowing a conclusion to be reached are represented in the models of both interpretations.

Thus the mental model theory can make predictions about *denial of the antecedent* and *affirmation of the consequent* inferences. A counterfactual interpretation allows *denial of the antecedent* inferences to be made more easily in contrast to a factual interpretation.

The reasoner's possibilities initially represented under a counterfactual interpretation include:

Moose Jaw *Medicine Hat*
not-Moose Jaw *not-Medicine Hat*
...

A conclusion from the *denial of the antecedent* premise, not-A, *Sarah did not go to Moose Jaw,* corresponds to not-B, *Tom did not go to Medicine Hat*, despite being a fallacy. Reasoners representing possibilities from a factual interpretation, for instance after an indicative conditional, *If Sarah went to Moose Jaw than Tom went to Medicine Hat,* initially have a simpler model explicitly in mind:

Moose Jaw *Medicine Hat*
...

This hinders participants when reaching a conclusion because the matching clause is not represented. Commonly reasoners conclude then that '*nothing follows'* (Johnson-Laird & Byrne, 1991).

The *affirmation of the consequent* inference requires the premise:

Tom went to Medicine Hat (B).

The mental model theory predicts that a counterfactual interpretation will make no difference to the ease with which a conclusion will be reached. Both the model from a factual interpretation:

Moose Jaw *Medicine Hat*
...

and counterfactual interpretation:

not-Moose Jaw *not-Medicine Hat*
Moose Jaw *Medicine Hat*
...

both lead to a conclusion, *Sarah went to Moose Jaw,* despite being invalid.

The model theory's explanations of these effects and its ability to predict people's errors have made it the forerunner in understanding how people reason and make inferences from conditionals (Evans, 1993). Yet some theorists have offered a modified version of the mental model theory as an alternative theory of conditional reasoning.

One such approach is the suppositional theory of Evans and Over (2004), which is another dual process theory that also asserts two cognitive mechanisms: implicit and explicit representation. However, three principles are advocated by this approach which make it distinct from the mental model theory of Johnson-Laird and Byrne (1991, 2002): 1) the singularity principle 2) the satisficing principle and 3) the relevance principle. The singularity principle suggests people only keep one possibility in mind at a time assessing each possibility sequentially, contrasting with the mental model theory whereby more than one possibility can be represented at a time. The satisficing principle suggests that people accept the possibility according to a context dependent goal. This possibility is then examined under higher order cognition, such as memory or general knowledge retrieval, and relevant models are made explicit depending on this three-step process. Finally the relevance principle suggests that a model's relevancy is based on how probable it is within the context, and this principle controls what information is focused on within the scenario. This principle also contrasts with the mental model theory because it uses a theory of what is probable, rather than what is possible, to determine what is mentally represented. This

mechanism is rather like a subjective probability in which people ascertain if an assertion is valid (e.g. the probability of B given A is equal to *if A then B*), and is based on the Ramsey test. This test suggests that people hold the antecedent as true (A), and assess the probability of the consequent occurring (B). This theory also proposes that people do not hold in mind the possibility in which the antecedent is false but the consequent is true. In other words, people do not represent '*not-A, and B*' possibilities, another contradiction with a principle of the mental model theory.

In this thesis we seek to test which of these theories better explains our results and which principles prove more successful at helping determine the counterfactual thoughts people create. We also seek to extend the principles of these two theories to test whether they can go beyond the context of reasoning experiments and transfer across to the fields of decision-making and the representation of choice. In the next section we give two examples of how the mental model theory's principles have been extended to counterfactual research, and how these extensions prove difficult for the alterative theories principles.

Extending the Mental Model Theory: Counterfactual Thinking and Other Domains

The metal model theory was first developed to understand people's reasoning. Much of the early research used the mental model theory to examine people's reasoning from conditional statements, as we have just discussed. However, researchers have recently been extending it to understand other factors of thinking, some examples include decision making, imaginary thinking, and language comprehension (see Oakhill & Garnham, 1996 for a review). In this section we review the use of mental model theory in explaining some of the effects discussed earlier in counterfactual thinking. It is the aim of this thesis to use the mental model theory to understand counterfactual thoughts created when exceptional actions are carried out.

Explaining the Temporal Order Effect using the Mental Model Theory

Earlier we discussed the temporal order effect in counterfactual thinking. In a series of independent events that lead to an outcome, people undo the most recent event more so than the other events (Byrne et al., 2000; Miller & Gunasegaram, 1990; Walsh & Byrne, 2004). Recall the example of two individuals tossing a coin to win money. People may understand the scenario by constructing models of the following possibilities:

Jones Heads	*Cooper Tails*	*Loss*

Where *Jones Heads* represents Jones tossing heads and *Cooper Tails* representing Cooper tossing tails, and *Loss* represents the outcome (Byrne et al., 2000; Walsh & Byrne, 2004). People might also represent the counterfactual possibilities, three in total:

Jones Heads	*Cooper Heads*	*Win*
Jones Tails	*Cooper Tails*	*Loss*
Jones Tails	*Cooper Heads*	*Win*

However, the temporal order effect suggests that people do not keep all the possibilities in mind, but just a limited set. Miller and Gunasegaram (1990) found that most people created the counterfactual thought, "*if Cooper had tossed heads, then they would have won*":

Outcome:	*Jones Heads*	*Cooper Tails*	*Loss*
Counterfactual:	*Jones Heads*	*Cooper Heads*	*Win*

Recall that this also led them to ascribe more guilt and blame to Cooper for the fact that neither individual won any money.

A later study by Byrne et al. (2000) however found that the temporal order effect could be undone if an explicit alternative was introduced. Participants also create models of these events:

Pre-Hitch:	*Jones Tails*		
Post-Hitch:	*Jones Heads*	*Cooper Tails*	*Loss*
Counterfactual:	*Jones Heads*	*Cooper Heads*	*Win*
Counterfactual:	*Jones Tails*	*Cooper Tails*	*Win*

People constructed models of the counterfactual possibilities around either the pre-hitch or the post-hitch events, undoing both character's actions equally, a result more indicative of people keeping more than one possibility in mind. This suggested that the temporal order effect required the first event to be presupposed.

Walsh and Byrne also found that how the winning outcome was described also affected the temporal order effect. Describing the winning outcome as a 'heads' disjunction reversed the effect. They explained this by illustrating the possibilities people were keeping in mind. A fully explicit set of all the possibilities would be as follows:

Jones Tails	*Cooper Heads*	*Win*
Jones Head	*Cooper Tails*	*Win*
Jones Tails	*Cooper Tails*	*Loss*
Jones Heads	*Cooper Heads*	*Loss*

Thus they construct models including the winning possibilities with some information explicit and some implicit. The possibilities represented for the heads disjunction are as follows:

Jones Heads		*Win*
	Cooper Heads	*Win*

The possibilities for the tails disjunction are as follows:

Jones Tails		*Win*
	Cooper Tails	*Win*

Despite the fact that the possibilities are the same for each of the disjunctions, the fact that these different disjunctions could be represented differently led Walsh and Byrne to predict that counterfactual thoughts would differ in the two scenarios. However, the outcome is that both characters picked tails:

Jones Tails	*Cooper Tails*	*Loss*

People cannot readily match up the fact about the first player, 'Jones tosses tails' with their idea about the winning possibility, 'if Jones tosses heads…' The fact that their winning model represents the alternative of Jones tossing heads means that this first event becomes mutable, because this mutability could be driven by a mismatch between the possibility represented and the facts of the situation (Byrne et al., 2000; Markman & McMullen, 2005). Therefore they undo the first event most often. The availability of an explicit alterative overrides the temporal order effect.

The Mental Model of the Action Effect

We also discussed earlier the action effect, a tendency for people to change actions more than inactions when undoing an outcome. The scenario used to illustrate this was of two students who were contemplating changing their college course because they were unhappy. To represent actions, people keep in mind the possibility of not carrying out the action and the action itself:

Jim:	Factual	*College B*	*even more unhappy*
	Counterfactual	*College A*	*moderately satisfied*

…

Where *College B* refers to Jim moving to College B (action), and *College A* refers to Jim staying at College A (inaction). The three dots represent possibilities still remaining to be 'fleshed out'. Inaction requires a simpler model:

Dave: Factual *College A* *even more unhappy*

...

Where *College A* refers to Dave staying at College A (inaction), and the three dots represent possibilities still remaining to be fleshed out. The consequences of Dave acting are not known, and are therefore not represented. If the model of action consists of two explicit possibilities in contrast to the model of inaction, it means that constructing a counterfactual from the model of action will be easier. Decisions with unknown consequences, compared to those that are known, lead to different models and different fleshing out processes (Byrne & McEleney, 2000; Feeney & Handley, 2006), which lead to different counterfactual thoughts. Once consequences of inaction are known and participants are fully informed of all possibilities, the action effect occurs.

Both these examples of the application of mental models to understand phenomena in counterfactual thinking displays the potential strengths of examining the underlying mental representations of the exceptionality effect, justifications for actions and the effect of decision-making within the context of counterfactual thinking.

Aims of the Thesis

This research investigates people's counterfactual thinking following exceptional actions and normal actions and justified and unjustified actions. We examine counterfactual thoughts following everyday scenarios and counterfactual thoughts constructed after decisions in a card game scenario. We explain how people construct counterfactual thoughts by suggesting principles that apply to the possibilities they are holding in mind.

We apply findings from decision-making research and the principles of the mental model theory. In this thesis we also test the underlying representation of subjunctive conditionals commonly interpreted as counterfactual. We will test what effect *only* has on *if-then* forms of subjunctive conditional. These tests will incorporate measures from reasoning literature of consistency judgment tasks, implication tasks and conditional argument tasks. We attempt to show some parity between how people reason from possibilities, and how choices before a decision affect counterfactual thoughts. Our findings will have implications for theories of mental representation, counterfactual thinking and decision-making.

Chapter 2 investigates how people change exceptional actions that lead to negative outcomes for a protagonist in an everyday scenario when there are different justifications for carrying out different actions. We give participants three different scenarios in order to manipulate the level of justification for choosing exceptional actions. We also investigate people's counterfactual thoughts that follow from actions considered normal for the protagonist. We will interpret our findings in light of theories of counterfactual thinking and the mental model theory.

Chapter 3 will investigate how people change exceptional-justified actions that led to negative outcomes. We will divide participants into two different experimental groups and manipulate the questions they receive prior to knowing the outcomes in order to test if prior thinking affects participants' choices or the counterfactual thoughts that follow these decisions. We examine how justified actions affect the counterfactual thoughts people construct about a protagonist who carries out an exceptional outcome. Once again we will interpret our findings by investigating the underlying mental representations that form the basis for counterfactual thinking.

Chapter 4 will investigate how people change exceptional-unjustified and normal actions that lead to negative and positive outcomes. We will examine how decisions

considered not justified led to different counterfactual thoughts depending on which experimental group we randomly assign participants to. Again we interpret our results drawing on research literature that hypothesises how people mentally represent counterfactual possibilities.

Chapter 5 will investigate participants' reasoning from indicative and subjunctive conditional statements. We make predictions about how they reason based on the principles of the mental model theory. We examine *if only* subjunctive conditional statements in order to make a novel examination of the effect *only* has on how people represent possibilities from these statements. Our aim in this chapter is to show how the possibilities people hold in mind following different interpretations of conditional statements, lead to different inferences, consistency judgments and beliefs about what the conditional implied. Our results will have implications for theories of counterfactual thinking, reasoning, mental representation and decision-making.

Finally the last chapter attempts to develop an understanding of how people represent choices prior to a decision, the representation of information related to decisions and the counterfactual possibilities attached to a decision's outcome. We will contrast our explanations using this focus with other theories of reasoning, counterfactual thinking and decision-making. Lastly we will discuss future avenues for research that are implied by our results.

Chapter 2 Counterfactual Thinking and the Exceptionality Effect

Kahneman and Tversky (1982) identified a phenomenon in counterfactual thinking they termed the exceptionality effect. They used a scenario about a man called Mr. Jones who, driving home from work, was killed in a car crash. Mr. Jones had driven home by an alternative route, not taking his usual route, in order to enjoy pleasant sea views. Kahneman and Tversky asked participants to create *if only* thoughts after reading the scenario. They found that participants consistently undid the outcome by changing the exceptional behaviour of Mr. Jones, having him take his normal route home (e.g. *if only he had driven home by his normal route*).

Kahneman and Miller (1986) later formed norm theory to explain this effect. They suggested that exceptional events were easily mutable because people automatically recruited norms of behaviour when exceptional events occurred. This gave people an immediate alternative to exceptional events, which they used to change the outcome. Gavanki and Wells (1989) later tested this to see if people always undid outcomes in the direction of normality. They did find that people tended to focus on exceptional events more than normal events when changing the outcome. However, they also found that despite the tendency for exceptional events to be changed towards normality, normal events were changed towards both exceptionality and normality. This led them to suggest that the mechanism of counterfactual thinking operated by a correspondence effect, the correspondence between outcome and antecedent. This mediated what aspects were changed because exceptional outcomes stemming from exceptional antecedents were undone by returning the event to normality. However, normal outcomes stemming from normal antecedents were undone in the direction of exceptionality.

Exceptionality and Reasons

There has been a wealth of research carried out following the finding of the exceptionality effect in counterfactual thinking (Gavanski & Wells, 1989; Girotto et al., 1991; Markman et al., 1993; McCloy & Byrne, 2000; Roese, 1994; Wells et al., 1987). Much of it has shown that when people imagine alternatives to outcomes, the exceptionality effect holds in many contexts. For example, people tend to focus on exceptional actions when looking to undo an outcome where no other information is available about reasons for the exceptional action (Segura & McCloy, 2003; Wells et al., 1987). Further research has also shown that exceptional events tend to stand out and therefore attention is directed to them when people imagine alternatives (Seelau et al., 1995).

More recent research however has begun to examine the effect of reasons and justifications for actions on counterfactual thinking (Bonnefon et al., 2007; Pieters & Zeelenberg, 2005; Walsh & Byrne, 2007). Bonnefon et al. (2007) examined actions that were justified or unjustified and counterfactual thoughts created after the outcome of the decision had been disclosed. Bonnefon et al. tested for effects by giving one group of participants the original Kahneman and Tversky (1982) Mr. Jones scenario, Mr. Jones driving home by an unusual route in order to enjoy the view from the shore. In a modified version, another group were told that Mr. Jones took an unusual route home to pick up medication for his sick wife. Both groups were then asked to choose which counterfactual thought Mr. Jones was most likely to have. Four different counterfactual thoughts were presented to participants, corresponding to the choice of route and three other focal aspects of the scenario (if only: he had departed at another time/ he had crossed at an amber light/ the other driver had not been on drugs). When undoing the accident, participants changed the choice of route significantly less when the decision was justified (picking up his wife's medicine), than when it was not (enjoying the view). Bonnefon and colleagues concluded that a justified deviation from the norm made mutation of the exceptional event more

difficult. It became harder to generate a counterfactual mutation about the route as participants felt Mr. Jones was required to pick up his wife's medication, making it harder to imagine an alternative to this action.

Exceptionality and Regret

Much research has shown that justifications for decisions are a mediator of regret (N'gbala & Branscombe, 1997; Pieters & Zeelenberg, 2005; Seta, McElroy, & Seta, 2001). Regret from decisions has drawn considerable interest from researchers (Savitsky, Medvec, & Gilovich, 1997; Seta et al., 2001; Sevdalis & Kokkinaki, 2006; E. van Dijk & Zeelenberg, 2005; Zeelenberg et al., 2000). Connolly and Zeelenberg (2002) have proposed a model which they call decision justification theory. They propose that there are two core components to regret. One is the comparative evaluation of the outcome. The other is the feeling of self-blame for having made a bad choice. A person can regret that the outcome is below the standard desired *and* that the decision made was unjustified. Yet, these two components do not have to go hand in hand. Connolly and Zeelenberg used the example of a parent vaccinating his or her child to explain. The vaccination protects against a serious disease, but the child could suffer bad side effects. Now imagine that unfortunately the child does suffer these effects and the parent feels regret. Now compare the parent's regret to the following story. A young man gets into his car after too many drinks to be legally safe to drive. He gets home with no negative consequences, yet he regrets his decision. Connolly and Zeelenberg propose that where the decision was justified, the parent feels no personal blame, despite regretting the outcome, whereas the young man regrets his unjustified decision, blaming himself despite suffering no negative consequences.

Counterfactual thinking can also lead to an anticipation of negative emotions, which impacts on decisions. Imagine being in a restaurant and wondering what to order. Anticipated counterfactual thoughts may keep people from choosing something unknown,

especially if their companion chooses a dish they know they like. They might imagine looking across at their companion's plate and thinking, 'if I had ordered the duck then I would have enjoyed my meal more,' and this thought moves them to say, 'I'll go for my usual, the duck please'. Where a person fails to carry out an action for fear of regretting it more than their inaction their behaviour is known as omission bias, and it is a phenomenon observed in both experimental and everyday contexts (Baron & Ritov, 1994; Ritov & Baron, 1990).

Pieters and Zeelenberg (2005) have extended this research by showing that counterfactual thoughts can be triggered regardless of a decision outcome's valence:

> Joop and Richard do not know each other. They have individually formed the intention to buy a video recorder, and it is important for both to make the decision about the brand of video recorder as good as possible. After extensive deliberation, Joop intends to buy a video recorder of the brand AKA. After extensive deliberation, Richard intends to buy a video recorder of the brand BYNO. Just before entering the store, Richard and Joop hear that *in a recent test of Consumer Reports the BYNO video recorder received the evaluation 'fair'*. Joop implements his plan and he buys a video recorder of the brand AKA. Richard changes his intention at the last minute, and he also buys a video recorder of the brand AKA. The picture and sound quality of both brands of video recorder turn out to be worse than expected.

The scenario above was given to participants with one of three manipulations; they included either a strong (as above), medium or weak reason for the characters to change their behaviour. Asking participants three questions i) who made the more sensible choice ii) who felt most regret, iii) who felt most disappointment, Pieters and Zeelenberg looked at intention-behaviour inconsistency (Joop was consistent and Richard was inconsistent). They found that as the justification for changing behaviour became stronger, participants estimated that Richard made the better choice, and that his regret diminished. However, the estimates of disappointment increased as justification increased. Further, even where

justifications for behaviour inconsistency were strong, estimated regret for both individuals was equal. The authors point to the fact that this may be because both outcomes were known. Nevertheless, the research supports the view that decision processes and decision outcomes are two independent sources of regret. By further testing simultaneously the prediction that intention-behaviour consistency induced a lower judged decision quality, and that these lower levels of judged decision quality led to higher levels of decision process regret, they clearly demonstrated that outcome regret and process regret were independent of each other in determining overall regret. The findings also support the idea that it is not necessarily actions that produce more regrets but what the norm for behaviour is in the situation. The researchers referred also to Zeelenberg et al. (2002) who used the scenario of the football manager to show an inaction effect when there is an assumption of action. Zeelenberg et al. posited that regret about decisions might prompt attempts to reverse the negative outcomes of the prior decisions by reversing future decisions (i.e. a reversal from inaction to action).

Counterfactual thinking plays an important role in preparing behaviour to be more effective for the future by comparing outcomes to alternative better outcomes, these upward counterfactual comparisons focus on possibilities that would improve on the current state (Markman et al., 1995; Roese, 1994; Roese et al., 2005). Counterfactual thinking can prompt a justification of the prior decision by searching for downward comparisons to alleviate regret (McMullen & Markman, 2000). Downward comparisons, whereby a focus is placed on alternatives that would have produced a worse outcome compared to the actual outcome, produces positive affect that can reduce motivation to change behaviour. We earlier used the example of the young driver who had a near miss when driving too fast, in order to illustrate this point. Depending on the affective consequence that the downward counterfactual elicits, he might be shocked into slowing down if he reflects on possible injury. On the other hand, he might also continue to speed if

he feels elation that he escaped any negative consequences. Markman and McMullen (2003) have clarified somewhat this difference in downward comparison functioning by discerning that depending on whether the counterfactual thought is assimilative or contrastive, counterfactual thoughts can ameliorate or intensify affective consequences. An assimilative counterfactual thought focuses on an expected feeling about the self that originates from an outcome, for example, *"I am happy because I almost won."* A contrastive counterfactual thought compares outcomes at a distance from the self, *"I'm fairly happy with my performance in that race, I could have lost to the other competitor."* Or to use another example, an assimilative comparison made by the young driver focuses on the counterfactual possibility of being involved in a serious accident, suffering the emotional and physical consequences that impact on his own self and others involved. On the other hand, a contrastive counterfactual highlights his current state of being alive and well by comparing it with the counterfactual possibility of being seriously injured.

Experiment 1: The usual action is chosen when exceptional alternatives lead to no better outcome.

The aim of the experiment in this chapter was to examine whether participants' counterfactual thoughts exhibit the exceptionality effect - that is, whether their *if only* thoughts change the exceptional action to be like the usual action (e.g. if only he had carried out his usual action) - even when the exceptional action is a justified better action (i.e. participants know a good reason for it). Also we test whether exceptional events can appear less justified than normal events and may appear to have fewer reasons attached to them (Bonnefon et al., 2007). We adapted Kahneman and Tversky's (1982) scenario about Mr. Jones who has a car accident when he takes an exceptional route home (see Appendix 1). We tested whether participants' counterfactual thoughts focused on the exceptional route, even when the route was justified because there was a reason for choosing it, coming

under the goal of the actor wanting to unwind after work. We modified the scenario to include an exceptional route that was justified (it afforded a high quality view and a medium journey time) and an exceptional route that was not justified (it provided a medium quality view and long journey time). The usual route provided a low quality view and a short journey time.

We predicted that participants would estimate regret as greater for the actor when the choice of route was unjustified than when it was justified, due to choice regret being increased (Connolly & Zeelenberg, 2002; van Dijk & Zeelenberg, 2005). We predicted that participants' counterfactual thoughts would focus on the usual route home (e.g. if only he had taken his usual route) more often when they were told that the actor took an exceptional route which was not justified than participants given a route which was justified (Bonnefon et al, 2007).

Overall, our aim was to test whether reasons for actions influenced the presence of the exceptionality effect and we predicted that attaching good reasons to an exceptional action would reduce the occurrence of the exceptionality effect. We also aimed to test a two part theory of regret (Connelly & Zeelenberg, 2002) and predicted that overall estimated regret would be influenced by independently existing process and outcome regret estimates.

Method

Materials

We constructed a scenario based on Kahneman & Tversky's (1982) route scenario, in which Mr. Jones is in a car accident on his way home from work. Participants were asked for a counterfactual thought following being informed about the outcome of the accident, with this making up the dependent measure. The scenario described Mr. Jones's usual route home (through a plain urban area taking half an hour), and two exceptional routes:

the shore route (with wonderful views and taking three quarters of an hour), and the village route (with interesting views and taking an hour). The independent variable was whether Mr. Jones took the usual, or one of the exceptional routes home. The scenario was a version of Kahneman & Tversky's (1982) original route scenario modified in the following ways: (i) Mr Jones was injured rather than killed - and so participants could be asked to consider the *if only* thoughts of Mr. Jones, rather than those at the further remove of his family, and also, participants could imagine how things could have been worse as well as better, unlike for a dramatic outcome such as death (Markman et al., 1993); (ii) it included a goal for the actor relevant to the choice of route – his desire to unwind after his day's work; (iii) it described two exceptional routes with the necessary additional information about the two exceptional routes and the usual route (the quality of the view and the duration of the drive). We first piloted these modifications to ensure that the exceptionality effect occurred in the modified version of the scenario, and we report the results of this materials test first.

Materials test: We constructed three incremental modifications to the original exceptional route scenario (Kahneman and Tversky, 1982). The first modification in the first version was that the actor, Mr. Jones was injured rather than killed:

> Mr. Jones was seriously hurt, badly injuring his leg in the accident

And we asked participants to consider the *if only* thoughts of Mr. Jones, rather than his family. In addition to this information, the second version provided information about two routes in relation to view quality (wonderful or plain) and duration of journey (an hour or a half an hour) so that the exceptional route was described as providing a wonderful view and it took about an hour; the regular route was described as providing a plain view and it took about a half an hour:

> Mr. Jones did not drive home by his regular route: his regular route was through a plain, built-up urban area although it generally got him home in about a half an hour. Mr. Jones decided he would drive home along the shore: the day was exceptionally clear and there was a wonderful view to enjoy although it would take about an hour to get home.

The third version in addition provided a relevant goal for the actor, to unwind after his day's work:

> Mr. Jones likes to unwind on his way home after his day's work

The three versions of the scenario are provided in Appendix 1. We expected the exceptionality effect to occur in each of the versions, in that participants would generate *if only* thoughts for Mr. Jones that focused on his choice of route home, "*if only I had driven home by his usual route*", more than on other aspects of the scenario.

The 90 participants in the materials test were recruited from Trinity College Dublin and included undergraduates, postgraduates and visitors to the campus (51 men and 39 women) who took part voluntarily. Their average age was 30 years (with an age range of 20 to 65 years). Thirty participants received each version: the first 60 participants were randomly assigned to versions 1 and 2 of the scenario, and the remaining 30 participants were assigned to version 3.

As expected, participants exhibited the exceptionality effect for each of the three versions of the scenario, creating the counterfactual thought, *"if only I had driven home by my usual route"* on 50% of trials or more for each version, more often than most other thoughts (see Table 2.1). They imagined a change of route more often than they imagined a change in the time he left the office for each of the three scenarios (scenario 1: 50% vs. 7%, $\chi^2 = 9.94$, df = 1, $p = .002$; scenario 2: 50% vs. 17%, $\chi^2 = 5.00$, df = 1, $p = .025$; scenario 3: 57% vs. 3%, $\chi^2 = 14.22$, df = 1, $p < .001$), more often than the presence of the

drugged boy (scenario 1: 50% vs. 0%, binomial, (N =15), z = 1.87, $p < .001$[3]; scenario 2: 50% vs. 0%, (N =15), z = 1.87, $p < .001$; scenario 3: 57% vs. 3%, $\chi^2 = 14.22$, df = 1, $p < .001$), and more often than any other aspect (scenario 1: 50% vs. 7%, $\chi^2 = 9.94$, df = 1, $p = .002$; scenario 2: 50% vs. 3%, $\chi^2 = 12.25$, df = 1, $p < .001$; scenario 3: 57% vs. 7%, $\chi^2 = 11.84$, df = 1, $p = .001$). After the route, the next most common focus for counterfactual thoughts was Mr. Jones continuing through the amber light at the crossing (about 35% of trials), and there were no differences between them (scenario 1: 50% vs. 37%, $\chi^2 = .62$, df = 1, $p = .433$; scenario 2: 50 vs. 30, $\chi^2 = 1.50$, df = 1, $p = .221$; scenario 3: 57 vs. 30, $\chi^2 = 2.46$, df = 1, $p = .117$). For each of the three versions, participants changed the route about one third more often or twice as often as the crossing, which is comparable to Kahneman and Tversky's (1982) original finding (53% versus 23%). The somewhat increased focus on crossing at the amber light in all three scenarios may reflect the requirement to complete Mr. Jones's *if only* thought rather than the *if only* thoughts of his family, unlike the original scenario.

Table 2.1: The percentages of first counterfactual thoughts that changed different aspects of the three incrementally modified versions of the scenario in the materials test of Experiment 1 (n = 30 for each scenario).

Counterfactual Focus	**Route**	**Time**	**Crossing**	**Boy**	**Other**
Materials test					
Scenario 1	50	7	37	0	7
Scenario 2	50	17	30	0	3
Scenario 3	57	3	30	3	7

There were no differences between the three versions of the scenario in the frequency of *if only* thoughts that changed the route, $\chi^2 = .13$, df = 3, $p = .72$, or crossing at the amber light, $\chi^2 = .20$, df = 3, $p = .655$ (and there were too few data points for

[3] Binomial analyses were carried out in place of chi square analyses for comparisons where a cell = 0

comparison between the groups for any other aspects). Participants did not focus equally on the various aspects (route, crossing at the light, the drugged boy, the time leaving the office, and other aspects) (scenario 1; $\chi^2 = 17.20$[4], df = 3, $p = .001$; scenario 2; $\chi^2 = 14.27$, df = 3, $p = .003$; scenario 3; $\chi^2 = 32.67$, df = 4, $p < .001$).

The results confirm the occurrence of an exceptionality effect – a tendency to focus on the exceptional route and think, *"if only he had taken his usual route"* - comparable to that established by Kahneman and Tversky (1982). The effect occurs even when participants imagine Mr. Jones's *if only* thoughts after he was injured rather than his family's thoughts after he was killed, when they are provided with additional information about the quality of views and duration of journey of the routes, and when they are provided with a goal relevant to the exceptional action.

Based on the materials test, we constructed an experimental scenario further modified to remove the sentences about Mr. Jones failing to cross at the amber light (given that this aspect appeared to compete with the exceptional route as a key focus in all three scenarios), as outlined in Appendix 1. To test our hypotheses, we described two exceptional routes, one was the *shore* route and it was justified by high quality views (described as "wonderful") and medium duration journey time (three quarters of an hour); and the second was the *village* route and it was not justified – it provided medium quality views (described as "interesting") and a long duration journey time (one hour)(see Appendix 1).

Design and procedure

Participants were assigned at random to one of three groups, composing a between-groups design: usual route, exceptional-justified route, and exceptional-unjustified route. Which route the protagonist chose was the independent variable. After reading the scenario all

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[4] Degrees of freedom = 3 for scenario 1 and 2 as the focus on the drugged boy had a frequency of 0.

participants were asked to provide an *if only* counterfactual thought, constituting the dependent variable, in the following way:

> As commonly happens in such situations, Mr. Jones often thought and often said *if only* in the days that followed the accident. How did he continue this thought? Please write one or more likely completions.

After reading the story and providing a counterfactual thought, participants were required to complete a measure of regret for the outcome, which made up a second dependent variable:

> On the following scale, please rate the extent to which you think Mr. Jones feels regret about his accident.
>
> 0 1 2 3 4 5 6 7 8 9 10
>
> *No Regret* *Much Regret*

They were also required to complete a measure of regret for the choice of route:

> On the following scale, please rate the extent to which you think Mr. Jones feels regret about his choice of route.
>
> 0 1 2 3 4 5 6 7 8 9 10
>
> *No Regret* *Much Regret*

The order of presentation of the two regret measures was counterbalanced, with half of the participants receiving the accident regret scale first and the other half receiving the route choice regret scale first. The participants provided their answers in a printed booklet, which contained instructions, the scenario, space to record *if only* thoughts, the regret measures, and debriefing information on separate pages. They were tested in groups of varying sizes, and they answered the questions at their own pace.

Participants

The 120 participants were recruited from Trinity College Dublin and included undergraduates, postgraduates and visitors to the campus (59 men and 61 women) who did not participate in any of the materials tests, which were a separate series of pilot studies, and who took part voluntarily. Their ages ranged from 18 to 53 years (and the average age was 30 years). They were assigned at random to the three conditions (n = 40 per group). They had not taken part in the materials test or seen the scenarios before.

Results and Discussion

As we predicted, participants judged that Mr Jones would feel more regret overall (combined regret for the choice of route and for the accident) in the exceptional-unjustified route condition than in the usual route condition, 14.3 vs. 12.8, $t(117) = 1.24$, $p = .05$ ($r = .23$)[5], as Table 2.2 shows. There were no differences in estimates of overall regret between the exceptional-justified condition and the usual condition, 13.1 vs. 12.8, $t(117) = -.38$, $p = .353$ ($r = -.07$). The difference between the exceptional-justified and unjustified conditions was not significant, 13.1 vs. 14.3, $t(117) = -1.61$, $p = .109$ ($r = .15$), and there were no overall differences between the three conditions, $F(2, 119) = 1.43$, MSE = 17.28, $p = .244$, as shown by an ANOVA on the composite regret score (the sum of choice regret and outcome regret).

Participants judged that Mr Jones would experience high regret for the accident (overall mean from three 'choice of route' scores = 7.3 - on a scale of 0 to 10) and for his choice of route (overall mean from three 'accident' scores = 6.1 - on a scale of 0 to 10) and there were no differences in the three conditions in judgements of regret for the choice of

[5] Estimated effect sizes (r) based on Cohen's d (Rosnow, Rosenthal, & Rubin, 2000; Thalheimer & Cook, 2002)

route, ($F(2, 117) = .38$, MSE = 4.80, $p = .687$), or the outcome ($F(2, 117) = 1.75$, MSE = 7.89, $p = .178$), as shown by separate one-way analyses of variance on the two measures.

However, participants judged that Mr Jones would feel more regret about the accident than about the choice of route in the usual route condition, 7.1 vs. 5.7, $t(39) = 3.40$, $p = .002$ ($r = .48$), and the exceptional-justified condition, 7.3 vs. 5.8, $t(39) = 2.78$, $p = .008$ ($r = .41$); but judgments of his regret for the choice of route were sufficiently high in the exceptional-unjustified condition that the difference between regret for the accident and the choice of route was marginal, 7.5 vs. 6.8, $t(39) = 1.80$, $p = .080$ ($r = .28$). Overall, the results indicate that participants judge that Mr Jones feels more regret for the accident and choice of route in the exceptional unjustified condition.

Table 2.2: The means (standard deviations) for judgments of regret for the choice of route and regret for the accident in the three conditions of Experiment 1 (n = 40 in each condition).

Regret	**Choice of Route**	**Accident**	**Summed Score**
Experimental conditions			
Usual	5.7 (2.8)	7.1 (2.5)	12.8 (4.6)
Exceptional justified	5.8 (2.9)	7.3 (2.0)	13.1 (3.6)
Exceptional unjustified	6.8 (2.8)	7.5 (2.1)	14.3 (4.2)

Note: Regret was measured on two 11 point scales where 0 = no regret and 10 = much regret.

As we expected, when participants were told the actor had taken an exceptional-unjustified route (the villages route), their counterfactual thoughts exhibited an exceptionality effect (that is, they focused on the route, if only he had taken his usual route) on 55% of trials, as Table 2.3 shows. They changed the route more often than the drugged boy (3%, $\chi^2 = 19.17$, df = 1, $p < .001$), the time he left work (23%, $\chi^2 = 5.45$, df = 1, $p = .02$), continuing through the amber light at the crossing (15%, $\chi^2 = 9.14$, df = 1, $p = .002$), as well as other aspects (5%, $\chi^2 = 16.67$, df = 1, $p < .001$).

Unexpectedly, their counterfactual thoughts also exhibited an exceptionality effect on 58% of trials when they were told he had taken an exceptional justified route (the shore route). They changed the route more often than the drugged boy (3%, $\chi^2 = 20.17$, df = 1, $p < .001$), the time he left work (13%, $\chi^2 = 11.57$, df = 1, $p = .001$), continuing through the amber light at the crossing (20%, $\chi^2 = 7.26$, df = 1, $p = .007$), as well as other aspects (8%, $\chi^2 = 15.39$, df = 1, $p < .001$). Hence, there were no differences in the focus on route in the exceptional-justified and exceptional-unjustified conditions (58% vs. 55%, $\chi^2 = .02$, df = 1, $p = .881$).

Table 2.3: The percentages of first counterfactual thoughts that changed different aspects of the three experimental conditions of Experiment 1 (n = 40 for each condition).

Counterfactual Focus	**Route**	**Time**	**Crossing**	**Boy**	**Other**
Experimental conditions					
Usual	45	20	20	5	10
Exceptional-justified	58	13	20	3	8
Exceptional-unjustified	55	23	15	3	5

Moreover, participants' counterfactual thoughts focused on the route on 45% of trials when they were told he had taken his usual route, that is, *if only he had taken a different route.* They changed the route more often than the drugged boy (5%, $\chi^2 = 12.80$, df = 1, $p < .001$), the time he left work (20%, $\chi^2 = 3.85$, df = 1, $p = .05$), continuing through the amber light at the crossing (20%, $\chi^2 = 3.85$, df = 1, $p = .010$), as well as other aspects (10%, $\chi^2 = 8.91$, df = 1, $p = .003$). There were no differences in the focus on route in each of the exceptional conditions and the usual route condition (usual route versus exceptional-justified route: 45% vs. 58%, $\chi^2 = .61$, df = 1, $p = .435$; versus exceptional-unjustified route: 45% vs. 55%, $\chi^2 = .40$, df = 1, $p = .527$).

The results are consistent with one of two interpretations: either individuals change exceptional actions even when they are justified, or else the exceptional-justified route was not considered by participants to be more justified than the exceptional-unjustified route. An examination of the focus of their counterfactuals provides the answer. When participants focused on the route, they tended to create counterfactual alternatives that were specific about the alternative route they identified (e.g. if only he had taken his usual route) rather than general (e.g. if only he had taken a different route), in each of the exceptional route conditions, as Table 2.3 shows. In the exceptional-justified condition, participants created a specific counterfactual rather than a general one (40% vs. 12.5%, $\chi^2 = 5.76$, df = 1, $p = .016$), and the specific route they identified was the usual route rather than the other exceptional route (40% vs. 5%, $\chi^2 = 10.89$, df = 1, $p = .001$). Likewise, in the exceptional-unjustified condition, participants created a specific rather than a general counterfactual (40% vs. 15%, $\chi^2 = 4.55$, df = 1, $p = .033$) and the specific route they identified was the usual route rather than the other exceptional one (40% vs. 0%). In contrast, in the usual route condition they tended to create general counterfactual alternatives more than specific ones (35% vs. 5%, $\chi^2 = 9.00$, df = 1, $p = .003$). The result suggests that participants did not distinguish between the two exceptional routes.

Table 2.4: The percentages of first counterfactual thoughts that changed route and external factors in the three conditions of Experiment 1 (n = 40 in each condition).

	Usual	**Exceptional**		**'Other' route**	***Total***	**Other Factors**
		Just.	**Unjust.**			
Condition						
Usual	-	5	5	35	45	55
Exceptional						
Justified	40	-	5	12.5	58	42.5
Unjustified	40	0	-	15	55	45

Table 2.4 also shows that in each of the three conditions, the focus of counterfactual thoughts was split between the route and other factors (usual: 45% vs. 55%, $\chi^2 = .40$, df = 1, $p = 527$; exceptional-justified: 57.5% vs. 42.5%, $\chi^2 = .90$, df = 1, $p = .34$; exceptional-unjustified: 55% vs. 45%, $\chi^2 = .40$, df = 1, $p = .527$. The result confirms that the route was the salient feature of the scenario to mutate in counterfactual thoughts.

The experiment shows that participants judged that an individual would experience more regret for an exceptional unjustified action than for an exceptional justified one, compared to a usual action, in the everyday context of a traffic accident. However, their counterfactual thoughts focused on the exceptional action regardless of whether it was justified or unjustified, perhaps because route is the most salient feature of the scenario, participants did not distinguish between justified and unjustified actions in this context.

General Discussion

The experiments were designed to test whether participants would create counterfactual thoughts according to the exceptionality effect (i.e. changing the exceptional action to the normal action), even when they knew of a good reason for the exceptional action.

Counterfactual thoughts

We tested whether the reason for taking an exceptional route affected counterfactual thoughts, specifically whether the exceptionality effect (focusing on the usual route) would be displayed when Mr. Jones chose the shore route, because it had good reason to be chosen. We predicted that participants would change the route less because reasons for actions reduced the action's mutability (Bonnefon et al., 2007). We predicted that the village route would reliably display the exceptionality effect as it had little reason to be chosen as the route home, increasing that actions mutability. For the usual route condition

we expected participants to change the outcome by changing actions towards greater exceptionality (e.g. if only the protagonist drove home by the shore route).

(a) The exceptionality effect was observed for the exceptional–unjustified condition (villages route) as expected, participants changed route taken when undoing the outcome. The thought most prevalent for this condition was, "*if only he had taken his usual route home.*" (b) Our prediction that reasons would reduce the mutability of route in the shore condition was not supported. Participants focused on route and imagined the same thought, "*if only he had driven home by his usual route*". This showed that in this context the exceptionality effect was not affected by reasons for actions.

A counterfactual thought that participants do not imagine is Mr. Jones driving down the prescribed road and not having an accident. Likewise they do not tend to imagine Mr. Jones not going down the road and having the accident. These possibilities do not come to mind because principles regulate imagined possibilities (Johnson-Laird & Byrne, 1991; 2002). For instance a principle of truth discounts the possibility that Mr Jones drives down the prescribed road and he doesn't have an accident because that is against the facts of the scenario (Espino et al., In press). And people do not imagine thoughts about Mr. Jones taking another route because it does not equate with their goal of undoing the accident.

We suggest that for the alternative route conditions, participants hold the following possibilities in mind. The model for the shore route is as follows:

Factual:	*exceptional shore route*	*accident*
Counterfactual:	*usual urban route*	*no accident*
	...	

Where 'shore route' represents Mr. Jones taking the shore route and the outcome represented as the 'accident'. The salient counterfactual thought is represented as Mr.

Jones taking his 'usual route' and the outcome is that 'no accident' occurs. The three dots represent other possibilities that are not explicitly represented in the model but can be fleshed out later if necessary. For the villages route the model of possibilities is as follows:

Factual:	*exceptional villages route*	*accident*
Counterfactual:	*usual urban route*	*no accident*
	...	

The information about his usual route home not being taken gives participants an immediate alternative to the antecedents leading to the negative outcome. We predict that participants will explicitly represent the 'usual route' because it is explicitly mentioned in the scenario as the usual behaviour of Mr. Jones. This idea is related to Kahneman and Miller's (1986) idea of norm violation and Markman and McMullen's (2005, p.88) behavioural interruption. Our proposition is that it is the contrast within the model, regardless of whether the possibilities are norms or not, that leads participants to make the appropriate counterfactual thoughts.

Participants represent the following facts; Mr. Jones drives home by his usual route and has an accident:

Factual:	*usual urban route*	*accident*
	...	

It has been proposed that counterfactual thoughts are triggered when an interruption to normal or expected behaviour occurs. Participants flesh out counterfactual possibilities in this case:

Factual:	*usual urban route*	*accident*
Counterfactual:	*exceptional shore route*	*no accident*

Counterfactual: *exceptional villages route* *no accident*

...

In this experimental context, of little importance to participants was the difference between the alternative-exceptional routes, as their perspective of the scenario is to imagine how the accident could have been avoided. This limits the construction of possibilities because only the information that is being focused on and explicitly represented, the accident and the route, is available (Byrne & McEleney, 1997; Johnson-Laird & Byrne, 2002; Legrenzi & Girotto, 1996). Once reasoning that both counterfactual alternatives would undo the outcome in the same way, participants create the counterfactual thought, *"if he had chosen another route..."* because making a distinction is unnecessary.

Attributions of control are important when people imagine alternatives to outcomes (Girotto et al., 1991; Markman et al., 1995; McCloy & Byrne, 2000). And thinking counterfactually about non-controllable actions may serve little functional value (Roese, 1994; Wohl & Enzle, 2003). Girotto and colleagues (1991) have previously shown that a robust constraint on counterfactual thinking is controllability. Events a protagonist has control over will be focused on more than non-controllable events when people undo an outcome. The choice of Mr. Jones' route home leading to the accident is the only antecedent he can be considered to have control over. In fact, evidence for this is contained within the pre-test materials. It was necessary to remove the information about Mr. Jones continuing through the amber light in order to replicate Kahneman and Tversky's (1982) original results. Kahneman and Tversky first suggested that such a change should not be carried out because this behaviour was a norm of the actor's behaviour and therefore less mutable. The reason they may not have encountered this could be due to their original scenario being from the perspective of Mr. Jones' family. This is in contrast to our scenario as we stated that Mr. Jones constructed his own counterfactual thought. From the family's point of view, natural habits may not seem very mutable (continuing through the amber

crossing), but from the point of view of the protagonist, these aspects become mutable. People can imagine a scenario from different perspectives, and this changes the information they explicitly bring to mind, presenting different possibilities to them that affect their counterfactual thoughts (Girotto et al., 2007). Also, awareness is emerging that even from what could be considered equal perspectives, differences can arise in how possibilities are compared and assessed. People can evaluate or reflect on one possible event differently depending on their underlying motivations or individual outlooks (Markman & McMullen, 2003, 2005). These difference can be hard to identify, however mapping the possibilities they are likely to keep in mind, as predicted by understanding the principles attached to these different perspectives, may help overcome these initial difficulties.

The fact that participants in the usual route condition do not distinguish between the two alternative routes, regardless that one was justified and the other was not, indicates that reasons for choosing a specific alternative route home for Mr. Jones has little relevance for the eventual outcome in this context. The results do not support the view that exceptional events appear less justified than normal events and may appear to have fewer reasons attached to them (Bonnefon et al., 2007), because if this were so, participants should have made a distinction between the two exceptional routes as there were reasons to chose the justified shore route. One other possibility is that our manipulation is different from that of Bonnefon et al., in that their manipulation is closer to an obligation rather than a reason. Previous research has identified that obligations relating to actions have a stronger influence on an action's mutability, becoming harder to mutate, than reasons determined to be personal and internalised (Walsh & Byrne, 2007). In this case, taking as an example Mr. Jones' wish to take in the 'wonderful' sea views. Regardless of this question over differences in manipulations, the evidence remains that unless antecedents

are related to the goal of creating a better outcome, they will not be a factor in the counterfactual thoughts generated.

Examining counterfactual thoughts in the usual route condition using Kahneman and Tversky's (1982) basis of counterfactual categorisation showed that route was focused on most. Participants changed the outcome by imagining Mr Jones had taken an alternative route. Although participants focused on 'route' their thoughts changed the usual route in the direction of exceptionality (i.e. if only he had driven home by another route...). Although the route was the most salient aspect for counterfactual thinking, a large percentage of participants changed the outcome by changing 'other factors' (justified: 42.5%; unjustified: 45%). These factors accounted for an even larger percentage of thoughts in the usual route condition (55%). We conclude that although a large percentage of participants do display an exceptionality effect and a focus on route, close to half of participants undo the outcome by imagining other antecedents or events as factors in creating a different outcome. Few if any of these factors in our experiments can be considered as the result of norms being evoked automatically when imagining alternatives (Kahneman & Miller, 1982), as these possibilities were in no way tied into the protagonist's normal behaviour. Neither does this theory of the mechanisms of counterfactual thinking provide an explanation for why or how participants create these thoughts. This identifies that to fashion a predictive understanding of what possibilities participants are likely to represent requires a set of principles that goes beyond a normative explanation, one that encompasses situations where participants focus on exceptional or novel antecedents when mutating the outcome. Our approach is to first understand general principles that underlie the mental representation of possibilities, such as those emerging from reasoning studies (Espino et al., In press; Santamaria et al., 2005; Thompson & Byrne, 2002) with the amalgamation of the functional relevance of counterfactual thinking

and its orientation in goal cognition (Epstude & Roese, 2008; Markman & McMullen, 2003; Roese et al., 2005).

Regret Measures

The employment of regret measures following counterfactual thoughts tested levels of regret participants estimated Mr. Jones would feel following a) his choice of route and b) the outcome of the accident. These measures were designed in accordance with the hypothesis that regrets following decisions consist of two independent factors (Connolly & Zeelenberg, 2002; Pieters & Zeelenberg, 2005). *Process regret* is felt in relation to the quality of the decisions (i.e. whether the decision is based on good reason), which corresponded to the choice regret measure. *Outcome regret* occurs following a negative outcome (i.e. the accident), and is independent of process regret. We predicted that choice regret would be greater with an unjustified action (the village route) and less for a justified action (the shore route), comparable to the usual action being taken. We predicted that outcome regret would be consistent across all three conditions and would be unaffected by reasons for actions.

Levels of expected regret were significantly lower for choice regret versus the accident regret measures in the usual and shore route conditions. This was not the case in the village route condition. Regret was lower for the choice regret but not reliably so. The choice of route was regretted more in the villages route. Theory states that regret can stem from decisions consisting of two independent aspects, namely process regret and outcome regret (Connolly & Zeelenberg, 2002; Pieters & Zeelenberg, 2005; E. van Dijk & Zeelenberg, 2005). Poor decisions attract higher levels of process regret. Outcome regret and process regret are reliably different when decisions are justified. However, regret for the decision process and the outcome are not reliably different when the decision is unjustified. The results support a two-part theory of regret following decisions.

Counterfactual thoughts have been consistently linked to regret, and some researchers have proposed they play a mediating role (Boninger et al., 1994; Gilovich & Medvec, 1995; Niedenthal et al., 1994; Roese, 1999; Zeelenberg et al., 2002). Our findings suggest that in this context, counterfactual thoughts are not directly affected by regret. Despite the unjustified action being regretted more, counterfactual thoughts undid the outcome in the same way that justified actions were undone. In this scenario, participants' counterfactual thoughts changed antecedents that undid the outcome and did not undo antecedents that were most regrettable. We suggest that although estimates of regret are dependent on the presence of explicitly represented alternative possibilities, as is the construction of counterfactual thoughts, these two separate cognitive phenomenon remain separate and individual to each other. This suggestion is similar to the understanding that both counterfactual and causal thoughts are related indirectly by similarities in how alternative possibilities are mentally represented (Goldvarg & Johnson-Laird, 2001; McEleney & Byrne, 2006).

In the following chapters we will concentrate on the cognitive measures of counterfactual thought generation through *if only* sentence stem completion tasks, rather than the indirect measures based on emotions such as regret ratings. We employ experiments in the following chapter using a novel scenario designed to test our hypothesis that counterfactual thoughts carry out the goal of changing the outcome. We test the hypothesis that the goal of counterfactual thinking is to change the outcome, regardless of whether the action is exceptional or justified. We intend to show that contrary to other theoretical explanations (Kahneman & Miller, 1986; Kahneman & Tversky, 1982), it is the goal of changing the outcome that is a key principle from which counterfactual thinking operates. We will test this by showing that counterfactual thoughts gravitate towards alternatives that provide outcomes that fulfil specified goals (i.e. to win a game). We

extend our hypothesis by proposing that this is mediated by the possibilities people keep in mind.

Chapter 3 Counterfactual Thinking, Explicit Alternatives and the Undoing of Outcomes

The experiments in this chapter were designed to investigate the presence of the exceptionality effect in a card game scenario (see Table 3.1 below). In the previous chapter we investigated whether justified actions reduced the exceptionality effect in the Mr. Jones scenario, first used by Kahneman and Tversky (1982). We found that justified and unjustified exceptional actions were mutated equally as often when participants created counterfactual thoughts. We posited that, as alternatives would have brought about the same outcome, no distinction was found in the counterfactual thoughts generated.

In this chapter we examine whether information about how the alternatives could have produced different outcomes will affect the counterfactual thoughts that people create. One view of counterfactual thinking is that exceptional events bring to mind their normal counterparts, unlike normal events that do not bring to mind exceptional alternatives (Kahneman & Miller, 1986). Another possibility, which we tested in the previous chapter, is that exceptional events can appear less justified than normal events and may appear to have fewer reasons attached to them (Bonnefon et al., 2007). In this chapter we aim to test whether the exceptionality effect exists only when people believe that there are no other salient alternatives other than the usual action (e.g. 'if Mr. Jones had driven home by his regular route, then he would not have been in the car accident'). We test whether people change an exceptional action to be like an alternative equally exceptional action rather than a usual action, once the exceptional action would lead to a better outcome. We also investigate whether they change a justified exceptional action to be like an unjustified exceptional alternative, once it would lead to a better outcome. We report three experiments designed to test these questions, examining whether people are guided primarily by their judgments about the counterfactual outcome, that is, by their judgments about whether the changed action could lead to a better outcome.

Table 3.1: The materials used in Experiments 2, 3 and 4.

Peter is faced with a dilemma when playing a game of cards. The cards given to him give him a great chance of winning the game, and with that, a great chance of winning money. Peter alone knows the values of the cards he holds. However, Peter can only win money if the other players in the game decide to play with Peter by matching the bet he makes. If none of the other players decide to play with Peter by betting, all the players will surrender their cards and receive new cards. Peter knows new cards will probably not give him such a great chance of winning.

Peter has good cards. Peter usually places a small bet. However, there are actually three choices available to Peter. Peter can bet small, medium, or large. These three values are related to how much money Peter is willing to bet in the game.

Peter is playing with three other players who each use three separate and distinct techniques for playing the game. These techniques have earned them the names of The Mouse, The Lion, and The Jackal. The Mouse only plays small bets, the Lion plays small and medium bets, and the Jackal plays small, medium and large bets. Each of the players' individual techniques means that they will each respond differently to Peter's betting actions.

Peter's cards are very good. However, how much Peter bets has consequences. Betting small, medium or large will affect the reactions of the three opposition players in different manners, as follows:

If Peter bets small, his bet will be €10. This will result in probably all three opposition players matching his bet.

(Peter's €10 matched by Mouse's €10 + Lion's €10 + Jackal's €10)

If Peter bets medium, his bet will be €20. This will result in probably only the Lion and the Jackal matching his bet.

(Peter's €20 matched by Lion's €20 + Jackal's €20)

If Peter bets large, his bet will be €30. This will result in probably only the Jackal matching his bet.

(Peter's €30 matched by + Jackal's €30)

Our proposals are derived from the view that the regularities in counterfactual thinking arise because people create counterfactual alternatives by thinking about possibilities. We suggest that these possibilities are guided by a small set of principles

(Byrne, 2005). Consider a card game in which an actor must choose between a large bet, a medium bet, or a small bet (again see Table 3.1 above). The actor plays against three other players: the small-bet player only matches small bets, the medium-bet player only matches small and medium bets, and the large-bet player matches small, medium or large bets. The actor usually chooses to place a small bet. However, in this instance, the actor chooses to place a medium bet. In the game, the medium-bet player and the large-bet player both match his bet. It turns out that the actor had better cards than the large-bet player, but the medium-bet player had the best cards so the medium-bet player won. The possibilities that people think about for the action and the outcome can be summarised in the following diagram:

Action:	*Actor places exceptional medium bet*
Outcome:	*Large and Medium bet players play:* *Actor has better cards than Large-bet player:* *Medium-bet player has better cards than Actor and Large-bet player*

Imagine the actor thinks, "Things would have been different if..." How do you think he would complete the thought? The counterfactual alternative created by changing the actor's exceptional action (placing the medium bet) to be like his usual action (placing the small bet) would not change the outcome for the better (e.g. if he had placed his usual small bet he still would have lost, because the medium-bet player would have matched his bet and won):

Counterfactual Action:	*Actor places usual small bet*
Counterfactual Outcome:	*Large, Medium & Small bet players play:* *Actor has better cards than Large-bet player:* *Medium-bet player has better cards than Actor and Large-bet player*

The counterfactual alternative created by changing the actor's exceptional action to be like the other exceptional action (placing the large bet) *could* change the outcome to be better (e.g. if he had placed the large bet he would have won, because the medium-bet player would not have played):

Counterfactual Action:	*Actor places exceptional large bet*
Counterfactual Outcome:	*Large-bet player plays:*
	Actor has better cards than Large-bet player

We test whether people tend to change an exceptional action to be like the usual action because they believe the usual action could have lead to a better outcome, and whether they change the exceptional action to be like an equally exceptional alternative when the alternative would lead to a better outcome. We aim to show in this thesis that the 'ought to have done' intention requires the representation of possibilities. These possibilities provide the reference point for future counterfactual thoughts.

Experiment 2: The usual action is chosen when exceptional alternatives do not lead to a better outcome.

The first experiment of this chapter aimed to demonstrate the standard tendency of the exceptionality effect, to change an exceptional action to be like the usual action (Kahneman & Miller, 1986) but using the card game scenario. The aim of the experiment was to test our hypothesis that participants tend to create *if only* thoughts that change an exceptional action to be like the usual action, when an exceptional alternative would *not* lead to a better outcome. We gave participants a card game scenario in which an actor chooses to place a large bet, a medium bet, or a small bet (see Table 3.1). The small bet was described as the actor's usual bet, and the other two bets were exceptional. The monetary context of gains and losses allowed an objective measure of the justification of

the exceptional actions. The participants robustly considered the large bet to be unjustified and the medium bet to be justified as shown by our materials tests, reported later.

In the scenario, the actor plays against three other players: the small-bet player only matches small bets, the medium-bet player matches small or medium bets, and the large-bet player matches small, medium or large bets. Participants were informed that if the actor places a small bet (€10), all three opposition players match his bet; if he bets medium (€20), two of the opposition players match his bet (the medium-bet player and the large-bet player); and if he bets large (€30), only one opposition player matches his bet (the large-bet player). In the version of the scenario used in this experiment, participants were told that the actor chose to place the medium bet. The medium-bet player and the large-bet player both matched his bet. In this experiment participants were told that the large-bet player had better cards than the actor and the medium-bet player, and so the actor lost. We predicted that participants would exhibit the standard exceptionality effect, that is, they would create counterfactual alternatives that focused on the usual action (e.g. if only he had placed his usual small bet). Given the outcome of the game (the large-bet player had better cards than the actor), counterfactual thoughts that focus on the other exceptional bet cannot result in a win outcome (e.g. if he had placed a large bet he still would have lost). We predict that the tendency to say, *"if only he had carried out his usual action,"* will be observed in this situation.

In this experiment the action and outcome can be represented as follows:

Action:	*Actor places exceptional medium bet*
Outcome:	*Large and Medium bet players play:*
	Large-bet player has better cards than actor

The counterfactual alternative created by changing the actor's exceptional action to be like the usual action is as follows:

Counterfactual Action:	*Actor places usual small bet*
Counterfactual Outcome:	*Large, Medium & Small bet players play:*
	Large-bet player has better cards than actor

The counterfactual alternative created by changing the actor's exceptional action to be like the other exceptional action (placing the large bet) is as follows:

Counterfactual Action:	*Actor places exceptional large bet*
Counterfactual Outcome:	*Large-bet player plays:*
	Large-bet player has better cards than actor

The experiment also examined a secondary question about whether participants who were asked at the outset to think about the actor's strategy and provide an explanation about which bet was the best bet performed differently from participants who were not asked to do so. We hypothesised that prior thinking about the reasons for the decision may increase participants' tendency to focus on the reasons rather than the decision itself in their counterfactual thoughts (Bonnefon et al., 2007; Markman & Tetlock, 2000; Walsh & Byrne, 2007). Prior thinking may also ensure that more information is available to participants to create counterfactual thoughts based on reasons for actions (Girotto et al., 2007; Pighin, Byrne, Ferrante, Gonzalez, & Girotto, 2009).

Overall, this experiment tested our predictions that the exceptionality effect occurred in cases where no exceptional alternative actions were present that were capable of producing a better outcome, leading participants to change the exceptional outcome to the usual outcome. We also predicted that no significant differences would arise between the control and strategy groups in their counterfactual thoughts because the scenario had the protagonist chose the action participants deemed as the best action, the medium bet.

Method

Design and procedure

We employed a between-participants design, with a strategy group and a control group. All participants were asked to complete a counterfactual sentence stem: *Peter thinks to himself after the game, "Things could have been different if..."* after they learned of the outcome of the card game scenario. From this task participants constructed their counterfactual thoughts, taken as the dependent variable. Participants in the strategy group answered two questions prior to learning the decision made by the actor and the outcome of the game, constituting the independent variables: *'Explain what you think is the best decision for Peter'* and *'What bet do you think Peter places?'* Participants in the control group answered only the second of these two questions (and there were no other differences between the two groups). The questions were answered in a fixed order and participants completed them in their own time. The participants were given a booklet, which contained general instructions, the scenario, the explanation and prediction questions, the decision and outcome, the counterfactual question, and a debriefing paragraph. The participants were tested in several large groups.

Participants

The participants were 60 undergraduate and postgraduate volunteers (30 men and 30 women) and their ages ranged from 17 to 69 years (and the average age was 23 years). They were assigned at random to two groups, control and strategy (n = 30 in each). One participant did not provide their age.

Materials

Participants were given a scenario that described an actor choosing which size bet to place in a card game, which he lost (see Table 3.1). The participants were given a version of the

card game scenario in which the decision to place a medium bet was described in the following way:

> Peter thought about his choices carefully. He considered betting small, a bet of €10, as he usually does. He then considered a large bet of €30. Then Peter considered the medium bet, he decided to go with the medium bet of €20.
> Peter's medium bet meant that the small-bet player decided not to play with him, so the small-bet player did not place a bet. The medium-bet player and the large-bet player decided to play with Peter by matching Peter's bet of €20.

The outcome was described as follows:

> The large-bet player had better cards than Peter and the medium-bet player, so the large-bet player wins the game and receives €60 (The large-bet player's €20 + The medium bet player's €20 + Peter's €20 = €60).

Table 3.2: The potential gains and losses for three bets, small, medium and large in the card game scenario used in the experiments, and the means to establish the large bet as unjustified and the medium bet as justified.

	Usual	**Exceptional**	
	Small	**Medium**	**Large**
1. Bet (potential loss)	10	20	30
2. No. players match bet	3	2	1
3. Bets placed by others	10+10+10	20+20	30
4. Win (potential gain)	30	40	30
5. Win plus bet	40	60	60
Best bet?			
6. Risk averse	*		
7. Risk seeking		*	
8. Risk amalgamation		*	*
9. Risk modulation	*		

We tested that participants judged the exceptional-large bet choice to be unjustified and the exceptional-medium bet choice to be justified by their answers to the questions: *'Explain what you think is the best decision for Peter'* and *'What bet do you think Peter places?'* and we report the results of this materials test first.

Materials test: We expected that participants would consider the large bet to be unjustified and the medium bet to be justified. The actor's usual action (to bet small) and the two exceptional actions (to bet medium or large) differ in the potential loss for the actor (€10, €20, or €30), depending on the number of players who will match his bet and the bets they place, and the potential gain for the actor (€30 or €40), as summarised in Table 3.2. We predicted that in the hypothetical context of the small monetary sums in this card game scenario participants would rely on a 'potential gains' risk-seeking computation (row 4 in Table 3.2) of how much can be gained. People tend to be risk seeking when the monetary amounts are minor (Prelec & Loewenstein, 1991; Weber & Chapman, 2005). Based on the number of players who will match the bet and the bets they will place, the medium bet allows the maximum gain, 40 euro.

Table 3.3 The percentages of answers to the materials test question 1, "Explain what you think is the best decision to take", that focus on a small, medium or large bet by the participants in the strategy group of Experiment 2.

	Small	**Medium**	**Large**
Experiment 2 Medium bet (large bet would <u>not</u> win)	20 (6)	77 (23)*+	3 (1)

Key: ** = significantly different from number on left; + = significantly different from number on right*

The potential gains hypothesis competes against several alternatives. If participants rely instead on a 'potential losses' risk averse computation (row 1 of Table 3.2) of how much can be lost, they would judge that the small bet is justified given that it allows the

least loss (€10). Risk aversion is common in uncertain choices (Kahneman & Tversky, 1979; Sokolowska, 2006; Weber & Chapman, 2005). If they rely on a 'risk modulation' calculation of the relation between the potential loss and gain (in effect, seeking to choose the greatest proportionate increase against their original bet - €30 won being three times the original wager of €10), they would also judge the small bet to be justified, based on a calculation that the small bet allows the player to quadruple his monies (an input of €10 produces a total output of €40), the medium bet allows the player to triple his monies, and the large bet only to double them (see Table 3.2). If they rely on a 'risk-amalgamation' calculation of the total potential 'winnings' returned, including the 'unlost' bet placed by the player (row 5 of Table 3.2), they will conclude that the medium and large bets are both justified (allowing a total win €60 in each case).

Table 3.4 The percentages of answers to the materials test question 2, "What size bet do you think Peter places?" that predict that Peter would place a small, medium or large bet by the participants in the strategy and control group in Experiment 2.

	Predicted Bet		
	Small	**Medium**	**Large**
Experiment 2 Medium bet (large bet would not win)			
Control group	17 (5)	67 (20)*+	17 (5)
Strategy group	30 (9)	70 (21)*+	0 (0)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

The results confirm that participants judge the medium bet to be the best bet, and the large bet and small bet are not judged to be the best. Participants in Experiment 2 answered the question *'Explain what you think is the best decision for Peter'* (prior to being told about the actor's decision and the outcome) by judging that the best decision was to place the medium bet, rather than to place the small bet (77% vs. 20%, $\chi^2 = 9.97$, df $=1$, $p = .002$), or the large bet (77% vs. 3%, $\chi^2 = 2.01$ df $=1$, $p < .001$) as Table 3.3 shows.

This result provides evidence that participants rely on a potential gains calculation in this scenario.

Participants in both the strategy group and the control group answered the question '*What size bet do you think Peter places?*' (prior to being told about the actor's decision and the outcome) by judging that Peter would place the medium bet more often than the small bet (control: 67% vs. 17%, $\chi^2 = 9.78$, df = 1, $p = .002$, strategy: 70% vs. 30%, $\chi^2 = 4.80$, df = 1, $p = .028$), and the medium bet more than the large bet (control: 67% vs. 17%, $\chi^2 = 9.78$, df = 1, $p = .002$, strategy: 70% vs. 0%, Binomial[6], n = 21, z = -4.36, $p < .001$), as Table 3.4 shows. These results further suggest that participants rely on a potential gains calculation.

The results of the materials test confirm that participants consider the medium bet to be the best bet, and the large bet and the small bet not to be the best bets.

Results and Discussion

As we expected the tendency to change an exceptional action to be like the usual action in *if only* thoughts was observed: most participants' *if only* thoughts focused more often on the usual, small bet than on the medium bet (control: 43% vs. 10%, $\chi^2 = 6.25$, df = 1, $p = .012$; strategy: 67% vs. 10%, $\chi^2 = 12.57$, df = 1, $p < .001$), as Table 3.5 shows (and consistent with previous research, an independent judge who scored the responses of one third of the participants was in agreement on 88% of trials). The result shows that people change an exceptional action (the medium bet) to be like the usual action (the small bet) rather than an alternative exceptional action (the large bet) when the alternative does not lead to a better outcome.

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[6] Where frequencies in a cell fell below the level required for a chi-square analysis, a binomial test of significance was used.

Table 3.5 The percentages of counterfactuals constructed in response to the prompt "Things could have turned out differently if..." that focus on the small or large bet (medium bet was actual bet) in the strategy and control group in Experiment 2.

	Usual Small	**Exceptional Large**	**'Other' Bet**	***Total Bets***	**External Factors**
Experiment 2 Medium bet (large bet would not win)					
Control	43 (13)+	10 (3)	3 (1)	57(17)	43 (13)
Strategy	67 (20)+	10 (3)	3 (1)	80 (24)+	20 (6)

Key: * = *significantly different from other bets;* + = *significantly different from external factors*

Participants' counterfactual thoughts focused on the bets more so than on external factors (e.g. 'If only he had more luck...' 'If only he were a better player...') in both groups (strategy: 80% vs. 20%, $\chi^2 = 10.80$, df = 1, $p = .001$; 57% vs. 43%, $\chi^2 = .53$, df = 1, although the latter difference of 13% was not significant $p = .465$), and there was no difference between the groups in their focus on external factors (43% vs. 20%, $\chi^2 = 2.58$, df = 1, $p = .108$). The sorts of external factors that participants focused on are outlined in Table 3.6. The result confirms the salience of the bets placed in the scenario.

Participants said, *"if only he had placed his usual small bet"* at similar frequencies in the control group as the strategy group (43% vs. 67%, $\chi^2 = 1.49$, df = 1, $p = .223$). There were few differences between the content of the strategy group and the control groups' counterfactual thoughts, which suggest that there was little effect of having to explain what the best decision was.

Table 3.6 The percentages of 7 categories of 'other' responses to the counterfactual question in Experiment 2 (including all those responses made by more than 5% of participants in at least one condition of one experiment).

	Categories (see key below)						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Experiment 2 Medium bet (large bet would not win)							
Strategy	7	3	0	7	0	3	0
Control	17	7	10	0	3	0	7

Key:

1. *If I had better cards*
2. *If I hadn't played*
3. *If opposition had different cards*
4. *If I was more thoughtful/careful*[7]
5. *If opposition hadn't played*
6. *If I had not been so confident*
7. *If I had been a better/luckier player*

The experiment demonstrates an exceptionality effect, that is, participants' *if only* thoughts tend to change an exceptional action to be like the usual one, in this card game scenario (Kahneman & Tversky, 1982). It shows the effect occurs when participants chose an exceptional action, and an alternative exceptional action would *not* lead to a better outcome. In the next experiments we test whether this effect can be eliminated and reversed when the other exceptional action *might* lead to a better outcome.

Experiment 3: The exceptional alternative is chosen when it could lead to a better outcome

The aim of the experiment was to test the hypothesis that participants tend to create *if only* thoughts that change an exceptional action to be like an alternative exceptional action, when the alternative *could* lead to a better outcome. In the scenario used in this experiment

[7] Examples of these counterfactual thoughts include, "if only I had considered the risk", or "if only I had given it more thought".

the actor carried out an exceptional justified action (he placed a medium bet), and the other exceptional action was unjustified (the large bet): this represents a particularly strong test of our hypothesis. We predict that participants will change the exceptional justified action to be like the exceptional unjustified one rather than the usual one.

Once again, participants were told that the actor chose to place the medium bet; the medium-bet player and the large-bet player both matched his bet. This time, they were told that the medium-bet player had better cards than the actor and so the actor lost. We predicted that participants would not exhibit the exceptionality effect, that is, they would not create counterfactual alternatives that focused solely on the usual action (e.g. if only he had placed his usual small bet, then he would have lost less money). Given the outcome of the game (the medium-bet player had better cards than the actor), counterfactual thoughts that focus on the other exceptional bet could conjecture a win outcome (e.g. if only he had placed a large bet, then he might have won) - because if he had placed a large bet the medium-bet player would not have played. No information was provided in this experiment about whether the actor had better cards or worse cards than the large-bet player.

In this experiment the action and outcome can be represented as follows:

Action:	*Actor places exceptional medium bet*
Outcome:	*Large and Medium bet players play:*
	Medium-bet player has better cards than actor

The counterfactual alternative created by changing the actor's exceptional action to be like the usual action is as follows:

Counterfactual Action:	*Actor places usual small bet*
Counterfactual Outcome:	*Large, Medium & Small bet players play:*
	Medium-bet player has better cards than actor

The counterfactual alternative created by changing the actor's exceptional action to be like the other exceptional action (placing the large bet) is as follows:

Counterfactual Action:	*Actor places exceptional large bet*
Counterfactual Outcome:	*Large-bet player plays:* *Unknown who has better cards, Actor or Large-bet player*

Counterfactual thoughts that focus on the usual bet could conjecture a diminished loss outcome (e.g. if he had placed his usual small bet, then he would have lost less money). Counterfactual thoughts that focus on other factors (e.g. if he had better cards... if he hadn't played...) can also result in an imagined better outcome. We predict that the tendency to say, *"if only he had carried out his usual action,"* will be eliminated in this situation, and participants will focus on the other exceptional bet as often in their *if only* thoughts.

Therefore, in this experiment our aim was to test predictions that the exceptionality effect could be undone if participants were presented with exceptional alternative actions that provided the possibility of a better outcome. Again, we predicted no difference between the strategy and control groups in how they constructed counterfactual thoughts due to the fact that the protagonist chose the action deemed by participants to be the best action, the medium bet.

Method

Participants, design and procedure

The 60 participants were undergraduates and postgraduates from Trinity College Dublin who took part voluntarily (30 men and 30 women). Their ages ranged from 18 to 53 years (and the average age was 23 years). They were assigned at random to two groups, control

and strategy (n = 30 in each). The design and procedure was the same as the previous experiment, a between-groups design with counterfactual thoughts acting as the dependent measure and the number of questions within the two groups and outcome information acting as the independent variables.

Materials

Participants were given the same scenario as in the previous experiment. However, the outcome was described as follows:

> The medium-bet player had better cards than Peter and the large-bet player, so the medium bet player wins the game and receives €60 (The large bet player's €20 + Peter's €20 + the medium bet player's €20 = €60).

Materials test: As in the previous experiment, the results confirm that participants judge the medium bet to be the best bet, and the large bet and small bet are not judged to be the best. Participants in the strategy group answered the question '*Explain what you think is the best decision for Peter'* by judging that the best decision was to place the medium bet rather than to place the small bet (67% vs. 17%, $\chi^2 = 9.00$, df = 1, $p = .003$) or the large bet (67% vs. 17%, $\chi^2 = 9.00$, df = 1, $p = .003$) as Table 3.7 shows.

Table 3.7 The percentages of answers to the materials test question 1, "Explain what you think is the best decision to take", that focus on a small, medium or large bet by the participants in the strategy group of Experiment 3.

	Small	**Medium**	**Large**
Experiment 3 Medium bet (large bet could win)	17 (5)	67 (20)*+	17 (5)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

Participants in both the strategy group and the control group answered the question '*What size bet do you think Peter places?*' by judging that Peter would place the medium bet more often than the small bet (control: 70% vs. 17%, $\chi^2 = 9.85$, df = 1, $p = .002$, strategy: 57% and 30%, $\chi^2 = 2.46$, df = 1, although the latter difference was not significant, $p = .117$), as Table 3.8 shows. There were no reliable differences between the judgements of the strategy group and the control group in predictions that Peter would place a small bet (30% vs. 17%, $\chi^2 = 1.14$, df = 1, $p = .285$) or a medium bet (57% vs. 70%, $\chi^2 = .42$, df = 1, $p = .516$). Participants in both groups predicted the medium bet more than the large bet (control: 70% vs. 13%, $\chi^2 = 11.56$, df = 1, $p = .001$; strategy: 57% vs. 13%, $\chi^2 = 8.05$, df = 1, $p = .005$). The results of the materials test confirm that participants consider the exceptional medium bet to be justified, and the exceptional large bet to be unjustified.

Table 3.8 The percentages of answers to the materials test question 2, "What size bet do you think Peter places?" that predict that Peter would place a small, medium or large bet by the participants in the strategy and control group in Experiment 3.

	Predicted Bet		
	Small	**Medium**	**Large**
Experiment 3 Medium bet (large bet could win)			
Control group	17 (5)	70 (21)*+	13 (4)
Strategy group	30 (9)	57 (17)+	13 (4)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

Results and Discussion

As we expected the tendency to change an exceptional action to be like the usual action in *if only* thoughts was eliminated: participants *if only* thoughts focused as often on the alternative exceptional bet as on the usual bet (strategy: 43% vs. 37%, $\chi^2 = .17$, df = 1, $p = .683$; control: 40% vs. 50%, $\chi^2 = .33$, df = 1, $p = .564$), as Table 3.9 shows.

Table 3.9 The percentages of counterfactuals constructed in response to the prompt "Things could have turned out differently if..." that focus on the small or large bet (medium bet was actual bet) in the strategy and control group in Experiment 3.

	Usual Small	**Exceptional Large**	**'Other' Bet**	***Total Bets***	**External Factors**
Experiment 3 Medium bet (large bet could win)					
Control	50 (15)	40 (12)	7 (2)	97 (29)+	3 (1)
Strategy	37 (11)	43 (13)	0	80 (24)+	23 (6)

Key: * = *significantly different from other bets;* + = *significantly different from external factors*

The result shows that people change an exceptional action to be like an alternative exceptional action as often as like the usual action, when the alternative could lead to a better outcome. They do so even when the alternative exceptional action is considered unjustified.

Participants' counterfactual thoughts focused on the bets more so than on external factors in both groups (control: 97% vs. 3%, $\chi^2 = 26.13$, df = 1, $p < .001$; strategy: 80% vs. 20%, $\chi^2 = 10.80$, df = 1, $p = .001$), and there was no difference between the groups in their focus on the bets (97% vs. 80%, $\chi^2 = .18$, df = 1, $p = .674$). The result confirms the salience of the bets placed in the scenario.

Participants said, *"if only he'd placed the large bet"* similarly in the control group as the strategy group (40% vs. 43%, $\chi^2 = .04$, df = 1, $p = .841$), and they said, *"if only he'd placed the small bet"* similarly in both groups (50% vs. 37%, $\chi^2 = .62$, df = 1, $p = .433$). There were few differences between the strategy group and the control group, which suggests once again that there was little effect of having to explain what the best decision was.

The experiment shows that the tendency to change an exceptional action to be like the usual action in *if only* thoughts, e.g. *"if only he had placed his usual small bet"*, is eliminated when changing it to an alternative exceptional action, *"if only he had placed a large bet"*, could lead to a better outcome. In the next experiment we take this finding a step further to show that the tendency can be not only eliminated but also reversed when the alternative exceptional action would definitely lead to a better outcome.

Experiment 4: *If only* thoughts focus on an alternative exceptional action that would lead to a better outcome

The aim of the experiment was to test the hypothesis that participants tend to create *if only* thoughts that change an exceptional action to be like an alternative exceptional action, when the alternative *would* lead to a better outcome. We predict that in this case the tendency for participants' counterfactual thoughts to focus on the usual action will not only be eliminated, but will be reversed as they will focus most often on the exceptional unjustified action.

Once again participants were told that the actor chose to place the medium bet and the medium-bet player and the large-bet player both matched his bet; the medium-bet player had better cards than the actor and so the actor lost. This time, participants were also told that the actor had better cards than the large-bet player. We predicted that participants would not exhibit the exceptionality effect, that is, they would not create counterfactual alternatives that focused solely on the usual action (e.g. if only he had placed his usual small bet). Given the outcome of the game (the medium-bet player had better cards than the actor), and the additional information that the actor had better cards than the large-bet player, counterfactual thoughts that focus on the other exceptional bet result in a win outcome (e.g. if he had placed a large bet he would have won) - because if he had placed a large bet the medium-bet player would not have played. We predict that the tendency to

say *if only he had carried out his usual action* will not only be eliminated in this situation, but it will be reversed - participants will focus on the alternative exceptional bet more often than the usual bet in their *if only* thoughts.

In this experiment the action and outcome can be represented as follows:

Action:	*Actor places exceptional medium bet*
Outcome:	*Large and Medium bet players play:*
	Actor has better cards than Large-bet player
	Medium-bet player has better cards than Actor

The counterfactual alternative created by changing the actor's exceptional action to be like the usual action is as follows:

Counterfactual Action:	*Actor places usual small bet*
Counterfactual Outcome:	*Large, Medium & Small bet players play:*
	Actor has better cards than Large-bet player
	Medium-bet player has better cards than Actor

The counterfactual alternative created by changing the actor's exceptional action to be like the other exceptional action (placing the large bet) is as follows:

Counterfactual Action:	*Actor places exceptional large bet*
Counterfactual Outcome:	*Large-bet player plays:*
	Actor has better cards than Large-bet player

In summary, the final experiment in this chapter tested predictions that we could reverse the exceptionality effect by presenting an exceptional alterative action, the large bet, which provided a better outcome than the actual action. Again we predicted no differences in counterfactual thinking between the strategy group and the control group due to the fact that the protagonist chose the medium best bet.

Method

Participants, procedure and design

The 60 participants were undergraduates and postgraduates from Trinity College Dublin who took part voluntarily (31 men and 28 women; one participant did not submit information about age or gender). Their ages ranged from 18 to 65 years (and the average age was 27 years). They were assigned at random to two groups, control and strategy (n = 30 in each). The design and procedure was the same as the previous experiment, a between-groups design with counterfactual thoughts acting as the dependent measure and the number of questions within the two groups and outcome information acting as the independent variables.

Materials

Participants were given the same scenario as in the previous experiment, including the description of the same decision to place the medium bet, but the outcome was described as follows (with the additional information underlined):

> Peter had better cards than the large-bet player, but the medium-bet player had better cards than Peter and the large-bet player, so Peter and the large-bet player lose the game along with their bets of €20 (The large-bet player's €20 + Peter's €20 + the medium-bet player's €20 = So the medium-bet player wins €60).

Materials test: As in the previous experiments, the results confirm that participants judge the medium bet to be the best bet, and the large bet and small bet are not judged to be the best.

Table 3.10 The percentages of answers to the materials test question 1, "Explain what you think is the best decision to take", that focus on a small, medium or large bet by the participants in the strategy group of Experiment 4.

	Small	**Medium**	**Large**
Experiment 4 Medium bet (large bet would win)	40 (12)	53 (16)+	6 (2)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

Participants in the strategy group answered the question '*Explain what you think is the best decision for Peter'* by judging that the best decision was to place the medium bet, rather than to place the large bet or the small bet (53% vs. 6%, $\chi^2 = 10.89$, df = 1, $p = .001$; 53% vs. 40%, $\chi^2 = .57$, df = 1, although the latter difference is not significant, $p = .450$), as Table 3.10 shows.

Table 3.11 The percentages of answers to the materials test question 2, "What size bet do you think Peter places?" that predict that Peter would place a small, medium or large bet by the participants in the strategy and control group in the Experiment 4.

	Predicted Bet		
	Small	**Medium**	**Large**
Experiment 4 Medium bet (large bet would win)			
Control group	17 (5)	77 (23)*+	7 (2)
Strategy group	37 (11)	57 (17)+	7 (2)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

Participants in both the strategy group and the control group answered the question '*What size bet do you think Peter places?*' by judging that Peter would place the medium bet more often than the small bet (control: 77% vs. 17%, $\chi^2 = 11.57$, df = 1, $p = .001$, strategy: 57% vs. 37%, $\chi^2 = 1.29$, df = 1, although the latter difference is not significant $p = .257$),

and the medium bet more than the large bet (strategy: 57% vs. 7% $\chi^2 = 11.84$, df = 1, p = .001; control: 77% vs. 7%, $\chi^2 = 17.64$, df = 1, $p < .001$), as Table 3.11 shows.

Results and Discussion

As we expected the tendency to change an exceptional action to be like the usual action in *if only* thoughts was not only eliminated but reversed: participant's *if only* thoughts focused more often on the alternative exceptional bet than on the usual bet (control: 67% vs. 10%, $\chi^2 = 12.57$, df = 1, $p < .001$; strategy: 57% vs. 17%, $\chi^2 = 6.55$, df = 1, $p = .011$), as Table 3.12 shows.

Table 3.12 The percentages of counterfactuals constructed in response to the prompt "Things could have turned out differently if..." that focus on the small or large bet (medium bet was actual bet) in the strategy and control group in Experiment 4.

	Usual Small	**Exceptional Large**	**'Other' Bet**	***Total Bets***	**External Factors**
Experiment 4 Medium bet (large bet would win)					
Control	10 (3)	67 (20)*+	3 (1)	80 (24)+	20 (6)
Strategy	17 (5)	57 (17)*+	10 (3)	83 (25)+	17 (5)

Key: * = *significantly different from other bets;* + = *significantly different from external factors*

The result shows that people change an exceptional action to be like an alternative exceptional action rather than the usual action when the alternative definitely leads to a better outcome. They do so despite the fact that they consider the alternative exceptional action to be unjustified. Participants' counterfactual thoughts focused on the bets more so than on external factors in both groups (control: 80% vs. 20%, $\chi^2 = 10.80$, df = 1, $p < .001$; strategy: 83% vs. 17%, $\chi^2 = 13.33$, df = 1, $p = .001$), and there was no difference between the groups in their focus on the bets (80% vs. 83%, $\chi^2 = .02$, df = 1, $p = .886$). The result again confirms the salience of the bets placed in the scenario. Participants said, "*if only*

he'd placed the large bet" similarly in the control group as the strategy group (67% vs. 57%, $\chi^2 = .24$, df = 1, $p = .622$). There were again few differences between the strategy group and the control group, which suggests that there was little effect of having to explain what the best decision was.

The experiment shows that the tendency to change an exceptional action to be like the usual action in *if only* thoughts, e.g. *"if only he had placed his usual small bet"*, is reversed when changing it to an alternative exceptional action, *"if only he had placed a large bet"*, would definitely lead to a better outcome.

General Discussion

In each of the three experiments the actor was described as having chosen the justified action, the medium bet. The alternative exceptional action was unjustified, the large bet.

Table 3.13 The percentages of counterfactuals constructed in response to the prompt "Things could have turned out differently if..." that focus on the small, medium or large bet in the strategy and control groups in the experiments.

	Usual Small	**Exceptional Medium**	**Exceptional Large**	**'Other' Bet**	***Total Bets***	**External Factors**
Experiment 2 Medium bet (large bet would not win)						
Control	43 (13)+	-	10 (3)	3 (1)	57(17)	43 (13)
Strategy	67 (20)+	-	10 (3)	3 (1)	80 (24)+	20 (6)
Experiment 3 Medium bet (large bet could win)						
Control	50 (15)	-	40 (12)	7 (2)	97 (29)+	3 (1)
Strategy	37 (11)	-	43 (13)	0	80 (24)+	23 (6)
Experiment 4 Medium bet (large bet would win)						
Control	10 (3)	-	67 (20)*+	3 (1)	80 (24)+	20 (6)
Strategy	17 (5)	-	57 (17)*+	10 (3)	83 (25)+	17 (5)

Key: * = *significantly different from other bets;* + = *significantly different from external factors*

Experiment 2 showed that people change an exceptional action to be like the usual action when the alternative exceptional action would not lead to a better outcome, and Experiments 3 and 4 show that the tendency can be eliminated and reversed when the alternative exceptional action could or would lead to a better outcome (see Tables 3.13 and 3.14 above). Overall the experiments show that people create *if only* counterfactual thoughts that change an exceptional action to be like an exceptional alternative, rather than to be like a usual action, when the exceptional alternative would lead to a better outcome.

Table 3.14 The percentages of 7 categories of 'other' responses to the counterfactual question in each group in the experiments (including all those responses made by more than 5% of participants in at least one condition of one experiment)

	Categories (see key below)						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Experiment 2 Medium bet (large bet would not win)							
Strategy	7	3	0	7	0	3	0
Control	17	7	10	0	3	0	7
Experiment 3 Medium bet (large bet could win)							
Strategy	7	7	0	0	3	3	0
Control	3	0	0	0	0	0	0
Experiment 4 Medium bet (large bet would win)							
Strategy	0	3	3	0	3	3	3
Control	7	0	0	3	0	7	3

Key:

1. If I had better cards
2. If I hadn't played
3. If opposition had different cards
4. If I was more thoughtful/careful[8]
5. If opposition hadn't played
6. If I had not been so confident
7. If I had been a better/luckier player

[8] Examples of these counterfactual thoughts include, "if only I had considered the risk", or "if only I had given it more thought".

In Experiment 2, the actor chose a justified action but it led to a bad outcome. The experiment showed that people focus on the usual action (e.g. if only he'd placed his usual small bet...) when the exceptional alternative would *not* have led to a better outcome, and it replicates the standard 'exceptionality effect' (Kahneman & Tversky, 1982). Experiments 3 and 4 eliminated and reversed this trend. Experiment 3 showed that people focus as often on the exceptional alternative as on the usual action when the exceptional alternative could have led to a better outcome. Experiment 4 showed that they focus more often on the exceptional alternative when it definitely would have led to a better outcome. They do so even though the exceptional alternative is considered to be an unjustified action (it is not judged to be the best action). Experiments 3 and 4 show that the counterfactual outcome (the potential for the outcome to have been different) guides *if only* thoughts – people do not focus on the usual action when it could not have led to a better outcome (Kahneman & Tversky, 1982).

Table 3.15 The percentages of answers to the materials test question 1, "Explain what you think is the best decision to take", that focus on a small, medium or large bet by the participants in the strategy groups of the experiments.

	Small	**Medium**	**Large**
Experiment 2 Medium bet (large bet would <u>not</u> win)	20 (6)	77 (23)*+	3 (1)
Experiment 3 Medium bet (large bet <u>could</u> win)	17 (5)	67 (20)*+	17 (5)
Experiment 4 Medium bet (large bet <u>would</u> win)	40 (12)	53 (16)+	6 (2)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

In all of the experiments participants judged the medium bet to be the best bet and rarely considered the small bet or the large bet to be the best bets. The experiments also revealed few differences between participants who were asked to explain what the best bet was for the actor, for which they had to think explicitly about the best strategy (the strategy

group) and those who were not (the control group). These two groups performed similarly except in one case: in Experiment 2 there was a pronounced exceptionality effect in the strategy group. Systematic variance in answers to the questions, '*Explain what you think is the best decision to take*' and "*What size bet do you think Peter places?* (see Tables 3.15 and 3.16) indicates that some effect of this manipulation may have been present and led to this result. It may be the case that participants, who were asked to explicitly think about the best bet, and to write these thoughts down, were later able to draw on a richer more detailed set of represented possibilities. These might include such possibilities as worse outcomes, attributable to the greater frequencies of 'small bet' choices seen within each experiment's material tests (questions 1 and 2). No reliable differences were found between the control and strategy groups in the individual experiments. Nevertheless, such a consistent pattern across three experiments could be suggestive of a small shift in goal focus, more akin to a prevention focus in counterfactual thinking as suggested by some functional theories of counterfactual thinking (Epstude & Roese, 2008; Roese et al., 2005).

Table 3.16 The percentages of answers to the materials test question 2, "What size bet do you think Peter places?" that predict that Peter would place a small, medium or large bet by the participants in the strategy and control groups in the three experiments.

	Predicted Bet		
	Small	**Medium**	**Large**
Experiment 2 Medium bet (large bet would not win)			
Control group	17 (5)	67 (20)*+	17 (5)
Strategy group	30 (9)	70 (21)*+	0 (0)
Experiment 3 Medium bet (large bet could win)			
Control group	17 (5)	70 (21)*+	13 (4)
Strategy group	30 (9)	57 (17)+	13 (4)
Experiment 4 Medium bet (large bet would win)			
Control group	17 (5)	77 (23)*+	7 (2)
Strategy group	37 (11)	57 (17)+	7 (2)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

Further support for this explanation comes from the results of the material tests in the strategy group of Experiment 4. Despite the medium bet being the favoured strategy for this group, there was no reliable difference between preferences for the small and medium bet. Further, participants in the strategy groups across all three experiments predicted the small bet almost twice as many times as participants in the control group. Prior thinking about the best decision may induce more risk-averse preferences in bet choice.

The result indicates that participants rely on a 'potential gains' calculation of how much they could win in this scenario, rather than focusing on how much they might lose, or calibrating their potential gains and losses. Their focus on gains may reflect a tendency to be risk seeking in this specific situation, in which only relatively minor wins and losses could be sustained (Prelec, & Loewenstein, 2000; Weber & Chapman, 2005).

The experiments provide evidence that people think about the counterfactual outcome (the potential for the outcome to have been different) and calibrate the focus of their counterfactual *if only* thoughts to change only those antecedents that could lead to a better outcome. They do not change an exceptional action to be like a usual action if the usual action would not have led to a better outcome (see Kahneman & Tversky, 1982; Kahneman & Miller, 1986). The results provide some support for the idea that people think about different possibilities when they create counterfactual alternatives, and the possibilities that they think about are guided by a small set of principles, namely that people only think of few possibilities and true possibilities (Byrne, 2005). In this context, the results show that people attempt to construct counterfactuals leading to better outcomes. This is consistent with the view that counterfactual thinking is goal directed (Roese et al., 2005; Byrne, 1997; 2005).

Experiment 2 was designed to test for the standard exceptionality effect as previously recorded in Kahneman and Tversky (1982) and our previous experiment from Chapter 2. However, our hypothesis for this context was that the exceptionality effect only

occurred when no other explicit alternatives would have led to a different outcome from that of the usual action. Thus our model for the possibilities people keep in mind is suggested as follows:

Factual Action:	*Actor places exceptional medium bet*
Factual Outcome:	*Large and Medium bet players play:*
	Large- bet player has better cards than actor
	Actor loses

The counterfactual alternative created by changing the actor's exceptional action to be like the usual action is as follows:

Counterfactual Action:	*Actor places usual small bet*
Counterfactual Outcome:	*Large, Medium & Small bet players play:*
	Large-bet player has better cards than actor
	Actor loses

We construct the following models to represent the factual and counterfactual possibilities:

Factual:	*exceptional medium bet*	*loss*
Counterfactual:	*usual small bet*	*loss*
	...	

Where 'medium' represents the fact that the actor placed a medium bet, which led to a 'loss' outcome. The counterfactual possibility is represented by 'usual' as in he could have placed his usual bet, regardless that this would have led to an outcome of a 'loss' also. The three dots represent other possibilities that are not explicitly represented. As in the previous chapter we refer to Markman and McMullen's (2003) account that, similar to Kahneman and Miller's (1986) norm theory, an interruption of behaviour, in this case the actor placing a exceptional medium bet, draws people to keep the usual behaviour explicitly in mind.

The other alternative is the large bet, which we summarised earlier in the following diagram:

Counterfactual Action:	*Actor places exceptional large bet*
Counterfactual Outcome:	*Large-bet player plays:*
	Large-bet player has better cards than actor
	Actor loses

We propose the large bet is not represented initially because the outcome it leads to would be worse than the current outcome. We also suggest that as the large bet is considered an unjustified bet, participants would not represent it as a possibility. This principle of parsimony reduces the number of alternatives that have to be kept in mind, and has been documented throughout both decision-making and reasoning literature (Johnson-Laird and Byrne, 1991; 2002; Kahneman & Tversky, 1979; Tversky, 1972a, 1972b). In decision-making research people find it difficult to represent two alternatives and their imagined consequences (Legrenzi & Girotto, 1996; Mynatt, Doherty, & Dragan, 1993). Reasoning researchers have shown that people instead reach conclusions from simpler initial representations or search for counterexamples, they do not represent all possibilities (Johnson-Laird, 1983; Johnson-Laird & Byrne, 1991; Legrenzi & Girotto, 1996). In fact, peoples ability to reach conclusions or make decisions is paramount to the idea that not all possibilities have to be represented (Johnson-Laird et al., 1992; Shafir, 1994; Tversky & Kahneman, 1981). Because people are parsimonious with the possibilities they keep in mind, the only alternative possibility that people keep in mind in order to create counterfactual thoughts for this context is that of the usual behaviour.

In Experiment 3 we designed the scenario so that another alternative became salient to participants. We provided them with information that the large bet, though considered an exceptional unjustified action, could have led to a winning outcome:

Factual Action:	*Actor places exceptional medium bet*
Factual Outcome:	*Large and Medium bet players play:*
	Large-bet player has better cards than actor
	Actor loses

The counterfactual alternative created by changing the actor's exceptional action to be like the usual action is as follows:

Counterfactual Action:	*Actor places usual small bet*
Counterfactual Outcome:	*Large, Medium & Small bet players play:*
	Large-bet player has better cards than actor
	Actor loses

These possibilities can be summarised in the following set of possibilities:

Factual:	*exceptional medium bet*	*loss*
Counterfactual:	*usual small bet*	*loss*

...

The counterfactual alternatives created by changing the actor's exceptional action to be like the exceptional alternative is as follows:

Counterfactual Action:	*Actor places exceptional large bet*
Counterfactual Outcome:	*Large-bet player plays:*
	Unknown who has better cards, Actor or Large-bet player

We suggest that the exceptional alternative is represented explicitly in the initial set of models this time because it could possibly lead to a wining outcome:

Factual:	*exceptional medium bet*	*loss*
Counterfactual:	*usual small bet*	*loss*
Counterfactual:	*exceptional large bet*	*unknown*

...

From this set of models, participants have two counterfactual possibilities in mind with both leading to different outcomes. The small bet would have resulted in less money being lost, while the large bet may have resulted in a win. We predicted that if two possibilities were represented explicitly in participants' models, the exceptionality effect would be undone as participants could create counterfactual thoughts based on either. This is the pattern of counterfactual thoughts that we found. Previous research has also highlighted that people actively try to avoid disjunctions (i.e. either/or choices) and to that end, people will sometimes use arbitrary information or motivation in order to satisfy themselves when picking one possibility over another (Shafir, Simonson, & Tversky, 1993; Tversky & Shafir, 1992). It may also be the case that given two functionally equivalent goals, either that based on a prevention focus or that of a promotion focus (Roese et al., 2005), participants arbitrarily chose between the two. In this case, it may be that our participants went through such a decision process or were swayed by such a goal; this may explain the dividing of counterfactual thoughts between the two possibilities in both groups in such a similar manner. Regardless of these proposed individual differences, our representational understanding of counterfactual thoughts partially overcomes these difficulties by being aware and incorporating the presence of both of the relevant possibilities into the explanation.

Lastly for this chapter, Experiment 4 tested our prediction that if participants were given a counterfactual possibility that presented a certain avenue to a winning outcome, this would reverse the exceptionality effect, as participants would focus their counterfactual thoughts exclusively on this alternative. We summarised the possibilities earlier as follows:

Factual Action:	*Actor places exceptional medium bet*
Factual Outcome:	*Large and Medium bet players play:*
	Actor has better cards than Large-bet player
	Medium-bet player has better cards than Actor
	Actor loses

The counterfactual alternative created by changing the actor's exceptional action to be like the usual action is as follows:

Counterfactual Action:	*Actor places usual small bet*
Counterfactual Outcome:	*Large, Medium & Small bet players play:*
	Actor has better cards than Large-bet player
	Medium-bet player has better cards than actor
	Actor loses

The counterfactual alternative created by changing the actor's exceptional action to be like the other exceptional action (placing the large bet) is as follows:

Counterfactual Action:	*Actor places exceptional large bet*
Counterfactual Outcome:	*Large-bet players plays:*
	Actor has better cards than Large-bet player
	Actor wins

We propose that these possibilities can be summarised in the following models:

Factual:	*exceptional medium bet*	*loss*
Counterfactual:	*usual small bet*	*loss*
Counterfactual:	*exceptional large bet*	*win*
	...	

Participants initially represent the small bet, as it was the usual action of the protagonist, however they do not choose to create a counterfactual based on this possibility because it

leads to a loss outcome. Instead the exceptionality effect is reversed because they chose the option that leads to a winning outcome. Our explanation is in keeping with a functional explanation of counterfactual thinking, in that participants are goal oriented toward bringing about a better outcome (Epstude & Roese, 2008; Roese et al., 2005). Nevertheless, simply explaining that a counterfactual thought is based on a promotion-focused goal, even in this example one that is centred on a winning possibility, without taking into account participants' representation of such a possibility, does not provide a complete explanation of the process. Instead, encompassing the representational significance of the large bet as a winning possibility, especially evident within the strategy group's models of possibilities, distinguishes clearly the over-arching function of counterfactual thinking as a process based on the imagination of a better outcome derived from an assessment of numerous alterative possibilities.

In the next chapter we investigate what aspects participants change when the actor carries out unjustified exceptional actions and loses. We aim to test our predictions that participants will use a risk-seeking simple gains hypothesis. We continue to examine the effect of prior thinking on strategies and counterfactual thoughts, especially as the strategy group showed a more pronounced exceptionality effect if compared to the control group. We predict that prior thinking will have a greater effect on group differences in counterfactual thoughts when unjustified exceptional actions have been carried out. We also examine what participants change when faced with unjustified exceptional actions and winning outcomes, and we also examine what changes occur when negative outcomes occur from usual actions.

Chapter 4 Counterfactual Thoughts After Normal and Exceptional Events

In the previous chapter we tested the hypothesis that people think about how outcomes could have been different and calibrate counterfactual *if only* thoughts to change only those antecedents that would result in a different outcome. Previous theories have suggested that certain aspects of antecedents make them more susceptible to change when thinking counterfactually. For example, if an action is controllable (Girotto et al., 1991; Markman et al., 1993) or exceptional (Kahneman & Miller, 1986) or unjustified (Bonnefon et al., 2007), it will be mutated more. In this chapter we employ the same design as used in the previous chapter, a scenario based on a card game. The results from the previous chapter provided support for the idea that people think about different possibilities when they create counterfactual alternatives, and the possibilities that they think about are guided by a small set of principles (Byrne, 2005). The results also indicated that counterfactual thinking was goal directed (Roese et al., 2000; Byrne, 1997; 2005). Participants in three experiments created counterfactual thoughts that altered antecedents on the basis that the outcome would change for the better.

In the previous chapter we stated the hypothesis that regularities in counterfactual thinking can be understood because the possibilities people think could have happened are guided by a small set of principles (Byrne, 2005). In the previous chapter we indicated that certain principles lead participants to construct a model of possible alternatives to an outcome. And our findings showed that participants changed the antecedents of a scenario in order to bring about a better outcome. In this chapter we will use the same methodology to predict and explain how people create alternatives in cases of exceptional unjustified actions and usual actions.

Reconsider the card game used in the previous chapter. There is a choice between a large bet, a medium bet, or a small bet, and the actor usually places a small bet. The three other players act in the same way as before: the small-bet player only matches small bets,

the medium-bet player only matches small and medium bets, and the large-bet player matches small, medium or large bets. We now examine what happens when the actor chooses a large bet. In the game, only the large-bet player matches his bet. Suppose the outcome of the scenario is that the large-bet player had better cards than the actor. We summarise the possibilities in the following diagram:

Action:	*Actor places exceptional large bet*
Outcome:	*Large-bet player plays:*
	Large-bet player has better cards than Actor

The actor may think, "Things would have been different if..." Examining the counterfactual alternatives created by changing the actor's exceptional action (placing the large bet) to be like his usual action (placing the small bet) shows that the outcome would not have been better (e.g. if he had placed his usual small bet he still would have lost, because the large-bet player would still have played and beaten the Actor):

Counterfactual Action:	*Actor places usual small bet*
Counterfactual Outcome:	*Large, Medium & Small bet players play:*
	Large-bet player has better cards than Actor

Imagining the alternative as the medium bet also fails to bring about a better outcome:

Counterfactual Action:	*Actor places exceptional medium bet*
Counterfactual Outcome:	*Medium-bet player and Large-bet player plays:*
	Large-bet player has better cards than Actor

In the previous chapter we found that people only changed an exceptional action to be like the usual action when no other alternative would have lead to a different outcome. We illustrated that participants changed the exceptional action to an equally exceptional

alternative when that alternative led to a different outcome. In this chapter we predict this pattern to continue in the case where the actor chooses an exceptional unjustified action and loses, and in the case of an exceptional unjustified action and a winning outcome. However, we extend our findings by showing that participants in the strategy group who are focusing on the decision process as well as the outcome will create different counterfactual thoughts to the control group. We show that they mutate different antecedents when carrying out the goal of changing the outcome. We suggest that this shift in focus depends on a changing goal of whether to improve behaviour for the future or to improve on the emotional consequences following the decision.

Goals of Counterfactual Thinking

One hypothesis is based on the idea that counterfactual thinking is motivated by the mediation of aspirations or goals. These goals come in one of two guises, either performance goals or affect goals (Roese et al., 2005). Performance goals enhance the possibility of achieving these goals in the future by focusing on better plans and strategies that enhance goal attainment. In contrast, affect goals operate through one of three sub goals, either the need to repair mood, maintain mood or pre-empt future affective consequences (Epstude & Roese, 2008). Controllable failures for instance draw comparisons with a better possible outcome and are termed upward counterfactual thoughts, while downward counterfactual thoughts, imagining a worse outcome, often follow uncontrollable successes (Markman et al. 1993; Roese & Olson, 1995b).

However, research has shown that the comparison process can be more complicated in its function to that of a simple upward or downward contrast (Markman & McMullen, 2003, 2005; McMullen & Markman, 2000). Markman and Tetlock (2000) found that people who were accountable for a decision-making process had more pronounced emotional reactions than people who were only accountable for bottom-line

outcomes, and this led to differences in their counterfactual thoughts. Take the case of a doctor who loses a patient. A review board may assess the quality of the doctor's decisions made during the treatment of the patient. If the doctor carried out a thorough and comprehensive treatment plan then the board will find little wrong. Compare this to the situation of a professional football manager who must satisfy a corporate board and thousands of fans. Few will care about whether the manager's decision processes are sound if the team is losing, and if the team wins, few will care if his processes are unsound. In the case of the manager who loses a game, a change in behaviour is the bigger motivation, "*if I had selected a different team we would have won.*" Yet in the case of the doctor, having a patient die may lead to counterfactual thoughts concerned with emotions, "*if I had given the patient more time he would still have died.*"

Within the previous chapter we found empirical support for our hypothesis that counterfactual thoughts are generally constructed to change the outcome. And we found little in the way of reliable differences between the strategy groups and the control groups in how they constructed counterfactual thoughts. However, in this chapter we predict differences will arise because the actor carries out unjustified exceptional actions. We predict that the control group will create counterfactual thoughts from the perspective of changing the outcome. Thus a poor decision process will not be to the fore within the possibilities they keep in mind, and the counterfactual thoughts they generate will focus only on changing the bottom-line outcome. In contrast we predict that the strategy group will also attend to the decision-process that leads to the outcome. Thus, a poor decision process will affect the strategy groups' counterfactual thoughts. We test this hypothesis in the following three experiments.

Experiment 5: The usual action is chosen when a justified exceptional alternative would not have led to a better outcome

The aim of the experiment was to test whether *if only* thoughts change an exceptional action to be like the usual action if alternative exceptional actions do not lead to an improved outcome. We predict this to be the case even when the alternative exceptional action is justified. In the scenario, the actor chooses an exceptional action, which participants judge to be unjustified (he places a large bet) and there is an alternative exceptional action, which is justified (the medium bet) but it does not lead to a better outcome.

Participants were told this time that the actor chose to place the *large* bet, and the large-bet player matched his bet. Participants were told that the large-bet player had better cards than the actor, and so the actor lost. We predicted that participants *would* exhibit the exceptionality effect, that is, they *would* create counterfactual alternatives that focused on the usual action (e.g. if only he had placed his usual small bet...). Given the outcome of the game (the large-bet player had better cards than the actor), thinking counterfactually about the other exceptional bet would still result in a negative outcome (e.g. if he had placed a medium bet he would still have lost, albeit lost less). We predict that the tendency to say, *"if only he had carried out his usual action,"* will be observed in this situation, even though the alternative exceptional action is justified (it is judged to be the best bet).

In this experiment the action and outcome can be represented as follows:

Action:	*Actor places exceptional large bet*
Outcome:	*Large-bet player plays:*
	Large-bet player has better cards than actor

The counterfactual alternative created by changing the actor's exceptional action to be like the usual action is as follows:

Counterfactual Action:	*Actor places usual small bet*
Counterfactual Outcome:	*Large, Medium & Small bet players play:*
	Large-bet player has better cards than actor

The counterfactual alternative created by changing the actor's exceptional action to be like the other exceptional action (placing the medium bet) is as follows:

Counterfactual Action:	*Actor places exceptional medium bet*
Counterfactual Outcome:	*Large and Medium bet players play:*
	Large-bet player has better cards than Actor

In this experiment overall, we tested predictions that the exceptionality effect would be found where no alterative action could produce a better alternative outcome. We also tested predictions that the strategy group and control group would differ in their counterfactual thoughts. We predicted that the strategy group would incorporate an awareness of the protagonist's decision process into their thoughts about how the outcome could have been different, especially as the protagonist chose an exceptional bet that was deemed worse by participants. This differs from the focus of the control group, as we predicted that they would remain only outcome orientated when creating counterfactual thoughts.

Method

Participants, design and procedure

The 60 participants were undergraduates and postgraduates from Trinity College Dublin who took part voluntarily (34 men and 26 women). Their ages ranged from 17 to 68 years (and the average age was 26 years). They were assigned at random to two groups, control and strategy (n = 30 in each). The design and procedure was the same as the previous

experiment, a between-groups design with counterfactual thoughts acting as the dependent measure and the number of questions within the two groups and outcome information acting as the independent variables.

Materials

Participants were given the same scenario as in the previous experiment. The decision to place a large bet was described as follows:

> Peter thought about his choices carefully. He considered betting small, a bet of €10, as he usually does. He then considered a medium bet of €20. Then Peter considered the large bet, he decided to go with the large bet of €30.
> Peter's large bet meant that the small-bet player and the medium-bet player decided not to play with him, so neither the small-bet player nor the medium-bet player placed a bet. So the large-bet player decided to play with Peter by matching Peter's bet of €30.

The outcome was described as follows:

> The large-bet player had better cards than Peter, so the large-bet player wins the game and receives €60 (The large-bet player's €30 + Peter's €30 = €60).

Materials test: As in the previous experiments, the results confirm that participants judge the medium bet to be the best bet, and the large bet and small bet are not judged to be the best. Participants in the strategy group answered the question '*Explain what you think is the best decision for Peter'* by judging that the best decision was to place the medium bet, rather than to place the small bet (80% vs. 20%%, $\chi^2 = 10.80$, df = 1, $p = .001$), or the large bet (and in fact, no-one judged that the best decision was to place the large bet) as Table 4.1 shows.

Table 4.1. The percentages (with frequencies in parentheses) of answers to the question "Explain what you think is the best decision to take", that focus on a small, medium or large bet by the participants in the strategy group of Experiment 5.

	Small	**Medium**	**Large**
E5 Large bet, losing	20 (6)	80 (24)*+	0 (0)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

Participants in both the strategy group and the control group answered the question '*What size bet do you think Peter places?*' by judging that Peter would place the medium bet more often than the small bet (control: 63% vs. 20%, $\chi^2 = 6.76$, df = 1, $p = .009$; strategy: 70% vs. 20%, $\chi^2 = 8.33$, df = 1, $p = .004$), and the medium bet more than the large bet (control: 63% vs. 17% $\chi^2 = 8.20$, df = 1, $p = .004$; strategy: 70% vs. 10% $\chi^2 = 13.50$, df = 1, $p < .001$), as Table 4.3 shows.

Table 4.2. The percentages (with frequencies in parentheses) of predictions that Peter would place a small, medium or large bet by the participants in the strategy and control group in Experiment 5 in response to the question, "What size bet do you think Peter places?"

	Predicted Bet		
	Small	**Medium**	**Large**
E5 Large bet, losing			
Control group	20 (6)	63 (19)*+	17 (5)
Strategy group	20 (6)	70 (21)*+	10 (3)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

The results of the materials test confirm that participants consider the exceptional medium bet to be the best bet, and the exceptional large bet and the usual bet not to be the best bets.

Results and Discussion

As we expected the tendency to change an exceptional action to be like the usual action in *if only* thoughts was observed: participants *if only* thoughts focused more often on the usual, small bet than on the medium bet, in the control group (50% vs. 20%, $\chi^2 = 3.86$, df = 1, $p = .05$), as Table 4.1 shows.

Table 4.3 The percentages of counterfactuals (with frequencies in parentheses) constructed in response to the prompt "Things could have turned out differently if..." that focus on the small, medium or large bet in the strategy and control group in Experiment 5.

	Small	**Medium**	**Large**	**Other Bets**	***Total Bets***	**Other Fact.**
E5 Large bet, losing						
Control group	50 (15)+	20 (6)	-	0 (0)	70 (21)+	30 (9)
Strategy group	20 (6)	17 (5)	-	0 (0)	37 (11)	63 (19)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

The result shows that people change an exceptional action to be like the usual action rather than like an alternative exceptional action, when the alternative does not lead to a better outcome, even though they judged the alternative to be the best action to take.

Interestingly, in the strategy group, participants' *if only* thoughts did not tend to focus frequently on either the small or the medium bet (20% vs. 17%, $\chi^2 = .09$, df = 1, $p = .76$). Participants in the control group said, "*if only he'd placed his usual small bet*" more than those in the strategy group (50% vs. 20%, $\chi^2 = 3.86$, df = 1, $p = .05$), and they focused on the bets more so than on external factors (70% vs. 30%, $\chi^2 = 4.80$, df = 1, $p = .028$).

In contrast, participants in the strategy group focused on external factors marginally more than those in the control group (63% vs. 30%, $\chi^2 = 3.57$, df = 1, $p = .059$), and they focused on external factors more so than on the bets (63% vs. 37%, $\chi^2 = 2.13$, df = 1, although the difference is not significant $p = .144$).

Table 4.4. The percentages of 6 categories of 'other' responses to the counterfactual question in each group in Experiment 5 (including all those responses made by more than 5% of participants in at least one condition of one experiment). No thoughts such as *if only I had been a better/luckier player,* were recorded so this category was removed.

	Categories (see key below)					
	1	**2**	**3**	**4**	**5**	**6**
E5 Large bet, losing						
Control group	13	3	3	0	3	3
Strategy group	20	7	7	20	0	3

Key:

1. *If I had better cards*
2. *If I hadn't played*
3. *If opposition had different cards*
4. *If I was more thoughtful/careful*[9]
5. *If opposition hadn't played*
6. *If I had not been so confident*

These notable differences between the strategy and control group occur when the actor carries out an exceptional action, which participants have judged to be unjustified (placing the large bet). The outcome would not have been different if he had carried out the exceptional justified action, or the usual action (e.g. if he had placed the small/medium bet he still would have lost, but he would have lost less money). In this situation, prior thinking about the best decision (the medium bet) leads participants to shift their focus to external factors, e.g. *"if he had had better cards..." "if he had not played..."* (Girotto et al., 2007; Markman & Tetlock, 2000). This indicates that participants in the strategy group are including information about the decision process and quality of the protagonist's decision when constructing counterfactual thoughts, which is not evident in the control groups' counterfactual thoughts.

[9] Examples of these counterfactual thoughts include, "if only I had considered the risk", or "if only I had given it more thought".

The experiment demonstrates the standard tendency for *if only* thoughts to focus on a usual action, in the card game scenario. It shows the effect occurs when participants chose an exceptional action, and an alternative exceptional action would not lead to a better outcome, even though it was a justified action. The result, examined in light of the results of the previous experiments, suggests that participants consider a better counterfactual outcome to take precedence over a justified action.

In the next experiment we again show the tendency can be reversed – people focus on the (this time, justified) alternative exceptional action instead of the usual action when the counterfactual outcome is unknown and the alternative exceptional action leads to less uncertainty than the usual action.

Experiment 6: The exceptional justified alternative is chosen when it leads to a less uncertain outcome

The aim of the experiment was to test the hypothesis that participants tend to create *if only* thoughts that change an exceptional action to be like a *justified* exceptional alternative when the counterfactual outcome is unknown. This occurs because the alternative exceptional action leads to less uncertainty than the usual action. In this experiment we used the same version of the scenario as in the previous experiment - the actor chooses an exceptional action (the large bet). However, in this version, the actor has better cards than the large-bet player and so the actor wins. In this experiment the action and outcome can be represented as follows:

Action:	*Actor places exceptional large bet*
Outcome:	*Large-bet player plays:*
	Actor has better cards than Large-bet player

The counterfactual alternative created by changing the actor's exceptional action to be like the usual action is as follows:

Counterfactual Action:	*Actor places usual small bet*
Counterfactual Outcome:	*Large, Medium & Small bet players play:* *Actor has better cards than Large-bet player* *Unknown whether Actor has better cards than Medium or Small bet players*

The counterfactual alternative created by changing the actor's exceptional action to be like the other exceptional action (placing the medium bet) is as follows:

Counterfactual Action:	*Actor places exceptional medium bet*
Counterfactual Outcome:	*Large and Medium bet players play:* *Actor has better cards than Large bet player* *Unknown whether Actor has better cards than Medium bet player*

The counterfactual outcome from the alternative exceptional action is less uncertain (it is unknown whether the actor has better cards than one other player, the medium-bet player) than that from the usual action (it is unknown whether the actor has better cards than two other players, both the medium-bet player and the small-bet player). The player could have won more money, €40 rather than €30 profit - if he had placed a medium bet and won, and the alternative exceptional action (the medium bet) is also considered justified.

People think *if only* primarily after bad outcomes, but they can also create counterfactuals after good outcomes, particularly after dramatic good outcomes (Kahneman & Varey, 1990; Landman, 1987; Markman et al., 1995; Teigen, 1997). The factors that they focus on after a good outcome are similar to those that they focus on after a bad outcome. For example, people change actions more than inactions, when the actions lead to a good outcome just as they do for a bad outcome (Landman, 1987; Byrne &

McEleney, 2006). People tend to change an exceptional action to be like the usual action in their *if only* thoughts, following a bad outcome (Bonnefon et al., 2007; Kahneman & Tversky, 1982; Wells et al., 1987). We examine if this is so for good outcomes by examining participants' *if only* thoughts following an exceptional action that leads to a good outcome.

To clarify, the aim of the experiment was to test predictions that the presence of an exceptional alternative that leads to a better alternative outcome, in this case the exceptional medium bet, would reverse the exceptionality effect. We again tested predictions that because the protagonist chose the large exceptional bet, not considered a good action by participants; differences would arise between the strategy and control groups in how they constructed counterfactual thoughts.

Method

Participants, design and procedure

The 72 participants were undergraduates and postgraduates from Trinity College Dublin who took part voluntarily (34 men and 38 women). Their ages ranged from 18 to 60 years (and the average age was 27 years). They were assigned at random to two groups, control and strategy (n = 36 in each). The design and procedure were the same as the previous experiments, a between-groups design with counterfactual thoughts acting as the dependent measure and the number of questions within the two groups and outcome information acting as the independent variables.

Materials

Participants were given the same scenario as in the previous experiment. The outcome was described as follows:

Peter had better cards than the large-bet player, so Peter wins the game and receives €60 (The large-bet player's €30 + Peter's €30 = €60).

Materials test: Participants in the strategy group answered the question '*Explain what you think is the best decision for Peter'* by judging that the best decision was to place the medium bet or, similarly, the small bet (44% vs. 50%, $\chi^2 = .12$, df = 1, $p = .732$); few participants judged the large bet to be best (medium vs. large: 44% vs. 6%, $\chi^2 = 1.08$ df = 1, $p = .001$, small vs. large: 50% vs. 6%, $\chi^2 = 1.08$, df = 1, $p = .001$) as Table 4.5 shows.

Table 4.5 The percentages (with frequencies in parentheses) of answers to the question "Explain what you think is the best decision to take", that focus on a small, medium or large bet by the participants in the strategy group of Experiment 6.

	Small	**Medium**	**Large**
E6 Large bet, winning	50 (18)	44 (16)+	6 (2)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

Participants in both the strategy group and the control group answered the question '*What size bet do you think Peter places?*' by judging that Peter would place the medium bet more often than the small bet (control: 75% vs. 22%, $\chi^2 = 10.31$, df = 1, $p = .001$; strategy: 53% vs. 39%, $\chi^2 = .76$, df = 1, although this difference is not significant, $p = .38$), and the medium bet more than the large bet (control: 75% vs. 3%, $\chi^2 = 24.14$, df = 1, $p < .001$; strategy: 53% vs. 8%, $\chi^2 = 11.64$, df = 1, $p = .001$), as Table 4.6 shows. The results of the materials test confirm that participants consider the exceptional large bet to be unjustified.

Table 4.6 The percentages (with frequencies in parentheses) of predictions that Peter would place a small, medium or large bet by the participants in the strategy and control group in Experiment 6 in response to the question, "What size bet do you think Peter places?"

	Predicted Bet		
	Small	**Medium**	**Large**
E6 Large bet, winning			
Control group	22 (8)	75 (27)*+	3 (1)
Strategy group	39 (14)	53 (19)+	8 (3)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

Results and Discussion

As expected, participant's *if only* thoughts focused more often on the alternative exceptional bet than on the usual bet (control: 53% vs. 19%, $\chi^2 = 5.54$, df = 1, $p = .019$; strategy: 33% vs. 17%, $\chi^2 = 2.00$, df = 1, although the latter difference was not significant $p = .157$), as Tables 4.7 shows. The result shows that people change an exceptional action to be like the alternative exceptional action rather than the usual action, when the counterfactual outcome from the alternative exceptional action is less uncertain than that from the usual action.

Table 4.7 The percentages of counterfactuals (with frequencies in parentheses) constructed in response to the prompt "Things could have turned out differently if..." that focus on the small, medium or large bet in the strategy and control group in Experiment 6.

	Small	**Medium**	**Large**	**Other Bets**	***Total Bets***	**Other Fact.**
E6 Large bet, winning						
Control group	19 (7)	53 (19)	-	6 (2)	78 (28)+	22 (8)
Strategy group	17 (6)	33 (12)	-	14 (5)	64 (23)	36 (13)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

Participants imagine a counterfactual alternative in which the player won more money, *"if he had placed the medium bet, then he might have won €40"*. Of the counterfactual thoughts that focused on the medium bet as an alternative, 78% of them specified that the medium bet could have brought about a better outcome, more than those who imagined it to bring about a worse outcome (6%, $\chi^2 = 18.62$, df = 1, $p < .001$) and more than those that did not specify what effect the medium bet would have (i.e. *if only he bet medium...*) (19%, $\chi^2 = 10.80$, df = 1, $p = .001$).

Participants' counterfactual thoughts focused on the bets more so than on external factors (see Table 4.8 for an overview) in both groups (control: 78% vs. 22%, $\chi^2 = 11.11$, df = 1, $p < .001$; strategy: 64% vs. 36%, $\chi^2 = 2.78$, df = 1, although the latter result was not significant, $p = .096$), and there was no difference between the groups in their focus on the bets (78% vs. 64%, $\chi^2 = .49$, df = 1, $p = .484$). The result again confirms the salience of the bets placed in the scenario.

Table 4.8 The percentages of 6 categories of 'other' responses to the counterfactual question in each group in Experiment 6 (including all those responses made by more than 5% of participants in at least one condition of one experiment). No thoughts such as *if only I had been a better/luckier player,* were recorded so this category was removed.

	Categories (see key below)					
	1	**2**	**3**	**4**	**5**	**6**
E6 Large bet, winning						
Control group	0	0	11	0	8	0
Strategy group	0	3	17	0	14	0

Key:

1. If I had better cards
2. If I hadn't played
3. If opposition had different cards
4. If I was more thoughtful/careful
5. If opposition hadn't played
6. If I had not been so confident

Participants said, "*if only he'd placed the medium bet,*" similarly in the control group as the strategy group (53% vs. 33%, $\chi^2 = 1.58$, df = 1, $p = .209$). Again, differences

between the strategy group and the control group were not significant. However, the control group significantly focused on the medium bet but the strategy group did not.The results show that participants tend to create *if only* thoughts that change an exceptional action to be like the exceptional justified alternative when the counterfactual outcome is unknown but the exceptional alternative leads to less uncertainty than the usual action. In the next and final experiment we examine what people focus on when the actor carried out his usual action.

Experiment 7: External factors are chosen when alternatives do not lead to better outcomes

Thus far we have examined the counterfactual alternatives that people create when an actor carries out an exceptional action; in this final experiment of this phase, we examine the counterfactual alternatives they create when the actor carries out his usual action (Gavanski & Wells, 1989). In the experiment the actor chooses his usual action and he loses; there are two exceptional actions but neither leads to a better outcome. The aim of the experiment was to test the hypothesis that in this situation participants will tend to create *if only* thoughts that focus on external factors because none of the betting alternatives provide a better outcome. Regardless of whether they are justified or unjustified, the exceptional actions lead to the same outcome therefore participants will search for other possibilities lending to a different outcome.

Participants were told that the actor chose to place the small bet. The small-bet player, medium-bet player and large-bet player all matched his bet. The large-bet player had better cards than the actor, and the small-bet player and the medium-bet player and so the actor lost. Given the outcome of the game (the large-bet player had better cards than any of the other players), counterfactual thoughts that focus on the other bets ('if he had

placed a large/medium bet …') cannot result in a win outcome ('… he still would have lost') or in a better outcome ('…he would have lost even more money'):

Action:	*Actor places usual small bet*
Outcome:	*Small, Medium and Large bet players play: Large-bet player has better cards than Actor, Small-bet Player, and Medium bet player*

The counterfactual alternative created by changing the actor's usual action to be like the exceptional justified action (the medium bet) is as follows:

Counterfactual Action:	*Actor places medium bet*
Counterfactual Outcome:	*Large, & Medium bet players play: Large-bet player has better cards than Actor, and Medium bet-player*

The counterfactual alternative created by changing the actor's usual action to be like the exceptional unjustified action (the large bet) is as follows:

Counterfactual Action:	*Actor places large bet*
Counterfactual Outcome:	*Large-bet player plays: Large-bet player has better cards than Actor*

We expect participants to focus on external factors (e.g. 'if he had better cards…') in order to undo the outcome because none of the betting alternates provide a better outcome.

In summary, the final experiment of this chapter examined the counterfactual thoughts participants created when the protagonist chose his usual action, the small bet. We predicted that participants would focus on external factors when undoing the outcome in order to bring about a better outcome. We also predicted that both the strategy group and control group would show differences in counterfactual thinking, as the strategy group

focused on both the process and outcome of the protagonist's decision while the control group focused on the outcome only.

Method

Participants, procedure and design

The 60 participants were undergraduates and postgraduates from Trinity College Dublin who took part voluntarily (17 men and 42 women, one participant did not record their gender). Their ages ranged from 17 to 63 years (and the average age was 26 years, two participants did not record their age). They were assigned at random to two groups, control and strategy (n = 30 in each). The design and procedure was the same as the previous experiment, a between-groups design with counterfactual thoughts acting as the dependent measure and the number of questions within the two groups and outcome information acting as the independent variables.

Materials

Participants were given the same scenario as in the previous experiment. The decision to place the small bet was described in the following way:

> Peter thought about his choices carefully. He considered betting medium, a bet of €20. He then considered a large bet of €30. Then Peter considered betting small, as he usually does. He decided to go with the small bet of €10.
> Peter's small bet meant that the small-bet player and the medium-bet player and the large-bet player decided to play with Peter by matching Peter's bet of €10.

The outcome was described as follows:

> The large-bet player had better cards than Peter and the medium-bet player and the small-bet player. So the large-bet player wins the game and receives €40 (The small-bet player's €10 + the medium-bet player's €10 + the large-bet player's €10

+ Peter's €10).

Materials test: As in the previous experiments, the results confirm that participants judge the medium bet to be the best bet, and the large bet and small bet are not judged to be the best. Participants in the strategy group answered the question '*Explain what you think is the best decision for Peter'* by judging that the best decision was to place the medium bet rather than the small bet (60% vs. 37%, $\chi^2 = 1.69$, df =1, although the difference did not reach significance, $p = .194$); few participants judged the large bet to be best (60% vs. 3%, $\chi^2 = 15.21$, df = 1, $p < .001$) as Table 4.9 shows.

Table 4.9 The percentages (with frequencies in parentheses) of answers to the question "Explain what you think is the best decision to take", that focus on a small, medium or large bet by the participants in the strategy group of Experiment 7.

	Small	**Medium**	**Large**
E7 Small bet, losing	37 (11)	60 (18)+	3 (1)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

Participants in both the strategy group and the control group answered the question '*What size bet do you think Peter places?*' by judging that Peter would place the medium bet more often than the small bet (control: 63% vs. 13%, $\chi^2 = 9.78$, df = 1, $p = .002$; strategy: 60% vs. 37%, $\chi^2 = 1.69$, df = 1, although the latter difference was not significant, $p = .194$); and the medium bet more than the large bet (control: 63% vs. 25%, $\chi^2 = 5.54$, df = 1, $p = .019$, strategy: 60% vs. 3%, $\chi^2 = 15.21$, df = 1, $p < .001$), as Table 4.10 shows. The results of the materials test confirm that participants consider the exceptional large bet to be unjustified.

Table 4.10 The percentages (with frequencies in parentheses) of predictions that Peter would place a small, medium or large bet by the participants in the strategy and control groups in the three experiments in response to the question, "What size bet do you think Peter places?"

	Predicted Bet		
	Small	**Medium**	**Large**
E7 Small bet, losing			
Control group	13 (4)	63 (19)*+	25 (7)
Strategy group	37 (11)	60 (18)+	3 (1)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

Results and Discussion

As expected, participant's *if only* thoughts focused as often on external factors as on the exceptional bets, in the control group (47% vs. 53%, $\chi^2 = .13$, df = 1, $p = .715$), and also in the strategy group (33% vs. 67%, $\chi^2 = 3.33$, df = 1, $p = .068$).

Table 4.11 The percentages of counterfactuals (with frequencies in parentheses) constructed in response to the prompt "Things could have turned out differently if..." that focus on the small, medium or large bet in the strategy and control group in Experiment 7.

	Small	**Medium**	**Large**	**Other Bets**	***Total Bets***	**Other Fact.**
E7 Small bet, losing						
Control group	-	17 (5)	27 (8)	10 (3)	53 (16)	47 (14)
Strategy group	-	17 (5)	40 (12)	10 (3)	67 (20)	33 (10)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

However, there was no difference between the groups in their focus on the bets (67% vs. 53%, $\chi^2 = .44$, df = 1, $p = .505$). Participant's *if only* thoughts focused similarly on the exceptional large bet and the exceptional medium bet in the control group (27% vs. 17% $\chi^2 = .69$, df = 1, $p = .405$), and somewhat more on the large bet in the strategy group (40% vs.

17%, χ^2= 2.88, df = 1, p = .09), as Table 4.11 shows. However, participants said, "*if only he'd placed the large bet*" similarly in the control group as the strategy group (40% vs. 27%, χ^2 = .80, df = 1, p = .371), and they also said, *"if only he'd placed the medium bet"* similarly in both groups (17% in both instances).

The experiment shows that participants' counterfactual thoughts often focus on external factors (see Tale 4.12 for an overview of external factors) when an actor carries out his usual action and the alternative exceptional actions would not lead to a better outcome.

Table 4.12 The percentages of 6 categories of 'other' responses to the counterfactual question in each group in Experiment 7 (including all those responses made by more than 5% of participants in at least one condition of one experiment). No thoughts such as *if only I had been a better/luckier player,* were recorded so this category was removed.

	Categories (see key below)					
	1	**2**	**3**	**4**	**5**	**6**
E7 Small bet, losing						
Control group	19	0	6	0	6	8
Strategy group	22	6	0	0	0	0

Key:

1. If I had better cards
2. If I hadn't played
3. If opposition had different cards
4. If I was more thoughtful/careful
5. If opposition hadn't played
6. If I had not been so confident

General Discussion

In the three experiments reported in this chapter the actor either chose an exceptional *unjustified* action, the large bet (Experiments 5 and 6) or chose to carry out his usual action, the small bet (Experiment 7). This contrasts with the previous chapters' experiments, where participants were informed that the actor chose a *justified* exceptional action, the medium bet. Experiment 5 tested what effect there would be on counterfactual

thoughts when the actor carried out an unjustified exceptional action and lost. We also examined counterfactual thoughts that followed from an unjustified exceptional action leading to a winning outcome in Experiment 6. Experiment 7 examined counterfactual thoughts following a usual action and a losing outcome.

Table 4.13 The percentages of counterfactuals (with frequencies in parentheses) constructed in response to the prompt "Things could have turned out differently if..." that focus on the small, medium or large bet in the strategy and control groups in the three experiments.

	Small	**Medium**	**Large**	**Other Bets**	***Total Bets***	**Other Fact.**
E5 Large bet, losing						
Control group	50 (15)+	20 (6)	-	0 (0)	70 (21)+	30 (9)
Strategy group	20 (6)	17 (5)	-	0 (0)	37 (11)	63 (19)
E6 Large bet, winning						
Control group	19 (7)	53 (19)	-	6 (2)	78 (28)+	22 (8)
Strategy group	17 (6)	33 (12)	-	14 (5)	64 (23)	36 (13)
E7 Small bet, losing						
Control group	-	17 (5)	27 (8)	10 (3)	53 (16)	47 (14)
Strategy group	-	17 (5)	40 (12)	10 (3)	67 (20)	33 (10)

Key: * = *significantly different from number on left;* + = *significantly different from number on right*

We predicted an exceptionality effect for counterfactual thoughts in Experiment 5. The results, displayed in Table 4.13, showed that people focused on the usual action, *"if only he had chosen his usual small bet"*, rather than an exceptional alternative that would not have changed the outcome, even though it was a justified action. The result shows that in this experimental context, the counterfactual outcome takes precedence over the justification for the action (Bonnefon et al., 2007). We predicted a reversal of the exceptionality effect in Experiment 6. The results showed that when the actor chose the unjustified action, participants focus on the exceptional justified alternative, *if only he had chosen the exceptional medium bet,* rather than the usual action when the counterfactual

outcome could lead to a better outcome. For Experiment 7, we showed that in this experimental context, people focus on external factors (see Table 4.14) when betting alternatives present little possibility of changing the outcome for the better. Examples of counterfactual thoughts focusing on external factors are, *"If he had had better cards..." "If he had not played..."* when the exceptional alternatives would not lead to a better outcome.

Table 4.14 The percentages of 6 categories of 'other' responses to the counterfactual question in each group in the three experiments (including all those responses made by more than 5% of participants in at least one condition of one experiment). No thoughts such as *if only I had been a better/luckier player,* were recorded so this category was removed.

	Categories (see key below)					
	1	**2**	**3**	**4**	**5**	**6**
E5 Large bet, losing						
Control group	13	3	3	0	3	3
Strategy group	20	7	7	20	0	3
E6 Large bet, winning						
Control group	0	0	11	0	8	0
Strategy group	0	3	17	0	14	0
E7 Small bet, losing						
Control group	19	0	6	0	6	8
Strategy group	22	6	0	0	0	0

Key:

1. *If I had better cards*
2. *If I hadn't played*
3. *If opposition had different cards*
4. *If I was more thoughtful/careful*[10]
5. *If opposition hadn't played*
6. *If I had not been so confident*

The experiments also revealed differences between the strategy group, who were asked to think about the best bet for the actor, prior to knowing the outcome, and the control group, who were not. Experiment 5 showed that when the actor carried out an

[10] Examples of these counterfactual thoughts include, "if only I had considered the risk", or "if only I had given it more thought".

exceptional action, which participants had judged to be unjustified, the control group focused on the usual bet, the small bet. In contrast, the strategy group focused their *if only* thoughts on external factors. In this situation, prior thinking about the best decision led them to shift their focus from the bets entirely. In Experiment 6 the pattern of counterfactual thoughts between the two groups were similar but the control group focused reliably on the medium bet, the bet considered the best bet, but this reliable focus was not observed for the strategy group. In Experiment 7, both groups showed a similar pattern of counterfactual thoughts but the strategy group showed a marginally reliable focus on the large bet. This focus was not found within the control groups' counterfactual thoughts.

We predicted differences between the two groups would arise in the three experiments because of the effect unjustified exceptional actions have on the possibilities people keep in mind. We predicted that the control group would imagine actions for the actor from a perspective that focused on the outcome only (i.e. whether the actor won or lost). However, we suggested that the strategy group - who are explicitly required to think about the best bet prior to the outcome, given the question 'what is the best bet for the actor' - take a perspective that focuses on the actor's decision process as well as the outcome (i.e. taking into account the quality of the decision leading up to the outcome).

Previous studies have found that focusing on a decision process leads to pronounced emotional reactions to outcomes (Markman & Tetlock, 2000). Levels of expected emotions can also mediate what alternatives are imagined (Kahneman & Miller, 1986; Mellers et al., 1999; Miller et al., 1990). Based on these findings, we suggested that the strategy groups have an understanding that the decision process of the actor was a poor one (i.e. it led to an unjustified choice), and they could better envisage affective consequences for the actor following the negative outcome (Girotto et al., 2007; Pighin et al., 2009).

For Experiment 5, the exceptionality effect was observed. We suggest that participants keep the following possibilities in mind:

Factual:	*exceptional large bet*	*loss*
Counterfactual:	*usual small bet*	*loss*
	...	

similar to the models we suggested they constructed for Experiment 2 in Chapter 3. The distinction in this experiment is that the actor chooses an unjustified action. This results in differences between the strategy and control groups' models. The above example is the models of possibilities that we propose the participants in the control group construct: in contrast, the participants in the strategy group construct the following models:

Factual:	*exceptional large bet*	*loss*
Counterfactual:	*usual small bet*	*loss*
Counterfactual:	*exceptional medium bet*	*loss*
	...	

Prior thinking about the best strategy makes salient the fact that the large bet is an unjustified action and that there are two counterfactual possibilities to that action. We suggest that this draws participants' focus towards reasons for choosing the large bet, or in this case, the absence of such reasons, because two better alternatives existed. This moves the strategy group participants to construct counterfactual thoughts that undo this action, namely constructing thoughts such as, "*if only I had thought about it more*" or "*if only I had considered the risks*". This effect is not found in the control group, as their focus remains simply on undoing the outcome by imagining a smaller loss. Our explanation is again in keeping with a functional explanation of counterfactual thinking, in that participants are goal oriented toward bringing about a better outcome (Epstude & Roese, 2008; Roese et al., 2005). Nevertheless, suggesting that a counterfactual thought centred

on a better possibility is simply a prevention-focused goal cannot explain the differences between the two groups if the representation of possibilities is ignored. This is the case with a purely functional explanation of this experiment's result. Instead, encompassing the representational differences between the two groups better accounts for a difference in focus within the strategy group from that of a prevention focus present in the control group centred on the outcome, to a prevention focus centred on the decision process of the protagonist.

Experiments 6 gave participants a winning outcome, and showed that participants reversed the exceptionality effect by focusing on an exceptional alternative. Again, the two groups differ in how they created counterfactual thoughts. The control group significantly focused on the exceptional alternative, *"if only he had bet medium"* while the strategy group did not. The possibilities that the control group represent are as follows:

Factual:	*exceptional large bet*	*win*
Counterfactual:	*exceptional medium bet*	*unknown*
Counterfactual:	*usual small bet*	*unknown*
	...	

Both counterfactual alternatives outcomes are unknown. However, the medium bet offers the possibility of greater reward if compared to the small bet so participants focused on this justified alternative action (see Table 4.13).

This was not so for the strategy group. Despite the winning outcome, we suggest that strategy group participants may keep in mind that the large bet was an unjustified action, as better, justified counterfactual alternatives were represented in their models. Evidence for this lies in the content of the strategy groups' counterfactual thoughts, which show an increase in counterfactual thoughts that imagine a worse possible outcome (e.g. 'if the opposition had better cards then…' or 'if I had not played') (see Table 4.4). The inference that a poor decision process led the actor to an unjustified action results in the

strategy group creating counterfactual thoughts that evaluate the actor's decision to place a large bet (Markman & McMullen, 2003; Markman & Tetlock, 2000). From the perspective of knowing that the action was unjustified, the strategy group create counterfactual thoughts that reflect the need for the actor to improve his behaviour in order to avoid future negative outcomes or to be happy about the lucky win:

Factual:	*exceptional large bet*	*win*
Counterfactual:	*exception medium bet*	*unknown*
Counterfactual:	*usual small bet*	*unknown*
	...	

Our explanation of counterfactual thinking remains functional, as participants are goal oriented towards a better outcome (Epstude & Roese, 2008; Roese et al., 2005). However, attempts to explain counterfactual thoughts as promotion focused or prevention focused, even in this case where participants are centred on a winning possibility, remains in obscurity if the representation of possibilities is ignored. If the representational differences between the two groups are encompassed, a better account is provided because the shift in focus within the strategy group to a possible prevention focus from that of a promotion focus present in the control group is better illustrated. The representational approach highlights the fact that the strategy group have numerous explicit models in mind, representational of better actions. Therefore this illustrates not only how but why the decision process becomes a factor for them when thinking counterfactually.

The strategy groups' reflection on the actor's decision process and their imagining of worse possible outcomes is consistent with previous research. Teigen et al. (1999) suggest that knowing that good luck has been experienced requires a counterfactual thought comparing the actual outcome with a worse outcome. We can conjecture that it may even be the case that participants in the strategy group may see the actor winning as lucky. Downward counterfactual thinking, that is, thoughts that imagine a worse world, are

also more common after uncontrollable events that lead to success (Roese & Olson, 1995b). We can conjecture that participants in the strategy group may not attribute the entirety of the winning outcome to the actor's actions because it was a poor decision with a good outcome. Wohl and Enzl (2003) also showed that participants who believed they narrowly avoided a big loss tended to generate more downward counterfactuals. If so, it may be the case that strategy group participants may contemplate that the actor's unjustified actions will lead to poor outcomes in the future. McMullen and Markman (2000) showed that bringing to mind how an outcome could have been worse could carry out both of these functions. A downward comparison can motivate a change in behaviour in order to avoid 'close calls' with negative outcomes in the future. Participants can also ameliorate negative affective consequences by increasing the imagined satisfaction the actor experiences with the actual outcome by contrasting it to a worse outcome. Downward counterfactual thoughts may therefore be more common in the strategy group.

For the final experiment in this chapter we examined the counterfactual thoughts participants constructed when the actor carried out his usual action and lost. In this experiment the information provided also allowed participants to infer that none of the betting alternatives contained a winning possibility. The large-bet player won the game so there were no circumstances in which the actor's cards could have led to a win. We predicted that counterfactual thoughts would be different for both groups' because their models of possibilities would be different. An absence of any salient betting alternatives that could produce a win leads participants to flesh out their models of possibilities:

Factual:	*usual small bet*	*loss*
Counterfactual:	*exceptional medium bet*	*loss*
Counterfactual:	*exceptional large bet*	*loss*

...

Within these possibilities only a downward counterfactual thought can produce a different outcome, "*if I had bet large I would have lost more money.*" From a perspective of improving the outcome, the control group participants construct thoughts such as, *"if only the large-bet player had not played" or "if only the opposition's cards were worse".*

From the perspective of the strategy group, the actor's choice of the small bet, when compared to the other possible bets, resulted in the least amount of money lost (i.e. all other betting alternatives would have lead to a worse outcome). Although they judge the medium bet is the justified action, in this case, the outcome of least amount of money lost compared to the counterfactual alternatives may even led participants in the strategy group to consider that the actor's choice of bet is justifiable, albeit post-hoc (Kahneman & Miller, 1986; Markman & Tetlock, 2000: Pieters & Zeelenberg, 2005). Therefore they create downward counterfactual thoughts comparing the actual choice of bet (i.e. the small bet resulting in the minimal loss) with an alternative that would have produced a worse outcome (i.e. the large bet resulting in the maximum loss) (Markman & McMullen, 2003). From the strategy groups' perspective that includes the decision process, the actor's choice was a good one. So the strategy group reflect on the actions of the actor and think about worse possible outcomes (McMullen & Markman, 2000). Again, a representational understanding of the possibilities participants' keep in mind is better able to illustrate the complexity in both process and outcome leading to a final counterfactual thought. Descriptions of counterfactual thoughts as either promotion focus or prevention focus is unable to distinguish participants' counterfactual thoughts in this case. Understanding the representational differences between the two groups is able to account for both contrastive effects between possibilities and highlight the effects of motivational differences, in that the strategy group can make an assessment between numerous alternatives which leads to the post-hoc realisation that the action actually turned out to be relatively good.

In the three experiments participants judged the medium bet to be the best bet, and few considered the small bet or the large bet to be the best bets.

Table 4.15 The percentages (with frequencies in parentheses) of answers to the materials test question 1, "Explain what you think is the best decision to take", that focus on a small, medium or large bet by the participants in the strategy groups of the three experiments.

	Small	**Medium**	**Large**
E5 Large bet, losing	20 (6)	80 (24)	0 (0)
E6 Large bet, winning	50 (18)	44 (16)	6 (2)
E7 Small bet, losing	37 (11)	60 (18)	3 (1)

The result indicates that participants rely on a 'potential gains' calculation of how much they could win in this scenario, rather than focusing on how much they might lose, or calibrating their potential gains and losses (see Appendix 3.2). Their focus on gains may reflect a tendency to be risk seeking in this specific situation, in which only relatively minor wins and losses could be sustained (Prelec, & Loewenstein, 2000).

In summary the three experiments provide evidence that people think about the counterfactual possibilities (the potential for the outcome to have been different) and calibrate the focus of their counterfactual *if only* thoughts to change only those antecedents that could lead to a better outcome. They do not change an exceptional action to be like a usual action if the usual action would not have led to a better outcome (see Kahneman & Tversky, 1982; Kahneman & Miller, 1986). They do not change an exceptional action to be like a justified action, if the justified action would not have led to a better outcome (see Bonnefon et al., 2007). The results again provide support for the idea that the different possibilities people think about when they create counterfactual alternatives are guided by

a small set of principles (Byrne, 2005; Johnson-Laird & Byrne, 2002), and that these thoughts are goal directed (Roese et al, 2000; Byrne, 1997; 2005).

Table 4.16 The percentages of answers to the materials test question 2,"What size bet do you think Peter places?" that predict that Peter would place a small, medium or large bet by the participants in the strategy and control groups in the experiments.

	Predicted Bet		
	Small	**Medium**	**Large**
E5 Large bet, losing			
Control group	20 (6)	63 (19)	17 (5)
Strategy group	20 (6)	70 (21)	10 (3)
E6 Large bet, winning			
Control group	22 (8)	75 (27)	3 (1)
Strategy group	39 (14)	53 (19)	8 (3)
E7 Small bet, losing			
Control group	13 (4)	63 (19)	25 (7)
Strategy group	37 (11)	60 (18)	3 (1)

Chapter 5 Reasoning from Counterfactual Conditionals: Inferences and the Effect of 'Only'

In the previous chapters we tested the way people create counterfactual thoughts following outcomes from exceptional and normal actions. We found that people created alternative possibilities to outcomes by imagining changes to antecedents that changed the outcome. Changing the outcome was found to be an important factor in determining counterfactual thinking in these experiments, regardless of whether the action was exceptional or normal and justified or unjustified. We suggested this supported the idea that counterfactual thinking was goal orientated (Byrne, 2002; Epstude & Roese, 2008; Roese et al., 2005). These counterfactual thoughts are often in the form, *"if A had happened then B would have happened"*. They allow people to reason that, had conditions been different, the outcome would have been different. We suggested that these conditional 'if' thoughts functioned according to a small set of principles (Byrne, 2005). In this chapter we examine this suggestion by testing the way people keep in mind and reason from these 'if' thoughts.

Despite much research and literature on the subject, the interpretation of 'if' remains a contentious point (Byrne & Johnson-Laird, In submission; Evans & Over, 2004; Schroyens, Schaeken, & d'Ydewalle, 2001). A conditional in the form 'if A then B' can be understood by imagining possibilities, such as the counterfactual possibilities participants constructed in the previous experiments. An example of a sentence in the indicative mood is, *"if there is an Ace, then there is a King"*. Basic conditionals, such as the ones used in this chapter, do not convey contextual or semantic information. Johnson-Laird and Byrne (2002) suggest that basic conditionals in the indicative mood are consistent with three true possibilities to be imagined, 'A and B', 'not-A and not-B', and 'not-A and B'. One other possibility that can be imagined is, 'A and not-B', however this possibility goes against the truth of the conditional utterance so is therefore not imagined. This, according to Johnson-Laird and Byrne (2002), is the principle of truth, people keep in mind only what is true

(Johnson-Laird & Byrne, 1991; Espino, Santamaria, & Byrne, In Press). To illustrate, consider the example, *"if there is an Ace, then there is a King"*. People can imagine the following possibilities:

Ace *King*
no Ace *no King*
no Ace *King*

As we have just mentioned, a fourth option is ruled out because it goes against the truth of the conditional:

Ace *no King*

Other principles also function to limit what possibilities are imagined. The principle of parsimony ensures that only a few of the true possibilities are thought about, possibly because of working memory constraints (Johnson-Laird, Byrne & Schaeken, 1992; García-Madruga, Gutiérrez, Carriedo, Luzón, & Vila, 2007). These principles lead to people initially keeping in mind just one possibility from the indicative conditional:

Ace *King*
...

However, people can imagine the other true possibilities if required to do so, whether prompted by information in the content of the conditional or from the context in which it is encountered. These implicit possibilities, those not explicitly represented in the model, are represented by the three dots. However, people can make other possibilities explicit or eliminate possibilities that are no longer valid (Johnson-Laird & Byrne, 2002). The final result is a set of models representing all relevant possibilities (Byrne & Johnson-Laird, In submission; Johnson-Laird, 1983; Johnson-Laird & Byrne, 1991).

Depending on the possibilities explicit in these mental models, some inferences can be made easily, while others are more difficult. To make an inference, people understand an additional premise A, and then reach a conclusion, B. This *modus ponens* inference (A, therefore B), can be easily made from the initial representation (e.g. A and B). *A modus tollens* inference (not-B, therefore not-A) is more difficult because it requires the fleshing out of further possibilities (e.g. not-A and not-B). Reasoners can also make errors with inferences. The *affirmation of the consequent* inference (B, therefore A) can be made from the initial possibility, but only when reasoners fail to think about the true possibility that goes against it (e.g. not-A and B). Likewise the *denial of the antecedent* inference (not-A, therefore not-B) can be made if reasoners flesh out the *not-A and not-B* possibility, but again only if they fail to flesh out the true possibility that goes against it (e.g. not-A and B).

Counterfactual conditionals, *"if there had been an Ace, then there would have been a King"*, are conditionals that are in the subjunctive mood. Unlike indicative conditionals, they deal with events that were once possible but are no longer so. Conditionals in the subjunctive mood enable people to keep in mind two sets of possibilities from the outset, the conjecture (A and B):

Ace *King*

and the presupposed facts (not-A and not-B):

no Ace *no King*

Reasoners judge that someone who uttered the counterfactual conditional meant to imply that there is no Ace (not-A) and there is no King (not-B) (Thompson & Byrne, 2002), and reasoners can mistakenly think that they were told that there was no Ace (not-A) and that there was no King (not-B) (Fillenbaum, 1974). They are also primed to read quickly the conjunction *"There is no Ace and there is no King"* (not-A and not-B) when they have

read the subjunctive conditional (Santamaria et al., 2005). They are primed to read quickly the conjunction *"There is an Ace and there is a King"* from both subjunctive and indicative conditionals (de Vega, Urrutia, & Riffo, 2007; Santamaria et al., 2005).

Because the inferences people make are reliant on the possibilities they are keeping in mind, previous research has shown that participants make more *modus tollens* inferences (There was no King, therefore there was no Ace) and *denial of the antecedent* inferences (There was no Ace, therefore there was no King) from subjunctive conditionals (Byrne & Tasso, 1999; Thompson & Byrne, 2002). These inferences rely on the presupposed facts (not-A and not-B), in comparison to the indicative conditional. Nevertheless participants make the same frequency of the *modus ponens* inference (There was an Ace, therefore there was a King) and the *affirmation of the consequent* inference (There was a King, therefore there was an Ace).

An alternative view is that people understand a conditional by thinking about suppositional probabilities (Oaksford & Chater, 2007; Evans & Over, 2004; Evans, 2007). They add the supposition of the antecedent 'A' to their beliefs, and assess whether the consequent, 'B' is probable. They compare the probability of B given A, and the probability of not-B given A. Another alternative view is that people understand a conditional by accessing inference rules, either formal abstract rules (Braine & O'Brien, 1998; Rips, 1994) or domain-specific rules (Fiddick, Cosmides, & Tooby, 2000; Holyoak & Cheng, 1995). These alternative views continue to be debated (e.g.: Barrouillet, Gauffroy, & Lecas, 2008; Byrne & Johnson-Laird, In submission; Evans, Over, & Handley, 2005; Oberauer, 2006; Schroyens & Schaeken, 2003; Schroyens et al., 2001 for a review).

Our aim in this chapter is to test predictions about the basic principles people use when generating alternatives, that is, the principles of truth and parsimony (Johnson-Laird and Byrne, 2002). In two experiments we show that differences in conditional mood

affects the possibilities that people represent but we also extend previous findings by showing the effect the word *'only'* has on the inferences participants make from conditionals. We test this by comparing conditional statements in the subjunctive mood, such as, 'if there had been an Ace, then there would have been a King'; with *if only there had been an Ace, then there would have been a King.*

'Only' is a versatile word which can convey different meanings depending on its location in a sentence, e.g. *"only John shouted at Ann", "John only shouted at Ann",* and *"John shouted only at Ann"* differ in meaning depending on whether *only* modifies the subject, object or verb of the sentence. When *only* is employed as a quantifier, e.g. *"only the artists are tall"*, individuals think about not just the affirmative possibility (artists who are tall) but also the negative possibility (individuals who are not artists, who are not tall) (Johnson-Laird & Byrne, 1989). When *only* is employed to modify 'if', e.g. *"She went to the meeting only if she received the papers"* it leads to systematic differences with 'if' (e.g.: Evans, Clibbens, & Rood, 1995; Grosset & Barrouillet, 2003; Santamaría & Espino, 2002), perhaps because it brings to mind the negative possibility as well as the affirmative possibility (Egan, García-Madruga, & Byrne, In submission). We examine the effect of *only*, not when it is used with 'only if', but when it is used with *if only*, e.g. *"if only Mr. Jones had taken the shore route, then he would not have been injured"*. We propose that *if only* emphasises the negative possibility, *"Mr. Jones did not take the shore route and he was injured"*. We test this proposal in two experiments, which compare subjunctive-if only, subjunctive-if, and indicative-if conditionals by examining inferences, consistency judgments, and implication judgements drawn from these different conditionals.

Experiment 8: Inferences from *if only*

The aim of the experiment was to examine how people mentally represent subjunctive *if only* conditionals, by comparing the inferences they make from them to those they make

from subjunctive conditionals based on 'if', and indicative conditionals based on 'if'. We gave participants problems of the following sort:

Mary says that: *If only Abi had gone to Bray, then Tim would have gone to Cork.*

Paul says that: *I know that Tim did not go to Cork.*

What, if anything, can they infer about Abi's whereabouts?

(a) Abi went to Bray

(b) Abi did not go to Bray

(c) Abi may or may not have gone to Bray

We propose that subjunctive *if only A had been, then B would have been* conveys the presupposed facts (not-A and not-B), which are the opposite of the conjecture (A and B) - even more so than subjunctive '*if*'. Accordingly, we predict that individuals will make more of the *modus tollens* (not-B therefore not-A) and *denial of the antecedent* inferences (not-A therefore not-B) from subjunctive *if only* compared to subjunctive 'if' and indicative 'if'. They will make the same frequency of the *modus ponens* (A therefore B) and *affirmation of the consequent* inferences (B therefore A) from subjunctive-if only, subjunctive-if, and indicative-if.

To surmise, the experiment aimed to test predictions derived from mental model theory (Johnson-Laird & Byrne, 1991; Johnson-Laird & Byrne, 2002) and was designed and data analysed based on preceding research (Byrne & Tasso, 1999; Thompson & Byrne, 2002)(17). We predicted that the form and mood of a conditional would influence the type and frequency of inferences participants would make. We predicted that indicative-if conditionals would lead to the representation of facts related only to the conjecture (the *true-antecedent-true consequent* conjunction), subjunctive-if conditionals would lead to the representation of both facts related to the conjecture and the presupposed facts (the

true-antecedent-true consequent and *false antecedent-false consequent* conjunctions) and subjunctive-if only conditionals lead to the representation of facts related to only the presupposed facts (the *false antecedent-false consequent* conjunction). Following, we made specific predictions regarding inference rates for *modus ponens* and *affirmation of the consequent* inferences, in that they would not significantly differ between groups. However, we predicted that *modus tollens* and *denial of the antecedent* inferences would differ in frequency, increasing from indicative-if conditionals to subjunctive-if conditionals and from subjunctive-if to subjunctive-if only conditionals.

Method

Participants

The participants were 36 undergraduate and postgraduate volunteers from Trinity College Dublin (11 men and 24 women; one participant did not submit age or gender). Their ages ranged from 18 to 46 (and the average age was 23 years).

Design

The design employed a 4 (inference) x 3 (group) mixed factors analysis, with three groups of participants (indicative-if, subjunctive-if, and subjunctive-if only). The independent variables were the type of conditional (mood) the participants were assigned to. The dependent variable was the number of valid conditional arguments made.

Materials

Based on the preceding research of Byrne and Tasso, (1999) and Thompson and Byrne (2002), the conditional statements were all written in the past tense, with two sets of materials assigning 12 conditional contents to the inferences at random, to control for content and order effects, and we assigned the two sets of materials to the participants at

random. The constructed conditional arguments consisted of a conditional premise (e.g. if A then B) followed by a minor premise that corresponded to *modus ponens* (A), *modus tollens* (not-B), *denial of the antecedent* (not-A) or *affirmation of the consequent* (B). Participants were asked to judge what followed, if anything, from the premises, and they were given a selection of three conclusions to choose from, e.g. for *modus ponens*: (i) B, (ii) not-B, (iii) B may or may not be the case. Whether the participant completed the argument according to the corresponding premise constituted the dependent measure. The conditionals were in the past tense and in either the indicative mood (e.g. If Abi went to Bray, then Tim went to Cork), or the subjunctive mood (e.g. If Abi had gone to Bray, then Tim would have gone to Cork). We used the connective 'if' for the indicative mood, and the connectives 'if' and *if only* for the subjunctive mood (e.g. If only Abi had gone to Bray, then Tim would have gone to Cork), which constituted the independent variable. The content of the conditionals was based on people-in-places (see Appendix 4 for complete examples).

Procedure

Participants were assigned at random to one of three conditions (n = 12 in each), whereupon they were given either indicative, subjunctive 'if' or subjunctive 'if only' conditional inference tasks. They received a booklet containing 12 arguments, each presented on a separate page. They were instructed that their task was to judge what followed, if anything, from the premises corresponding to the *modus ponens*, *modus tollens*, affirmation of the consequent and *denial of the antecedent* arguments. They were asked to read the questions carefully and to circle their answers, and to take as much time as they needed.

Results and Discussion

Subjecting the inference data to a 3 x 4 ANOVA, which produced the following effects, tested the prediction about conditional type. There was a main effect of inference $F(3, 99) = 7.14$, MSE = 1.18, $p < .001$, no main effect of connective $F(2, 33) = 1.87$, MSE = 2.35 $p = .169$, and an interaction between the two $F(6, 99) = 2.28$, MSE = 1.18, $p = .050$, as shown by the 3 (mood) x 4 (inference) mixed factorial ANOVA carried out on the endorsements of inferences[11].

For *modus tollens* inferences (not-B therefore not-A), as we expected, participants made different frequencies of inferences from subjunctive-if only (86%), subjunctive-if (72%), and indicative-if (42%), $F(2, 19.05) = 4.86$, MSE = 1.06, $p = .020$, as Table 5.1 shows[12]. They made more of these inferences from subjunctive-if only than indicative-if, $t(13.84) = -3.05$, $p = .008$ ($r = .63$); marginally more from subjunctive-if than indicative-if, $t(19.04) = -1.86$, $p = .078$ ($r = .39$); but not more from subjunctive-if only than subjunctive-if, $t(17.08) = 1.35$, $p = .18$ ($r = .31$).

Table 5.1: The percentages of inferences endorsed for the three conditionals

	Inference			
Connective	**MP**	**AC**	**MT**	**DA**
Indicative-if	78 (28)	39 (14)	42 (15)	28 (10)
Subjunctive-if	78 (28)	36 (13)	72 (26)	36 (13)
Subjunctive-if only	64 (23)	53 (17)	86 (31)*	69 (25)*+

Key: *MP = modus ponens; AC = affirmation of the consequent; DA = denial of the antecedent; MT = modus tollens.*
+ = The percentages of inferences in this cell differ reliably from the percentages of inferences in the cell immediately above it.
** = The percentages of inferences in this cell differ reliably from the percentages of inferences in the top cell.*

[11] Results relevant to the hypotheses were reported only, as in previous research (Thompson & Byrne, 2002)

[12] Planned orthogonal contrasts were used to compare the frequencies of inferences across the three group (see Rosnow & Rosenthal, 2002; Winer, 1971 for the legitimacy of such comparisons). We report a Welch *F*-ratio when Levine's test was significant and the population variance was unequal, in this experiment and the next. In these cases, equal variances were not assumed and the degrees of freedom were adjusted accordingly.

Likewise, for *denial of the antecedent* inferences (not-A therefore not-B), participants made different frequencies of inferences from subjunctive-if only (69%), subjunctive-if (36%), and indicative-if (28%, $F(2, 33) = 3.50$, MSE = 1.50, $p = .042$). They made more of these inferences from subjunctive-if only than from indicative-if, $t(33) = 2.50$, $p = .018$ ($r = .40$); more from subjunctive-if only than subjunctive-if, $t(33) = 2.00$, $p = .054$ ($r = .33$); but not more from subjunctive-if than indicative-if, $t(33) = .50$, $p = .62$ ($r = .09$).

As we expected, there were no differences for the affirmative inferences. For *modus ponens* inferences (A therefore B) there were no differences between subjunctive-if only (64%), subjunctive-if (78%), and indicative-if conditionals (78%, $F(2, 33) = .47$, $p = .638$), and none of the pair wise comparisons were reliable: subjunctive-if only vs. indicative-if, $t(33) = -.83$, $p = .414$ ($r = .14$); subjunctive-if vs. indicative-if (78% in each case), and subjunctive-if only vs. subjunctive-if, $t(33) = -.83$, $p = .414$ ($r = .14$). Likewise, there were no differences for *affirmation of the consequent* inferences (B therefore A) for subjunctive-if only (53%), subjunctive-if (36%), and indicative-if (39%, $F(2, 33) = .21$, $p = .814$). Also none of the pair wise comparisons were reliable: subjunctive-if only vs. indicative-if, $t(33) = .46$, $p = .646$ ($r = .08$); subjunctive-if vs. indicative-if, $t(33) = -.15$, $p = .878$ ($r = .03$); and subjunctive-if only vs. subjunctive-if, $t(33) = .62$, $p = .54$ ($r = .11$).

The results corroborate the new proposal that subjunctive-if only emphasises the counterfactual nature of the conditional. It increases the tendency to represent the presupposed facts (not-A and not-B), and thus increases the tendency to make the *modus tollens* and the *denial of the antecedent* inference, even more so than subjunctive-if compared to indicative-if. The results also replicate previous research that shows that participants make more of the *modus tollens* and *denial of the antecedent* inferences from subjunctive-if compared to indicative-if (e.g. Byrne & Tasso, 1999). In some experiments,

the increase is observed in one but not both inferences as here, perhaps because of the difference in the 'direction' of the inference, that is forwards from A to B or backwards from B to A (Egan et al., In submission; Quelhas & Byrne, 2003; Thompson & Byrne, 2002).

One observation was unexpected: The experiment shows that for subjunctive-if only conditionals, the affirmative inferences (MP: 64% and AC: 53%) are made at a lower rate than the negative inferences (MT: 86% and DA: 69%). The observation suggests a modification to our initial hypothesis. Reasoners may represent *if only* by thinking most readily about the presupposed facts (not-A and not-B), even to the extent that they tend to neglect to represent the conjecture (A and B). We test this modified hypothesis in the next experiment.

Experiment 9: Implications and Consistency Judgments for *if only*

The aim of the experiment was to test whether people mentally represent subjunctive-if only conditionals by thinking most readily about the presupposed facts (not-A and not-B). In contrast, they represent subjunctive-if conditionals by thinking about two possibilities, the presupposed facts (not-A and not-B) and the conjecture (A and B); and they represent indicative-if conditionals by thinking most readily about the conjecture (A and B).

In the experiment we compared the consistency judgments and implication judgments that reasoners make from subjunctive conditionals based on *if only*, subjunctive conditionals based on 'if', and indicative conditionals based on 'if'. We gave participants three tasks (based on Thompson & Byrne, 2002). One task was a consistency judgment task, e.g.

Paul says that: *If only Alicia had gone to Donegal, then Mark would have gone to Kerry.*

Which combination of events would be consistent with Paul's statement? Which would be inconsistent? Tick the appropriate box for each of the following events:

	Consistent	Inconsistent
Alicia went to Donegal and Mark went to Kerry	❑	❑
Alicia did not go to Donegal and Mark did not go to Kerry	❑	❑
Alicia did not go to Donegal and Mark went to Kerry	❑	❑
Alicia went to Donegal and Mark did not go to Kerry	❑	❑

The hypothesis that people understand subjunctive *if only* by thinking about the presupposed facts leads to the prediction that individuals will judge as consistent the conjunction corresponding to the presupposed facts (not-A and not-B). These judgments of consistency will be made more so than judgments from subjunctive-if and indicative-if. And they will judge as consistent the conjunction corresponding to the conjecture (A and B) *less* often than such judgments from subjunctive-if and indicative-if (see Thompson & Byrne, 2002).

We also gave participants an implications task, e.g.

Mary says that: *If Ellen went to Lucan, then Tom went to Kildare.*

What, if anything, do you think that Mary meant to imply? Choose as many of them as you think appropriate:

(a) That Ellen went to Lucan.
(b) That Ellen did not go to Lucan.
(c) That Tom did not go to Kildare.
(d) That Tom went to Kildare.
(e) Nothing was implied.

We predict that individuals will endorse the assertions corresponding to the presupposed facts - not-A and not-B, and they will not endorse the assertions corresponding to the conjecture – A and B - more often from subjunctive-if only compared to subjunctive-if and indicative-if (see Thompson & Byrne, 2002).

We also gave participants an inference task similar to that used in the previous experiment. We presented the three tasks – consistency judgments, implication judgments, and inferences - for conditionals with affirmative components (e.g. if A then B) and also those with negated components (e.g. if not-A then not-B). Our predictions are based on the representation of the presupposed facts, which for 'if A then B' is 'not-A and not-B' and for 'if not-A then not-B', is 'A and B'. Our predictions do not hinge on whether the conditionals are affirmative or negative, and so we make the same predictions for both forms (Thompson & Byrne, 2002; see also Evans, 1977; Johnson-Laird & Byrne, 1991).

Method

Participants

The participants were 156 undergraduate and postgraduate volunteers from Trinity College Dublin (98 women and 58 men) and their ages ranged from 18 to 65 years (with an average age of 25 years).

Design

The results of these tasks constituted the dependent measures; resulting in a 3x4x2 mixed groups design. As in the previous experiment, participants were assigned at random to one of three groups, subjunctive-if only, subjunctive-if and indicative-if, constituting the independent variable. The dependent variables consisted of responses given by participants to the three forms of task and measured against the experimental predictions.

Materials

The inference task was the same as in the previous experiment and based on Thompson and Byrne (2002): participants selected conclusions for *modus ponens*, *modus tollens*, *denial of the antecedent* and *affirmation of the consequent* inferences. They carried out one

instance of each, this time for both affirmative (e.g. if A then B) and negative conditionals (e.g. if not-A then not-B), that is, eight inference tasks. The content was again people-in-places and the eight arguments were presented in four fixed orders presented at random to participants.

The consistency task required participants to judge whether a conjunction was consistent or inconsistent with the conditional. The four conjunctions corresponded to: (i) the true antecedent and true consequent (TA-TC), (ii) the false antecedent and false consequent (FA-FC), (iii) the true antecedent and false consequent (TA-FC), and (iv) the false antecedent and true consequent (FA-TC). Participants were given an affirmative and a negative conditional and each of the four conjunctions corresponding to them, i.e. 8 consistency judgment tasks.

The implications task required participants to judge what was implied by the conditional: (i) the true antecedent (TA), (ii) false antecedent (FA), (iii) false consequent (FC), (iv) true consequent (TC), and (v) nothing was implied. Participants were given an affirmative and a negative conditional, i.e. 2 implications tasks.

Complete examples of the experimental materials are contained in Appendix 4.

Procedure

Participants were assigned at random to three groups, indicative-if, subjunctive-if and subjunctive-if only (n = 52 in each). They were given the three sorts of task printed on separate pages in a booklet, which they completed at their own pace. The tasks were presented in the same order for every participant, and participants were tested in large groups. Each participant carried out three sorts of task in both positive and negative valence form; an inference task, a consistency judgment task, and an implications task, in keeping with previous research (Byrne & Tasso, 1999; Thompson and Byrne, 2002).

Results and Discussion

Consistency Judgment Task

Subjecting the consistency judgment data to a 3(connective) x 4(conjunction) x 2(valence) ANOVA, which produced the following effects, tested the prediction about conditional type. There were main effects of connective $F(2, 153) = 13.83$, MSE = .19, $p < .001$, conjunction type $F(2.72, 416.69) = 312.99$, MSE = .16, $p < .001$, and valence, $F(1, 153) = .35$, MSE = .06, $p = .003$, and the three factors interacted, $F(6, 380.63) = 2.47$, MSE = .07, $p = .033$, as shown by the 3 (mood) x 4 (conjunction type) x 2 (valence) mixed factorial ANOVA on the consistency judgments. Both mood and valence influenced the judgments of participants in what conjunctions was judged consistent, according to our predictions.

Table 5.2: Percentages of the four sorts of conjunctions judged consistent with the conditionals in Experiment 9.

	Conjunction			
Connective	**TA-TC**	**FA-FC**	**TA-FC**	**FA-TC**
Affirmative				
Indicative-if	90 (47)	58 (30)	10 (5)	10 (5)
Subjunctive-if	98 (51)	94 (49)+	0	21 (11)
Subjunctive-if only	48 (25)*+	90 (47)*	10 (5)	10 (5)
Negative				
Indicative-if	96 (50)	37 (19)	2 (1)	12 (6)
Subjunctive-if	98 (51)	77 (40)+	2 (1)	25 (13)
Subjunctive-if only	39 (20)*+	87 (45)*	10 (5)	6 (3)+

Key: *TA-TC = true antecedent and true consequent; FA-FC = false antecedent and false consequent; TA-FC = true antecedent and false consequent; FA-TC = false antecedent and true consequent*
+ = The percentages of inferences in this cell differ reliably from the percentages of inferences in the cell immediately above it.
** = The percentages of inferences in this cell differ reliably from the percentages of inferences in the top cell.*

Participants tended to judge the conjunction that corresponds to the presupposed facts for a counterfactual (e.g. not-A and not-B) to be consistent with subjunctive-if only

and subjunctive-if more readily than for indicative-if. They judged as consistent this false antecedent and false consequent conjunction (FA-FC) with different frequencies for the three connectives (affirmative: $F(2, 95.65) = 11.48$, MSE = .13, $p < .001$; negative: $F(2, 99.91) = 18.68$, MSE = .18, $p < .001$), as Table 5.2 shows. They made more of these judgments from subjunctive-if only than indicative-if (affirmative: $t(83.232) = -4.61$, $p < .001$ ($r = .45$); negative: $t(91.92) = -6.05$, $p < .001$ ($r = .53$)), more from subjunctive-if than indicative-if (affirmative: $t(72.64) = -5.15$ ($r = .52$), $p < .001$; negative: $t(100.23) = -4.51$, $p < .001$ ($r = .41$)), and there were no differences between subjunctive-if only and subjunctive-if (affirmative: $t(96.86) = .54$, $p = .467$ ($r = .05$), negative: $t(97.79) = -1.27$, $p = .208$ ($r = .03$)).

Participants tended to judge the conjunction corresponding to the conjecture (e.g. A and B) as consistent with indicative-if and subjunctive-if more often than subjunctive-if only. Participants judged as consistent this true antecedent and true consequent conjunction (TA-TC) with different frequencies for the three connectives (affirmative: $F(2, 83.43) = 23.98$, MSE = .12, $p < .001$; negative: $F(2, 87.54) = 35.21$, MSE = .11, $p < .001$). They made fewer of these judgments from subjunctive-if only than indicative-if (affirmative: $t(82.67) = 5.21$, $p < .001$ ($r = .50$); negative: $t(73.25) = 7.38$, $p < .001$ ($r = .65$)), fewer from subjunctive-if only than subjunctive-if (affirmative: $t(58.66) = 6.89$, $p < .001$ ($r = .67$), negative: $t(59.07) = 8.42$, $p < .001$ ($r = .74$)), and there were no differences between subjunctive-if and indicative-if (affirmative: $t(72.14) = -1.69$, $p = .096$ ($r = .20$), negative: $t(82.59) = -1.02$, $p = .313$ ($r = .11$)).

Participants judged the false antecedent and true consequent (FA-TC) case to be consistent with different frequencies for the three connectives only for the negative conditionals $F(2, 96.33) = 3.91$, MSE = .12, $p = .023$, not for the affirmative ones $F(2, 100.19) = 1.60$, MSE = .12, $p = .140$, and subsequent planned comparisons on the negative conditionals revealed only one reliable difference, between subjunctive-if only and

subjunctive-if $t(78.28) = 2.79$, $p = .007$ ($r = .30$). Participants did not judge the true antecedent and false consequent (TA-FC) case to be consistent with different frequencies for the three connectives (affirmative: $F(2, 153) = 2.71$, MSE = .06, $p = .07$; negative: $F(2, 96.01) = 1.56$, MSE = .04, $p = .216$).

The results show that people judge as consistent the presupposed facts (e.g. not-A and not-B) more often for subjunctive-if only and subjunctive-if, than for indicative-if. Conversely, they judge as consistent the conjecture (e.g. A and B) more often for subjunctive-if and indicative-if, than for subjunctive-if only. The result corroborates the new proposal that 1) people think about the presupposed facts for subjunctive-if only; 2) they think about both the presupposed facts and the conjecture for subjunctive-if; and 3) they think about the conjecture for indicative-if.

Implications Task

Again, we subjected the consistency judgment data to a 3(connective) x 4(implications) x 2(valence) ANOVA, which produced the following effects, tested the prediction about conditional type. There was a main effect of connective $F(2, 153) = 13.13$, MSE =.66, $p < .001$, a main effect of implication $F(2.024, 309.365) = 6.25$, MSE = .24, $p = .002$, no main effect for valence $F(1, 153) = .44$, MSE = .07, $p = .507$, and the three factors did not interact $F(4.744, 362.915) = .34$, MSE = .09, $p = .883$, as shown by the 3 (mood) x 4 (implication) x 2 (valence) mixed factorial ANOVA on the judgments that each of the four propositions were implied (see Table 5.3).

Despite non-significant results within the ANOVA, we further examined the data based on specific predictions by conducting planned contrasts. As we hypothesised, participants judged that the subjunctive-if only conditional (e.g. if only A had been then B would have been) implied its true antecedent (e.g. A) and its true consequent (e.g. B) *less* often than indicative-if. For the true antecedent, the judgments were made with different

frequencies from subjunctive-if only, subjunctive-if and indicative-if (affirmative: $F(2, 153) = 11.94$, MSE = .14, $p < .001$; negative: $F(2, 85.99) = 12.99$, MSE =.16, $p < .001$), as Table 5.3 shows. They made *fewer* of these judgements from subjunctive-if only than indicative-if (affirmative: $t(51) = 4.34$, $p < .001$ ($r = .52$); negative: $t(69.52) = 3.41$, $p = .001$ ($r = .38$)), fewer from subjunctive-if only than subjunctive-if (affirmative: $t(51) = -5.20$, $p < .001$ ($r = .59$); negative: $t(67.23) = -4.28$, $p < .001$ ($r = .46$)), but there were no differences between subjunctive-if and indicative-if (affirmative and negative, $t(101.50) = -.85$, $p = .400$ ($r = .08$) in each case).

Table 5.3: Percentages of propositions implied in Experiment 9

	Proposition				
Connective	**TA**	**TC**	**FC**	**FA**	**None**
Affirmative					
Indicative-if	27 (14)	50 (26)	8 (4)	6 (3)	40 (21)
Subjunctive-if	35 (18)	42 (22)	12 (6)	15 (8)	42 (22)
Subjunctive-if only	0*+	0*+	75 (39)*+	81 (42)*+	12 (6)*+
Negative					
Indicative-if	27 (14)	46 (24)	4 (2)	4 (2)	40 (21)
Subjunctive-if	35 (18)	50 (26)	12 (6)	12 (6)	42 (22)
Subjunctive-if only	4 (2)*+	8 (4)*+	79 (41)*+	83 (43)*+	4 (2)*+

Key: *TA = true antecedent; TC = true consequent; FC = false consequent; FA = false antecedent*
+ = The percentages of inferences in this cell differ reliably from the percentages of inferences in the cell immediately above it.
** = The percentages of inferences in this cell differ reliably from the percentage of inferences in the top cell.*

Likewise, for the true consequent, the judgements were made with different frequencies from subjunctive-if only, subjunctive-if, and indicative-if (affirmative: $F(2, 153) = 22.45$, MSE = .17, $p < .001$; negative $F(2, 92.41) = 21.18$, MSE = .19, $p < .001$), as Table 5.3 shows. They made *fewer* of these judgements from subjunctive-if only than indicative-if (affirmative: $t(51) = 7.14$, $p < .001$ ($r = .71$); negative: $t(77.94) = 4.86$, $p <$

.001 (r = .49)), fewer from subjunctive-if only than subjunctive-if (affirmative: $t(51)$ = -6.12, p < .001 (r = .65); negative: $t(77.81)$ = -5.33, p < .001 (r = .52)) but there were no differences between subjunctive-if and indicative-if (affirmative: $t(101.98)$ = .78, p = .44 (r = .07); negative: $t(101.50)$ = -.39, p = .698 (r = .03)).

Participants also judged that the subjunctive-if only conditional (e.g. if only A had been then B would have been) implied its false antecedent (e.g. not-A) and its false consequent (e.g. not-B) *more* often than indicative-if. For the false consequent (not-B), they made the judgements with different frequencies from subjunctive-if only, subjunctive-if and indicative-if (affirmative: $F(2, 98.68)$ = 47.93, MSE =.12, p < .001; negative: $F(2, 92.49)$ = 70.56, MSE =.10, p < .001), as Table 5.3 shows. They made *more* of these judgements from subjunctive-if only than indicative-if (affirmative: $t(84.78)$ = -9.45, p < .001 (r = .72); negative: $t(72.56)$ = -11.87, p < .001 (r = .81)), more from subjunctive-if only than subjunctive-if (affirmative: $t(93.83)$ = 8.42, p < .001 (r = .66); negative: $t(96.41)$ = 9.27, p < .001 (r = .69)), and there were no differences between subjunctive-if and indicative-if (affirmative: $t(98.82)$ = -.66, p = .51 (r = .07); negative: $t(83.67)$ = -1.47, p = .144 (r = .16)).

Likewise, for the false antecedent (e.g. not-A), they made the judgments with different frequencies from if only-subjunctives, if-subjunctives and if-indicatives (affirmative: $F(2, 96.11)$ = 69.37, MSE =.12, p < .001; negative: $F(2, 93.40)$ = 88.79, MSE = .20, p < .001), as Table 5.3 shows. They made *more* of these judgements from subjunctive-if only than indicative-if (affirmative: $t(82.80)$ = -11.70, p < .001 (r = .79); negative: $t(75.71)$ = -13.27, p < .001 (r = .84)); more from subjunctive-if only than subjunctive-if (affirmative: $t(101.22)$ = 8.74, p < .001 (r = .52); negative: $t(99.22)$ = 10.26, p < .001 (r = .72)) and there were no differences between subjunctive-if and indicative-if (affirmative: $t(87.27)$ = -1.60, p = .114 (r = .17); negative: $t(83.67)$ = -1.47, p = .144 (r = .16)).

Participants judged that *nothing was implied*[13] with different frequencies from subjunctive-if only, subjunctive-if and indicative-if (affirmative: $F(2, 97.20) = 10.09$, MSE .20, $p < .001$, negative: $F(2, 84.24) = 22.50$, MSE .18, $p < .001$). They made *fewer* of these judgements from subjunctive-if only than indicative-if (affirmative: $t(87.67) = 3.52$, $p = .001$ ($r = .35$); negative: $t(66.31) = 4.95$, $p < .001$ ($r = .42$)); fewer from subjunctive-if only than subjunctive-if (affirmative: $t(87.31) = -3.74$, $p < .001$ ($r = .37$); negative: $t(66.11) = -5.18$, $p < .001$ ($r = .54$)), and there were no differences between subjunctive-if and indicative-if (affirmative and negative, $t(98.82) = -.66$, $p = .511$ ($r = .07$) in both cases).

The results show that people judge as implied the presupposed facts (e.g. not-A, not-B) more often for subjunctive *if only* than subjunctive-if and indicative-if; and they judge as implied the conjecture (e.g. A, B) less often for subjunctive *if only* than for subjunctive-if and indicative-if. The result again corroborates the new proposal that people think about the presupposed facts for subjunctive-if only.

Inferences

We subjected the inference data to a 3(connective) x 4(inference) x 2(valence) ANOVA, which produced the following effects, tested the prediction about conditional type. There was a main effect of inference $F(3, 459) = 3.55$, MSE =.17, $p = .015$, no main effect of connective $F(2, 153) = 2.74$, MSE =.60, $p = .068$, no main effect of valence $F(1, 153) = .990$, MSE = .23, $p = .321$ and the three factors interacted $F(5.619, 429.871) = 3.21$, MSE .19, $p = .005$, as the 3 (mood) x 4 (inference) x 2 (valence) mixed factorial ANOVA on the endorsements of inferences shows (see Table 5.4).

[13] A separate analysis was carried out for the 'nothing implied' data.

Table 5.4: The percentages of inferences endorsed for the three conditionals.

Connective	Inference MP	AC	MT	DA
Affirmative				
Indicative-if	65 (34)	50 (26)	40 (21)	40 (21)
Subjunctive-if	75 (39)	46 (24)	63 (33)+	54 (28)
Subjunctive-if only	50 (26)+	42 (22)	63 (33)*	69 (36)*
Negative				
Indicative-if	75 (39)	46 (24)	27 (14)	23 (12)
Subjunctive-if	65 (34)	58 (30)	65 (34)+	40 (21)+
Subjunctive-if only	31 (16)*+	42 (22)	63 (33)*	63 (33)*

Key: *MP = modus ponens; AC = affirmation of the consequent; DA = denial of the antecedent; MT = modus tollens.*
+ = The percentages of inferences in this cell differs reliably from the percentages of inferences in the cell immediately above it.
** = The percentages of inferences in this cell differs reliably from the percentages of inferences in the top cell.*

For *modus tollens* inferences, as the previous experiment showed, participants made different frequencies of inferences from subjunctive-if only, subjunctive-if, and indicative-if conditionals (affirmative: $F(2, 153) = 3.86$, MSE = .24, p =.023; negative: $F(2, 153) = 10.97$, MSE =.22, p = < .001), as Table 5.4 shows. They made more of these inferences from subjunctive-if only than indicative-if (affirmative: $t(153) = 2.41$, p =.017 (r = .19); negative: $t(153) = -3.95$, $p < .001$ (r = .30)), more from subjunctive-if than indicative-if (affirmative: $t(153) = -2.41$, $p = .017$ (r = .19); negative: $t(153) = -4.16$, $p <$ .001 (r = .32)), but not more from subjunctive-if only than subjunctive-if (affirmative: 63% in each case, negative: $t(153) = .21$, $p = .836$ (r = .02)). The result replicates the previous experiment.

Likewise, for the *denial of the antecedent* inferences, participants made different frequencies of inferences from subjunctive-if only, subjunctive-if, and indicative-if (affirmative: $F(2, 101.88) = 4.67$, MSE =.24, p = .011, negative: $F(2, 101.50) = 10.09$,

MSE =.22, p = < .001). They made more of these inferences from subjunctive-if only than indicative-if (affirmative: t(101.62) = -3.06, p = .003 (r = .29); negative: t(100.23)= -4.51, p < .001 (r = .41)), more from subjunctive-if than indicative-if (affirmative: t(101.97)= -1.37, p= .172 (r = .13); negative: t(99.72) = -11.91, p = .059 (r = .77)), and more from subjunctive-if only than subjunctive-if (affirmative: t(101.40) = -1.62, p = .109 (r = .16); negative: t(101.96) = -2.40, p =.018 (r = .23)). The result also replicates the previous experiment.

The tendency observed for *modus ponens* inferences in the previous experiment was accentuated in this experiment. Participants made different frequencies of inferences from subjunctive-if only, subjunctive-if, and indicative-if conditionals (affirmative: F(2, 101.63) = 3.63, MSE =.23, p = .030; negative: F(2, 101.84) = 13.33, MSE =.21, p < .001), as Table 5.4 shows. They made *fewer* of these inferences from subjunctive-if only than indicative-if although the difference is reliable only for the negative conditionals (affirmative: t(101.75) = 1.60, p = .115, (r = .16); negative: t(153) = 4.89, p < .001 (r = .37)); and *fewer* from subjunctive-if only than subjunctive-if (affirmative: t(99.96) = 2.70, p = .008 (r = .26); negative: t(153) = 4.89, p < .001 (r = .37)), and there were no differences between subjunctive-if and indicative-if (affirmative: t(101.11) = -1.07, p = .288 (r = .11); negative: t(153) = 1.06, p = .290 (r = .09)). Subjunctive-if only conditionals reduced the frequency of *modus ponens* to a significant level within the negative valence condition.

For the *affirmation of the consequent* inferences, participants made the same frequencies of inferences from subjunctive-if only, subjunctive-if, and indicative-if (affirmative: F(2, 153) = .31, MSE = .25, p = .74; negative F(2, 153) = 1.33, MSE = .25, p = .262), and so we carried out no further comparisons.

The results show that people make the *modus tollens* and *denial of the antecedent* inferences that require access to the presupposed facts (e.g. not-A and not-B) more often

from subjunctive-if only and subjunctive-if than from indicative-if. They make the *modus ponens* inference, which requires access to the conjecture (e.g. A and B) less often from subjunctive-if only than from subjunctive-if and indicative-if. The result corroborates the new proposal that *if only* not only emphasises the presupposed facts (e.g. not-A and not-B) but it initially may also lead participants to failing to represent the conjecture (e.g. A and B).

General Discussion

The experiments in this chapter were carried out to test predictions about the basic principles people use when generating and representing conditionals and counterfactuals. The two principles advocated by Johnson-Laird and Byrne (2002), the principle of truth and the principle of parsimony, both function to reduce the number of possibilities people initially generate. We tested participants' representation of, and inferences from, three forms of 'if-then' conditionals. One form of conditional was presented in the indicative mood, and two were presented in the subjunctive mood. The two in the subjunctive mood differed through the use of the word *only*, presented after 'if' in order to modify the remainder of the clause. By examining participants' responses to conditional argument tasks, consistency-judgment tasks and implication tasks, we investigated differences that indicated effects of conditional mood and the effects of presenting the word *only* in a subjunctive conditional on the mental representations reasoners constructed from them.

In Experiment 8 we predicted that subjunctive conditionals would initially bring to mind facts relating to the conjecture (e.g. A and B) and the presupposed facts (e.g. not-A and not-B). For this reason we expected participants to make *modus tollens* inferences (not-B therefore not-A) and *denial of the antecedent* inferences (not-A therefore not-B) at higher rates with subjunctive conditionals. For conditionals in the indicative mood we expected participants to make the same frequency of *modus ponens* inferences and

affirmation of the consequent inferences but make fewer *modus tollens* inferences and *denial of the antecedent* inferences when compared to subjunctive conditionals. With the inclusion of *only* in subjunctive conditionals we expected the frequency of *modus tollens* inferences and *denial of the antecedent* inferences to increase when compared to indicative-if and subjunctive-if conditionals. We predicted that *only* would emphasise the counterfactual nature of the conditional. The results supported our predictions. Inferences based on the presupposed facts were more easily made from subjunctive conditionals compared to indicative conditionals. This increase in *modus tollens* and *denial of the antecedent* inferences was more pronounced for subjunctive-if only conditionals. *Modus ponens* inferences and *affirmation of the consequent* inferences were not affected by the mood of conditional. The experiment also led to the novel observation that *if only* reduced the frequency of both *modus ponens* inferences and *affirmation of the consequent* inferences. We suggest the reason for this finding lays with the emphasis that the word *only* places on the presupposed facts, as reasoners neglect to represent the conjecture (A and B).

Experiment 9 carried forward the investigation of whether subjunctive-if only conditionals emphasised the representation of presupposed facts (not-A and not-B), to the detriment of the conjecture being represented (A and B). This contrasts with predictions that subjunctive-if conditionals bring to mind both the conjecture and the presupposed facts, and the predictions regarding indicative-if conditionals that represent the conjecture only. We employed three tests, a consistency-judgment task, an implication task and a conditional argument task, as previously used in the literature (Thompson & Byrne, 2002). We expected the consistency-judgment task to show responses reflective of this difference in the representation of possibilities from the three different conditional types. Participants given indicative-if conditionals represent the conjecture. Therefore they judged the conjunction corresponding to the conjecture as consistent. Participants given subjunctive-if

conditionals represent both the conjecture and the presupposed facts, thus we found the conjunctions related to both the conjecture and the presupposed facts as consistent. Participants given subjunctive-if only conditionals represent the presupposed facts, neglecting the conjecture and thus found the corresponding conjunction consistent. The findings were consistent with the predicted pattern of judgments, which are indicative of the three groups differing in the mental representation of possibilities.

Nevertheless, according to the mental model theory's meaning of basic conditionals (Johnson-Laird & Byrne, 2002), one result was unexpected. The mental model theory proposes that the antecedent is sufficient but not necessary for the consequent to occur. This allows the possibility that the consequent can occur without the antecedent occurring. For this possibility to be represented participants would have to flesh out all the possibilities making up the core meaning of the conditional (Johnson-Laird & Byrne, 2002). Because of the principle of parsimony, participants only do so when necessary. Yet tentative evidence suggests some individuals are fleshing out the full set of possibilities in order to make conclusions, as indicated by frequencies of FA-TC in the consistency judgment tasks. This occurs only where participants are keeping in mind at least two possibilities from the outset, those participants reading if-subjunctive conditionals, thus implicating a full set of possibilities. This supports the mental model theory's account of conditional reasoning and conflicts with a suppositional account of conditional reasoning (Byrne & Johnson-Laird, In submission; Evans & Over, 2004; Evans et al., 2005).

Valence showed little effect but for the general reduction in inferences made from conditionals in the negative valence, perhaps because reasoners found them harder to interpret. Evans (1972; , 1977) found decreases in inferential arguments (apart from *modus ponens*) with negation in indicative inferences which he suggested was evidence of a negative conclusion bias (Evans et al., 1993). This bias was defined as accepting more negative conclusions than affirmative conclusions regardless of logic. This would predict

an increase in *denial of the antecedent* and *modus tollens* inferences, however we did not find this in our results, and neither did Thompson and Byrne (2002) find such an increase. Subjunctive conditionals therefore seem to show little effect of valence. This may be because the greater number of possibilities that can be imagined from a subjunctive conditional make them more similar to semantically rich material, which has been shown to remove the negative conclusion bias (Byrne, 1989; Fillenbaum, 1975). This indicates that the presence of a greater amount of explicitly represented information reduces valence effects. Overall, the evidence is supportive of the mental model theory's prediction that participants are keeping at least two possibilities in mind when representing counterfactual conditionals. This undermines the suppositional theory's singularity principle (Evans & Over, 2004), that people can only hold one possibility in mind at one time, instead representing numerous possibilities one at a time in sequential order.

Findings from the implications task also supported predictions derived from the mental model theory and the hypotheses of the corresponding mental representations. Participants reading the indicative-if conditionals judged as implied the conjecture more so than the presupposed facts. Participants reading subjunctive-if conditionals implied the conjecture, and to a greater extent than participants reading indicative-if conditionals, implied the presupposed facts also. However, participants reading subjunctive-if only conditionals implied the presupposed facts, and to a significantly greater extent than both the indicative-if and subjunctive-if participants. The 'nothing implied' data showed that participants reading subjunctive-if only conditionals judged less often than those reading indicative-if and subjunctive-if conditionals that nothing was implied. "Only' appears to enhance the belief that the conditional implies the presupposed facts.

The implications data also indicates that some reasoners are making a factual interpretation of the subjunctive-if conditional when imagining possibilities. That is, from the subjunctive-if conditional, 'if A had been then B would have been', they represent the

conjecture, A and B. This is similar to the interpretation made by reasoners given an indicative-if conditional, 'if A then B'. The nothing implied data also shows similar patterns in the subjunctive-if conditionals to the indicative-if conditionals. Participants in both conditions showed very similar frequencies.

These findings are similar to other results from previous literature, which advocated that individual differences in conditional reasoning could account for these effects. Byrne and Tasso (1999) showed that some reasoners made a factual interpretation of subjunctive conditionals, considering possibilities based on the presupposed factual reality of the conditional. They found that about one third of reasoners given a subjunctive conditional made a factual interpretation and about one third gave an interpretation focusing on the presupposed facts. Thompson and Byrne (2002) pointed to individual differences in reasoning, which allowed for different interpretations of subjunctive conditionals. Their findings indicated that the mood of the conditional was a poor predictor of interpretation. They also showed that reasoners commonly interpreted both subjunctive and indicative conditionals as implying truth regarding their component compositions. Thompson and Byrne noted this as surprising because conditionals express hypothetical relationships and do not presuppose truth. Our results can be interpreted in the same way as these two previous studies. However, we also make the suggestion based on evidence for the previous chapters, that individual differences in how possibilities are compared and contrasted, mediate to some degree the final conclusions participants make. There remains the possibility that there are dynamics between the mental models of possibilities that are as yet not understood.

Predictions regarding the conditional argument task remained as before in the previous experiment in regard to *modus tollens*, *denial of the antecedent*, *modus ponens* and *affirmation of the consequent* inferences. Participants representing the presupposed facts found it easier to make the *modus tollens* and *denial of the antecedent inference*,

while access to the conjecture was required to make the *modus ponens* and *affirmation of the consequent* inferences. This corresponded to predictions about differences in the three groups. The possibilities represented from the conditionals were affected by the mood of the conditional and the inclusion of *only* affected the remainder of the clause.

We note that in some previous studies an increase in frequency was observed in one but not both of *modus tollens* and *denial of the antecedent* inferences, as here, perhaps because of the difference in the 'direction' of the inference, forwards from A to B or backwards from B to A (Thompson & Mann, 1995). Egan, Garcia-Madruga and Byrne (In submission) have investigated *only if* conditionals, for example 'A *only if* B', and found that this form places an emphasis on the necessity of the consequent when drawing conclusions facilitating more *modus tollens* (MT) and *affirmation of the consequent* (AC) inferences. The inclusion of *only* in *if-then* forms of conditionals may place a greater negation on the remainder of the clause. Evans and Over (2004) suggest that this should reduce the believability of the conditional and reduce both *modus ponens* and *modus tollens* inferences. Representing this negation reduces the representation of the possibility that the antecedent occurs. However, our results show a reduction of *modus ponens* but not the reduction of *modus tollens* inferences, although the expected increases in *modus tollens* inferences may have been reduced. This contrasts with *only if* conditional forms, as previously found (Egan et al., In submission; Evans, 1977; Johnson-Laird & Byrne, 1989). Also the mental model theory offers an explanation for the lowering of *modus ponens*, due to the non-explicit representation of facts related to the conjecture, which would be necessary to make such an inferential argument. Further, explanation can be put forward under this theory as to the consistent levels of *affirmation of the consequent,* in that the presence of the consequent remains independent of the antecedent 'as it may or may not be the case', and is removed from the negating effects of the word *only*.

Overall our results show that *only,* conveys information regarding negation (Evans, 1977), its inclusion necessitates reasoners to represent the presupposed facts, *not-A and not-B*, and initially to neglect the conjecture, *A and B*. This is a novel finding and one that has implications for theories of reasoning and counterfactual thinking. The information of negation provided by *only* resulted in participants initially failing to represent the conjecture. The mental model theory allows for the importance of context in which the conditional is placed within its principle of pragmatic modulation (Johnson-Laid & Byrne, 2002). Our finding is similar to those reported by Egan (2005), who illustrated that in the context of promises and threats, participants keep in mind only the presupposed facts. Given the linguistic form of *only*, our participants could be making a similar interpretation.

Another implication, which we extend our findings to, lies in counterfactual research. It has been identified that there is an importance in identifying what aspect of a counterfactual thought is focused on most. Markman and McMullen (2003) have created a theory of comparative thinking that takes into account whether people reflect on or evaluate possibilities. They make the distinction between a contrast that is either displaced, or drawn to a counterfactual standard. People may reflect on, rather than evaluate, these statements and this could limit the possibilities they imagine. We suggest that this different simulation process could affect the representation of models of possibilities and, in turn, emphasise whether the conjecture or the presupposed facts takes precedence. We discuss this principle in more detail in the final chapter.

Chapter 6 Discussion

Our main aim in this thesis was to examine the exceptionality effect in counterfactual thinking. Overall our investigations were guided by the theory that a small set of principles allows a construction of models representing the underlying possibilities that participants keep in mind (Johnson-Laird & Byrne, 1991, 2002; Kahneman & Tversky, 1979). In the final empirical chapter we examined the ability to predict inference patterns, consistency judgments and implication tasks according to these principles. This research resulted in an understanding of how people reasoned from possibilities in order to construct counterfactual thoughts in an everyday context and a card game context. In this final chapter we will discuss our results further, make an interpretation of them under these principles, and explain how they can be used to understand the exceptionality effect and counterfactual thinking in general, and decision making and conditional reasoning.

This chapter is divided into four main sections. The first section summarises the main findings from each of the experiments. Our first research questions tested whether people focus on usual actions even when other counterfactual alternatives that provide better outcomes are made salient. We also tested whether less justified exceptional actions were changed more than justified exceptional actions. We tested the hypothesis that counterfactual thoughts are goal-based cognition, that is, guided by modifying an outcome to be better. Within our conditional reasoning experiments, we tested whether a subjunctive-if only conditional emphasises the representation of the conditional's presupposed facts. In the second section we consider the potential explanations for our results based on current theories of counterfactual thinking and reasoning. In the third section, we review our findings in light of the current literature on counterfactual thought, conditional reasoning and decision-making. The third section discusses the implications our findings have for research on counterfactual thought, conditional reasoning and

decision-making. In the fourth section we review the strengths and weaknesses of our research and finally we consider avenues for future research.

Summary of Experiments and Findings

In this first section we summarise the results from each of our series of experiments. We set out by describing the aims of each experiment and then consider their findings in detail. In Experiment 1 we tested whether participants' counterfactual thoughts exhibited the exceptionality effect even when an exceptional alternative was a justified better action in an everyday scenario. We also tested whether exceptional events appeared less justified than normal events because they appeared to have fewer reasons attached to them (Bonnefon et al., 2007). We tested participants' estimations of whether the unjustified actions carried out by the actor were more regrettable than justified actions. The series of experiments in Chapter 3 availed of a card game scenario in which the actor carried out a justified action. Experiment 2 tested our hypothesis that participants created *if only* thoughts that changed an exceptional action to the usual action, only when an exceptional alternative would *not* have led to a better outcome. Experiment 3 tested the hypothesis that participants would create *if only* thoughts that change an exceptional action to an alternative exceptional action as much as the usual action when the alternative *could* lead to a better outcome. Experiment 4 tested the hypothesis that participants tend to create *if only* thoughts that change an exceptional action to an alternative exceptional action more than the usual action when the alternative *would* lead to a better outcome. The series of experiments in Chapter 4 extended these findings to situations in which the actor carries out an unjustified action. Experiment 5 tested whether *if only* thoughts change an exceptional action to the usual action if alternative exceptional actions do not lead to an improved outcome in this scenario. Experiment 6 tested the hypothesis that participants' counterfactual thoughts would change an exceptional action to a justified exceptional

alternative when the counterfactual outcome was unknown. Experiment 7 tested the hypothesis that participants counterfactual thoughts would focus on external factors when none of the betting alternatives were capable of providing a better outcome. In the series of experiments in Chapter 5, we carried out a fine-grained examination of *if only* assertions. Experiment 8 examined how people mentally represent subjunctive *if only* conditionals, by comparing the inferences they make from them to those they make from subjunctive conditionals based on *if*, and indicative conditionals based on *if*. Experiment 9 tested whether people mentally represent subjunctive-if only conditionals by thinking most readily about the presupposed facts. We now summarise the findings of each of these experiments in more detail.

Counterfactual thinking and the exceptionality effect

Our aim in Chapter 2 was to investigate the exceptionality effect in counterfactual thinking, that is, the tendency to say, *"if only the actor had carried out his usual action"* (Kahneman & Tversky, 1982; Kahneman and Miller, 1986). We investigated whether reasons and justifications for actions reduced the occurrence of the exceptionality effect. We tested the prediction that when reasons are given for actions, it makes it harder to imagine alternatives to the action (Bonnefon et al., 2007). We modified the original scenario used by Kahneman and Tversky (1982) by informing participants that the actor took one of three routes home, an exceptional-justified, an exceptional-unjustified and a normal route. The results from Experiment 1 showed that participants judged that the actor would experience more regret overall for an unjustified exceptional action than for a justified exceptional action or a normal action. However, they generated *if only* thoughts that focused on the usual action, "*if only the actor had carried out their usual action*", regardless of whether the exceptional action was justified or unjustified.

The experiment shows that participants' *if only* thoughts exhibit the exceptionality effect even in cases where reasons for the action were given to justify the action. In our experimental contexts, justifications for actions did not reduce participants' focus on the exceptional action when undoing the outcome. However, their regret judgments were sensitive to the justification or otherwise of the action.

In Chapter 2 we examined whether justified exceptional actions were regretted more than unjustified actions. We defined "regret" as a function of the difference between an actual outcome and an outcome that could have been attained had an actor chosen differently (Bell, 1982; Loomes & Sugden, 1986; Mellers et al, 1997). Based on Connolly and Zeelenberg (2002), our regret measures tested a two-part theory of regret. Process regret is felt when the decision process is deemed to be poor, while outcome regret is experienced if the decision leads to a negative outcome. According to this theory, we predicted that outcome regret would be uniform across the three types of actions. We predicted that unjustified actions would be regretted more because they would increase process regret, whereas normal and justified actions would be low in process regret, reducing the total regret estimated. The results lend support for predictions corroborating the two-part theory of regret.

We also predicted that counterfactual thoughts would show evidence that participants focus on the most regrettable aspect of an event. This was not the pattern we observed, both justified and unjustified actions were undone equally and the exceptionality effect was present in both conditions. We concluded that our results were suggestive of an indirect relationship existing between counterfactual thinking and regret (Bonnefon et al., 2007) and therefore decided to remove regret measures from the following experiments.

Counterfactual thinking, explicit alternatives and the undoing of outcomes

In Chapter 3 we examined the exceptionality effect, that is, the tendency to say, *"if only the actor had carried out their usual action,"* using a card game scenario that informed participants that an actor was faced with three choices of bet, one of which was a usual action (the small bet) and two were exceptional (the medium bet and the large bet). Different consequences arose from the three actions therefore the actor was required to make a decision as to what action was best. In the three experiments the actor chose a justified action (the medium bet), as it was based on good reason, and lost. The scenario was designed to control for the contextual constraints, namely the lack of choices available to participants when imagining how things could have been different, within the previous scenario in Experiment 1 (Girotto et al., 1991; Markman et al., 1993) and in particular to ensure that the justification for the action could be objectively defined and measured. The aim in Experiment 2 was to reproduce the exceptionality effect according to the hypothesis that normal actions were focused on when other alternatives failed to produce a better potential outcome. In line with our predictions, participants created *if only* thoughts that undid the outcome by focusing on the normal alternative action. Experiment 3 tested our hypothesis that participants would change an exceptional action (the medium bet) to another exceptional alternative as much as the normal action if the exceptional alternative *could* lead to a better outcome. Participants created counterfactual thoughts in line with this prediction; the exceptionality effect was eliminated because an exceptional alternative (the large bet) was focused on as much as the normal action (the small bet). We predicted in Experiment 4 that the exceptionality effect would not only be eliminated but also reversed, because participants would focus on the exceptional action as it led to a better outcome, that is, they generated *if only* thoughts of the sort, *"if only the actor had carried out the other exceptional action"*. Corroborating our predictions, participants *if only*

thoughts changed a justified exceptional action to an unjustified exceptional action when it led to a better outcome.

In all three experiments we also tested the effects of requiring one group to explain what decision they thought was best for the actor, and we expected that this prior thinking would lead them to focus on the decision process as well as the outcome. The control group were not asked to complete this question. We found few effects of this manipulation in the three experiments in Chapter 3 in which the actor chooses a justified action, the medium bet.

In these three experiments, the bets participants judged to be the best revealed that they constructed a simple gains risk seeking strategy in order to make their decisions. They considered possibilities that would provide the largest monetary gain and did not attend to other possibilities such as more risk-averse betting options. We accounted for participants' preferences for this simple gains strategy by suggesting that the experimental context was equivalent to the "peanuts effect", namely, where monetary amounts decrease, risk aversion decreases (Prelec & Loewenstein, 1991; Weber & Chapman, 2005).

Counterfactual thoughts after normal and exceptional events

Chapter 4 used the same methodology as Chapter 3 but examined counterfactual thoughts following exceptional *unjustified* actions and normal actions, as well as winning and losing outcomes. In Experiment 5 we predicted that the exceptionality effect, that is, the tendency to say, *"if only he had carried out his usual action,"* would be observed in the case in which the actor carried out an exceptional unjustified action, when the exceptional justified action did not change the outcome to an alternative better outcome. The results supported our predictions and showed that regardless of the exceptional action being unjustified, the exceptionality effect remained in participants' *if only* thoughts in this experimental context. Experiment 6 tested our predictions that the exceptionality effect would be reversed,

examining whether participants would generate *if only* thoughts of the sort, *"if only the actor had carried out the other exceptional action"*, as participants would create *if only* thoughts that provide a better outcome. The results were in line with our predictions: participants focused on the justified exceptional action as its outcome was less uncertain than the outcome of the usual action and it could have led to a better outcome. Experiment 7 tested how participants would create *if only* thoughts that undo the outcome when neither of the exceptional alternatives provided a different outcome. We predicted that external factors would be focused on as participants imagine other possibilities of how the outcome could have been different. The results supported our predictions: participants focused on external factors when the exceptional alternatives presented no better outcomes.

In Chapter 4 we also predicted group differences, predicting that the strategy group would create counterfactual thoughts from a perspective inclusive of the actor's decision process. These predictions were made because the exceptional action carried out by the actor was unjustified so it would lead to the strategy group, who were focused on the decision process by the question 'what is the best decision for the actor?' to reflect differently on the scenario. Experiment 5 showed that, unlike participants in the control group, participants in the strategy group did not produce the exceptionality effect (they did not focus on the usual small bet): instead they focused on possibilities other than the alternative bets to undo the outcome. Experiment 6 showed that the strategy group did not reliably focus on the justified alternative (the medium bet) in contrast to the control group when imagining a different outcome. Experiment 7 showed that the strategy group created more counterfactual thoughts that focused on the exceptional large bet instead of on external factors that the control group focused on. We explained these differences in terms of both groups focusing on information within the experimental scenario in different ways, and this necessitated them to construct different alternative possibilities.

Reasoning from counterfactual conditionals: Inferences and the effect of only

The final series of experiments in Chapter 5 adopted a different methodology to allow a more fine-grained examination of the mental representations and cognitive processes underlying *if only* thoughts. The experiments in Chapter 5 were designed to test how the inferences and interpretations people make correspond to the principles of the mental model theory of how they represent possibilities (Byrne & Tasso, 1999; Johnson-Laird & Byrne, 1991; 2002; Thompson & Byrne, 2002). These principles indicate that people think about few possibilities, true possibilities, and that they have an awareness of semantic information within the sentence structure and the context in which the sentence is placed.

Experiments 8 and 9 both showed that differences in inferential arguments were found according to the mood of the conditional. We tested predictions, based on the mental model theory about how people mentally represent possibilities, by examining the initial models people created when reading different conditionals. We replicated findings that under a counterfactual interpretation of a subjunctive-if conditional, participants explicitly represented more possibilities than those formed from an indicative conditional. The mental model theory advocates that for an indicative conditional people only represent initially the conjecture. This resulted in predicted increases in *modus tollens* and *denial of the antecedent* inferences for subjunctive conditionals versus indicative conditionals. Our findings supported the predictions of the theory. Further evidence in support of the explanation afforded by the mental model theory was drawn from the consistency judgment task. Participants judged as consistent the conjunctions related to the counterfactual possibilities when given subjunctive-if conditionals but this was not the case with indicative conditionals.

Our novel findings were based on the inclusion of *only* in subjunctive-if conditionals, as we set out to show that *only* leads participants to focus on a different set of

possibilities. We predicted that *only* would focus participants on the presupposed facts. This prediction was corroborated but also the results provided a novel finding that initially participants did not appear to represent the clauses of the conjecture explicitly in their models. This impacted on the inferences they made - they made more *modus tollens* and *denial of the antecedent* inferences from *if only* subjunctive conditionals; and on what they judged was implied, as well their judgments of consistency regarding conjunctions. The inclusion of *only* also significantly lowered rates of the *modus ponens* inferences, which has shown robust high frequencies for other forms of conditionals. In line with the previous experiments, the Experiments in Chapter 5 allowed us to infer that the underlying representation of possibilities determined people's inferential and reasoning processes. We turn now to a consideration of alternative explanations of the results.

Theories of counterfactual thinking and reasoning

In this second section we consider potential explanations of our results. We consider in the first sub-section four existing theories of counterfactual thinking- the norm theory, the two functional theories, and the mental model theory. We show how the results of Experiments 1 to 7 corroborate the predictions of the mental model theory, lend some support to the predictions of the reflection-evaluation theory of comparative thinking, challenging the predictions of the current versions of norm theory and the functional theories. In the second sub-section we consider three types of theories of counterfactual reasoning – formal rule theories, suppositional theories and the mental model theory. We show how the results of Experiments 8 and 9 corroborate the predictions of the mental model theory and fail to support the predictions of the formal rule theories and suppositional theories.

Theories of counterfactual thinking

Norm theory

The exceptionality effect, which is the tendency to say, *"if only the actor had carried out his usual action"*, has been advocated as evidence of a norm based mechanism responsible for the generation of counterfactual thoughts (Kahneman & Miller, 1986), as outlined in Chapter 1. The results of Experiments 1 to 7 provide little support for this theory as no norm correspondence was found in our experiments; participants did not necessarily mutate antecedents based on whether they were exceptional or normal behaviours. Nor did participants focus only on normal actions when an exceptional action was taken. Instead participants focused on exceptional alternative actions that led to better outcomes.

However, the norm theory provided some insight into the results of the regret measures in Experiment 1. Norm theory suggests that counterfactual thinking amplifies emotions by bringing alternatives to mind (Kahneman & Miller, 1986). Other research suggests that the availability of these alternatives increases the exceptionality of an action (Wells & Gavanski, 1989). This provides some insight as to why regret was amplified in the exceptional-unjustified condition. The results from Experiment 1 support the conclusion that the availability of counterfactual alternatives increased estimates of regret. This indicates that the relationship between emotion and counterfactual thought is derived from the number of alternative possibilities participants imagine could have been in place of the actual action. The results from Experiment 1 indirectly link the number of represented possibilities to the emotion of regret. This explanation also extends to justified and unjustified actions. The presence of counterfactual alternative possibilities allowed participants to contrast the actions taken in order to decide if they were justified.

The Functional Theory of Counterfactual Thinking

The functional theory of counterfactual thinking advocates that they are goal-based cognition (Epstude & Roese, 2008; Roese et al., 2005). The results from the Experiments in Chapters 2, 3 and 4 suggest that the goal of counterfactual thinking was to change the outcome within the experimental scenarios to an alternative that produced a better outcome regardless of whether the events were normal or exceptional. The results lend support to the hypothesis that counterfactual thoughts are mediated by this goal-directed nature. Therefore our results lend support to theories advocating counterfactual thoughts as goal-based cognition (Epstude & Roese, 2008; Roese et al. 2005).

However, functional theories also specify that, not only are counterfactual thoughts goal cognition, but they are also activated by negative affect stemming from unmet goals (Epstude & Roese, 2008; Roese et al. 2005). The outcomes of all but one of our counterfactual thinking experiments informed participants that the goal was unmet, and this is suggestive of a resulting negative affect that focuses participants on alternative antecedents that could hypothetically, produce a positive outcome. Nevertheless, our results pose problems for explanations that focus solely on this aspect of counterfactual thinking. The problem with this approach has already been noted by Epstude & Roese (2008). They claim that "perceived opportunity" to achieve a positive outcome is the "master moderator" that shifts the focus of counterfactual thinking between behaviours suitable for goal attainment. This necessitates an understanding of how people represent and focus on these opportunities when creating counterfactual thoughts. These authors explicitly point out that, "to have counterfactual thoughts about an outcome, one must have a reference point to which the present may be compared" (Epstude & Roese, 2008, p.185). Yet, the lack of explanation within these functional theories about the mental representation of possibilities weakens their ability to account for our results.

One other theoretical conflict our results raise for a functional approach to counterfactual thought is the assumption that negative feedback occurs from goal blockage, and that this negative affect is the activator of counterfactual thought. The results from our experiments are at odds with this explanation. Examining the results of Experiment 1 indicates that regret was amplified by the number of counterfactual alternatives to the actor's action that participants kept in mind, based on the counterfactual thoughts they constructed. The end estimation of regret by participants is therefore a post-hoc result of the number of available counterfactual alternatives. Following this, the comparison process that people engage in can define whether regret or disappointment is felt. Regret focuses on choice, the clause or antecedents preceding an outcome, e.g. *"if he had chosen the small bet..."* (Bell, 1982; Loomes & Sugden, 1982), whereas disappointment focuses on the clauses related to the consequent, which are the possibilities of different outcomes e.g. *"...he would have won"* (Bell, 1985; Loomes & Sugden, 1986). It would be necessary for actual events and alternative possibilities to be represented before one of these emotions is felt. This led to the conclusion that the comparison process seems to produce the emotion rather than the emotion triggering the comparison process. Therefore, we suggest that a functional explanation of how counterfactual thoughts are activated does not provide a clear explanation of our results in Experiment 1.

The results from the card game experiments in Chapters 3 and 4 also showed that counterfactual thoughts were affected by changes in information about how the outcome could have been different. For example in Experiment 3, participants could infer that the large bet could lead to a better possible outcome. We suggested that participants represented these two alternatives (the usual small bet and the exceptional large bet) and this led to the undoing of the exceptionality effect. In this experimental context, it was the information about how the outcome could have been different that lead to the change in counterfactual thoughts.

Functional theories provide an understanding of counterfactual thoughts according to goal cognition. According to Roese et al. (2005), counterfactual thoughts conform to a prevention focus (i.e. avoiding loss) or a promotion focus (i.e. the goal to win). This definition of goals can help explain some counterfactual thoughts created in our experiments. In Experiment 1, participants carried out the goal of creating counterfactual thoughts that prevented the injury to Mr. Jones. However, an ambiguity remains with this definition of goals because it is unclear whether participants were trying to get Mr. Jones home safely by having him take another route or were instead imagining how the accident could have been prevented. This becomes no less clear with some of the experiments using the card game scenarios. In Experiment 2 participants created counterfactual thoughts according to the exceptionality effect, that is, they generated thoughts of the sort, *"if only he had placed his usual small bet"*. As stated in our hypothesis, the lack of winning alternatives reduces the ability of participants to create counterfactual thoughts under promotion goals – placing his usual bet would not enable the actor to win, despite the fact that he would lose less. Therefore it can be suggested that they create counterfactual thoughts through a prevention focus by changing the exceptional action to the normal action. Experiment 3 presents alternatives that allow both a prevention focus and a promotion focus – the player might have won or might have lost if he placed the other exceptional bet - and participants may create counterfactual thoughts from both perspectives. Experiment 4 provides a winning possibility and this focuses participants on the prospect of promotion (i.e. winning). However, the experimental results of Chapter 4 displayed differences between the control and strategy groups. Across the control groups in this chapter a promotion focus was evident as participants focused on antecedents that would provide a winning outcome. In contrast, the strategy groups in Experiments 5 and 6 displayed either a prevention or promotion focus. In Experiments 5 and 6 participants reflected on the actor's poor decision and it could be suggested that their counterfactual

thoughts either sought to prevent future bad decisions or promote better decisions. In Experiment 7 some ambiguity remains because participants reflected on the actual outcome as better than the alternative possibilities, and though suggestive of a promotion focus in bringing about a positive mood, this could be interpreted as a prevention focus of avoiding negative affective consequences.

The goal classification process is ambiguous but it nevertheless requires participants to represent the possibilities before it becomes clear to them whether promotion or prevention goals are possible given the possibilities on offer. It seems counterintuitive that goals are defined before the possibilities are known, and indeed we noted earlier the view expressed by Epstude & Roese (2008) that explicit possibilities are required before goals can be set for counterfactual thoughts. This illustrates the need to understand what possibilities participants initially mentally represent and what possibilities they do not mentally represent.

A reflective-evaluative model of counterfactual thinking

The reflective-evaluative model of comparative thought (Markman and McMullen, 2003; 2005) offers an explanation of how counterfactual thoughts can lead to different affective consequences following decisions depending on what comparisons are drawn between clauses. Using this theory's understanding of how counterfactual thoughts compare possibilities provides insight into the results of the experiments in Chapters 3 and 4. The scenarios of Experiments 2, 3 and 4 in Chapter 3 had the actor chose the medium bet, evaluated as a justified action. The justified action negated an evaluative focus on the decision process therefore the strategy group created counterfactual thoughts that changed the outcome, similar to the control group. The experimental scenarios in Experiments 5 and 6 in Chapter 4 informed participants that the actor chose the large bet. The large bet was evaluated as unjustified by the strategy group and drew their focus to the decision

process when creating counterfactual thoughts. This was not the case with the control group who created counterfactual alternatives that produced a better outcome.

In Experiment 5, we predicted the exceptionality effect; the tendency to say, *"if only the actor had carried out his usual action"* would occur because no betting alternatives were presented that would improve the outcome. This was the result for the control group, who focused on the small bet. However, the strategy group focused on external factors and this led to the two groups differing in their counterfactual thoughts. We explained the effect by suggesting that the control group represented alternative possibilities related to changing the outcome. The perspective of the strategy group, provoked by the question 'what is the best decision for the actor?' included consideration of the decision process. Hence as a more justified alternative action was represented within the strategy group's models of possibilities, they created counterfactual thoughts that undid the poor decision process of the actor, generating *if only* thoughts that focused on external factors such as, *"if only I had thought about it more carefully..."* The participants in the strategy group created counterfactual thoughts that indicated an evaluation of the poor decision process and consideration of the role of the actor in producing the negative outcome. This contrasts with the control group who create counterfactual thoughts that envisage ways to attain the winning outcome.

In Experiment 6 we predicted a reversal of the exceptionality effect as participants focused on an alternative justified exceptional action (the medium bet) because it would lead to a better outcome. The results were according to the predictions for the control group as they reliably focused on this alternative (the medium bet). However, the strategy group did not reliably focus on the medium bet. The perspective of the strategy group, who focus on the decision process as well as the outcome, identifies the presence of justified, better alternative possibilities.

This theory helps also to explain the results from the strategy group in Experiment 7. These participants focused reliably on the alternative exceptional large bet while the control group did not. The alternative large bet would have led to a greater amount of money being lost by the actor, resulting in a worse outcome e.g. *"if he had placed the large bet, he would have lost even more money"*. Therefore, based on the evidence form their constructed counterfactual thoughts, the strategy group imagined a worse outcome in their counterfactual thoughts while the control group focused equally on external factors such as, *"if only the large-bet player had not played"*. With the decision process in mind, the strategy group identified that the small bet resulted in the least amount of money lost (i.e. all other betting alternatives would have lead to a worse outcome). They may view the actor's choice of his usual small bet as a good decision.

A mental model account of counterfactual thinking

Throughout this thesis we have advocated that fundamental principles guided participants in the possibilities they represented when imagining counterfactual alternatives. These principles are encapsulated by the mental model theory and include the principles of truth and the principle of parsimony (Johnson-Laird & Byrne, 2002). The principle of truth maintains that people only represent what is true (Espino et al., In press), while the principle of parsimony maintains that people initially only represent few possibilities (García-Madruga et al., 2007; Mynatt et al., 1993). Throughout the chapters we suggested that understanding how people represented possibilities helped understand the counterfactual thoughts they created.

For example, in Experiment 2 we predicted that the exceptionality effect, the tendency to say, *"if only he had placed his usual small bet"* would be present because no winning possibilities would be represented by participants and the results corroborated this

prediction. We suggested that in this experiment the action and outcome could be represented as follows:

Action:	*Actor places exceptional medium bet*
Outcome:	*Large and Medium bet players play:*
	Large-bet player has better cards than actor

The counterfactual alternative created by changing the actor's exceptional action to be like the usual action is as follows:

Counterfactual Action:	*Actor places usual small bet*
Counterfactual Outcome:	*Large, Medium & Small bet players play:*
	Large-bet player has better cards than actor

The counterfactual alternative created by changing the actor's exceptional action to be like the other exceptional action (placing the large bet) is as follows:

Counterfactual Action:	*Actor places exceptional large bet*
Counterfactual Outcome:	*Large-bet player plays:*
	Large-bet player has better cards than actor

The counterfactual outcome does not differ in either of the two possibilities: the actor loses in both.

In contrast, in Experiment 4 we predicted that the exceptionality effect would be reversed, that is, participants would tend to create thoughts of the sort, *"if only he had placed the other exceptional bet"* because a winning possibility would be represented. The results corroborated this prediction. We suggested that in this experiment the action and outcome could be represented as follows:

Action:	*Actor places exceptional medium bet*
Outcome:	*Large and Medium bet players play:*
	Actor has better cards than Large-bet player
	Medium-bet player has better cards than Actor

The representation is similar to the one illustrating the facts, but with the additional information (which is underlined here for clarity). The counterfactual alternative created by changing the actor's exceptional action to be like the usual action is as follows:

Counterfactual Action:	*Actor places usual small bet*
Counterfactual Outcome:	*Large, Medium & Small bet players play:*
	Actor has better cards than Large-bet player
	Medium-bet player has better cards than Actor

The counterfactual alternative created by changing the actor's exceptional action to be like the other exceptional action (placing the large bet) is as follows:

Counterfactual Action:	*Actor places exceptional large bet*
Counterfactual Outcome:	*Large-bet player plays:*
	Actor has better cards than Large-bet player

The counterfactual alternative in which the actor places the exceptional large bet has a better counterfactual outcome than the one in which he places the usual small bet and so participants focus on it.

The manipulations in each of our Experiments 1 to 7 were designed to make some possibilities explicit so that participants could focus on them and thus construct different counterfactual *if only* thoughts. In Chapter 2, Experiment 1 showed how participants represented possibilities that led to the exceptionality effect being present in their counterfactual thoughts. We then tested our predictions that changing the possibilities people represented would affect their counterfactual thoughts. In Chapter 3, the

exceptionality effect occurred in Experiment 2 and was reversed in Experiment 4, by manipulating the representations as described above. In Experiment 3 we eliminated the exceptionality effect by leading participants to represent two counterfactual alternative possibilities (the small bet and the large bet) as both would lead to similar outcomes. We suggested that no differences between the control and strategy groups were found in Experiments 2, 3 and 4 because the actor carried out a justified action so the mental representations of possibilities were the same for both groups. Both groups considered alternative possibilities that affected the outcome only.

The three experiments in Chapter 4 identified that unjustified actions led to the strategy and control groups representing counterfactual alternatives in different ways. In Experiment 5 we again showed that once no better alternative possibility could be represented participants focused on the usual action (the small bet) and produced the exceptionality effect. We also explained that the strategy group identified from the possibilities they represented that the actor's action was unjustified because there were better, justified counterfactual alternatives (i.e. small and medium bets). Thus they created counterfactual thoughts that undid the decision process of the actor. Experiment 6 showed a reversal of the exceptionality effect following a win outcome once participants represented a better counterfactual outcome (i.e. the medium bet). This was not the case for the strategy group because they represented justified counterfactual alternatives that led them to imagine how the outcome could have been worse. Experiment 7 identified that once participants' representation of possibilities do not include a possibility that leads to a better outcome, they represent new possibilities producing counterfactual better outcomes. However, the strategy group's perspective includes the decision process so they created downward counterfactual thoughts. Their representation of the actual outcome (the small bet) led to its evaluation as better than the counterfactual possibilities (the medium and large bets), resulting in downward counterfactual thoughts.

An explanation of our results through an understanding of the principles of a mental representation of possibilities has several strengths that alternative theories lack. The norm theory's explanation of the mechanism of counterfactual thoughts cannot explain our results and is also implicitly reliant on an understanding of how normal and exceptional actions are represented. The mental model theory has explained our results by relying on its principles of mental representation, in particular, the representation of true possibilities and few possibilities.

The functional account of counterfactual thinking has identified that an understanding of mental representation is a prerequisite to understanding the counterfactual thoughts people create and the goals they operate under. However, these theories have yet to provide such a framework. The mental model theory provides this framework. In addition, our results show that changes in the information provided to the participants about the counterfactual possibilities affected counterfactual thinking. This suggests that how information is represented is an a-priori factor in counterfactual activation.

The reflective-evaluative theory (Markman & McMullen, 2003) helps explain the effects of focusing on the decision process and the outcome brought about by our strategy manipulation. This theory also requires a framework of how possibilities are represented. It does not currently advocate such a framework.

In the next section we consider how Experiments 8 and 9 also corroborate the mental model theory's predictions and rules out alternative explanations.

Theories of reasoning

We consider inference rule theories, both formal rules and content-sensitive rules, and probability theories including the suppositional theory as alternative explanations to the mental model theory's account of our reasoning results.

The mental model theory

Throughout this thesis we suggested that the models of possibilities people kept in mind were formed under the basic principles advocated by the mental model theory (Johnson-Laird, 1983; Johnson-Laird & Byrne, 1991; 2002). This theory proposes that people understand an indicative conditional such as, *if A then B*, by thinking about true possibilities (e.g. A and B, not-A and not-B, not-A and B) and they do not think about false possibilities (e.g. A and not-B). It proposes that people think about few of these possibilities and so their initial representation is a single possibility (e.g. A and B), although they are aware that there may be alternatives to this possibility. We note that possibilities formed under these principles are generated from the facts contained within the scenario and constraints of the context. Our findings support Byrne's (2005) hypothesis that imagination is bound in a similar way to rationality.

Our experimental results from Experiment 8 and 9 lend further weight to the idea that people reason by modelling possibilities and that these possibilities are generated from the meaning of premises and an awareness of the context in which these premises are placed. The results of Experiment 8 and 9 showed that, similar to findings from Thompson and Byrne (2002), participants seemed to make an interpretation of indicative conditionals (e.g. if A then B) based on thinking initially about the true possibility corresponding to their conjecture (e.g. A and B). They made an interpretation of subjunctive-if conditionals (e.g. if A had been then B would have been) by thinking initially about both the true possibility corresponding to the conjecture and also the presupposed facts (e.g. not-A and not-B), at least as indicated by their inferences. However, their interpretation of subjunctive-if only conditionals (e.g. if only A then B) appeared to be based on thinking initially about the presupposed facts (e.g. not-A and not-B). As a clear example of the principle of parsimony as derived from the mental model theory, the need to represent as

much information as required, participants initially neglected to think about the possibility of the truth of the conjecture after reading *if only...*

Inference rule theories

To compare our results to other theories of conditional reasoning, we begin by examining mental logic theories of conditional reasoning (Braine & O'Brien, 1998; Rips, 1994). Mental logic theories propose that people reason by constructing proofs similar to logic proofs, resulting in inherently rational thought. This rationality is based on abstract rules, and through abstract meaning they are removed from content effects because they use a syntactic approach. This focuses on the structure of a problem, in this case the structure of a conditional, for example, the form of conditional *if-then*, if A then B. These rules then code the problem through a language-based mental representation that focuses on the structure of the problem. Misunderstanding the problem leads to a different mental representation of its structure, and this leads to errors. However, even with our conditional results from Chapter 5, the form of the conditional does not change (if-then). Therefore inferences and conclusions from conditionals in different moods should not change. However, inferences, consistency judgment tasks and implication responses show significant differences across conditional moods and between subjunctive-if and subjunctive-if only conditionals. This theory's explanations are therefore not supported by our results.

Other rule theories constructed to understand how people reason are based on domain-specific rules (Cheng & Holyoak, 1985; Cosmides, 1989). These theories were developed in order to deal with content effects in conditionals. These theories advocate that human beings have evolved schemas that are designed for specific situations and are therefore pragmatic. For example, if people are asked to reason from a conditional stating, "*if a person is drinking alcohol, then that person is 18 years old*" they find this much

easier than reasoning from an abstract problem such as, "*if there is a Ace, then there is an King*". Domain-specific theories suggest that human thinking has evolved a pragmatic way of reasoning. A problem is solved depending on how it is understood; therefore context is accounted for, and defined by goal cognition. For example these goals regulate such contexts as causality, permissions, and obligations. Therefore the four inferences types, *modus ponens*, *modus tollens*, *affirmation of the consequent* and *denial of the antecedent* each have a specific rule of their own. Errors arise when people do not apply the correct rule to the problem, and if no rule is found people use a strategy. This theory can be applied to our counterfactual results and could attempt to explain why differences should arise between the strategy and control groups in the card game experiments. Nevertheless, it cannot predict why no differences should arise in the experiments in Chapter 3 and differences do arise in the experiments in Chapter 4 between the groups. In fact the theories are incomplete because they cannot make predictions beyond specific reasoning tasks (Quelhas & Byrne, 2003). Once the complexity of real world scenarios is encountered, rule theories have great difficulty in explaining the specific counterfactual thoughts participants generate from the numerous available possibilities. Even in our conditional inference results of Experiments 8 and 9, they cannot account for the results since these theories do not make predictions as to why a conditional in the subjunctive mood would differ from a conditional in the indicative mood. These theories could propose that negation affects the schema and therefore people would make different inferences based on negation, but we found no differences between affirmative conditionals (e.g. if A then B) and negative conditionals (e.g. if not-A then not-B) in Experiment 9.

Probability theories

Another alternative theory to the mental model theory is the probabilistic theory of reasoning (Oaksford & Chater, 2003, 2007). These theorists suggest that people reason by

making choices that will give them the most information about a situation. This theory proposes that negation in the form of *only* reduces people's estimations that an event is likely, however it makes no prediction about the differences between subjunctive-if and indicative-if conditionals. It also fails to explain why reasoners would consider both the true and false conjunctions as consistent for subjunctive-if conditionals but not for either of the other two conditionals, subjunctive-if only and indicative-if. Therefore this theory is not supported by our results.

A related theory is the suppositional approach of Evans and Over (2004), based on the mental model theory. This theory is a dual process theory asserting two cognitive mechanisms, that of implicit and explicit representation. This theory advocates three principles, 1) the singularity principle 2) the satisficing principle and 3) the relevance principle. The singularity principle suggests people only keep one possibility in mind at a time assessing each possibility sequentially. The satisficing principle suggests that people accept the possibility according to a context dependent goal. This possibility is then examined under higher order cognition, such as memory or general knowledge retrieval, and relevant models are made explicit depending on this three-step process. Finally the relevance principle suggests that a model's relevancy is based on how probable it is within the context, and this principle controls what information is focused on within the scenario. This theory asserts that people employ a subjective probability in order to ascertain if an assertion is valid (e.g. the probability of B given A is equal to *if A then B*). This probability judgment is based on the Ramsey test, people hold the antecedent as true (A), and assess the probability of the consequent occurring (B). This theory also proposes that people do not hold in mind the possibilities in which the antecedent is false but the consequent is true. In other words, people do not represent '*not-A, and B*' possibilities.

This theory seems to explain the results for the indicative and subjunctive-if only conditionals in that participants only represent a single possibility (albeit a different

possibility in each case). However, the data from Experiment 9's implications task and consistency-judgment task show that people think about two possibilities for subjunctive-if conditionals. It cannot explain why the conjunction task in Experiment 9 shows that subjunctive-if conditionals led participants to make consistency judgments about both the *true antecedent-true consequent* and *false antecedent-false consequent* conjunctions if people are keeping only one possibility in mind. Further, the claim in this theory that people never represent *not-A, and B* possibilities is undermined by the finding that the *false antecedent-true consequent* conjunction, especially in the negative valence, shows increases in the subjunctive-if condition. Lastly, the presence of *only* within if-then conditionals does not impede them in any way when making inferences and consistency judgments. This indicates that people are just as capable of making inferences and reaching conclusions from possibilities where the antecedent does not hold.

The need to be able to keep in mind two possibilities is also clearly demonstrated in the counterfactual generation experiments. The results from Experiment 1 indicate that people need to keep more than one possibility in mind to estimate regret. Also our explanations regarding justifications for actions in the experiments require participants to keep in mind more than one possibility as this allows them to recognise the presence of two justified alternatives to the action taken. Neither of these results can be understood if people represent just one possibility. Keeping just one possibility in mind reduces the comparison process to such a simplified state that the complexity necessary for human comparative thinking would be lost (Goodwin & Johnson-Laird, 2005). In the card game experiments in Chapters 3 and 4, it would also make it difficult for people to imagine alternatives to their initial choice if they were required to create a new model for each possibility when informed that their initial possibility failed to produce the desired outcome. For example, in Experiment 3 the presence of two valid alternatives showed participants focused on both alternatives, rather than favouring one. This result is more

suggestive of participants keeping two possibilities in mind rather than one, and that when deciding on a counterfactual thought, they made a choice, like that of a coin toss, between the two possibilities they represented.

In Experiments 5, 6 and 7 we also suggested that the presence of two salient alternative possibilities, the small and medium bet, identifies the large bet as an unjustified action, as in Experiment 1. This explanation can account for the strategy group participants' counterfactual thoughts, which focus on antecedents concerned with the decision process to undo the outcome. Finally, the results from Experiment 7 also indicated that the representation of a full model of possibilities within the card game scenario leads to a focus shift towards external factors while the strategy group create counterfactual thoughts from an evaluation of the small bet as a justified action. None of these results can be easily explained by an application of the suppositional theory due to the numerous steps this theory requires for a conclusion to be reached from a comparison of possibilities. Based on our counterfactual thinking results we believe the mental model theory is better able to explain the processes participants underwent as opposed to the explanations given under the alternative suppositional theory.

A further advantage of the mental model theory in comparison to alternative theories is its similarities to related theories in decision making which enables us to draw further implications from our experimental results not only for counterfactual thinking and conditional reasoning, but also for decision-making and emotion, which we outline in the next section.

Implications for Counterfactual Thinking, Conditional Reasoning, and Decision Making

In this third section we examine the implications of our results for the broader understanding of counterfactual thinking and conditional reasoning, as well as their

implications for decision-making theories such as prospect theory (Kahneman & Tversky, 1979; Tversky, Kahneman, & Shafir, 2004), utility theory (Bell, Edwards, Miles, & von Winterfeldt, 2007; Prelec & Loewenstein, 1991) and decision affect theory (Mellers et al., 1997; Mellers et al., 1999).

Implications for the generation of counterfactual thoughts

Overall, a general implication from this research for the understanding of counterfactual thoughts is that it is important to ascertain the principles of mental representation used in the construction of alternative possibilities. The experimental results provide novel evidence that counterfactual thoughts are goal-directed, undoing the actual outcome in order to bring about a better outcome. Counterfactual thoughts focused on antecedents that could bring about a better outcome, and this goal-directed nature of counterfactual thinking appeared to over-ride other determinants, such as events considered normal or exceptional, and events considered justified or unjustified. This new phenomenon advances our understanding of the determinants of mutability in the creation of counterfactual alternatives. We believe we have shown throughout these experimental contexts that the exceptionality effect, the tendency to say, *"if only the actor had carried out their usual action"*, can be manipulated – that is, it can to be demonstrated, eliminated, or reversed, depending on the possibilities participants are required to represent when imagining how an outcome could be improved.

Implications for conditional reasoning

Only has been recognised as a linguistic cue of negation in other conditionals (Egan, García-Madruga & Byrne, 2009; Evans, 1977). We have carried out the first empirical investigation of inferences, consistency judgments and implication judgments of conditionals using *if only*. We have extended the findings in regard to negation and shown

that the subjunctive-if only form is represented differently from other sorts of conditionals. However, embedded in our results is also support for the proposition that reasoners can think about more than one possibility in mind at the same time and that they do not represent possibilities one at a time (Evans & Over, 2004).

Extensive research has been carried out on the effect of negation on conditionals but this has been limited to indicative-if or only-if conditional forms (Evans, 1977, 1982, 1993). This research has shown that people are more hesitant when making affirmative conclusions if a clause in the conditional is negated (e.g. if A, then not-B) and are more likely to draw a negative conclusion. Johnson-Laird and Byrne (2002) have given a mental model account of this tendency and shown that reasoners have to work out a conclusion from a double negative (e.g. where not-A is false, A is true). This task is also harder however if reasoners are given only an implicit *denial of the antecedent* premise (e.g. C, which is the same as not-A) (Johnson-Laird & Byrne, 2002). Yet negation with conditionals in the form 'only if" does not show this tendency, nor do conditionals in the subjunctive form, as the research in this thesis and previous research has shown (Thompson & Byrne, 2002). We conclude from this evidence that where explicitly represented possibilities in initial models match the premises, the effect of negation is reduced. We suggest that this result supports the mental model theory that at least two possibilities are kept explicitly in mind from the outset for some conditionals. Subjunctive if conditionals are represented by keeping the possibilities *A and B*, and *not-A and not-B* in mind from the outset. Subjunctive-if only conditionals appear to focus reasoners initially on the presupposed facts (not-A and not-B) even to the extent that they may neglect to represent the conjecture (A and B) at the outset.

Implications for decision making

The principles of the mental model theory have strong similarities with principles described in the decision-making literature (Kahneman & Tversky, 1979; Tversky, 1972a, 1972b). These include prospect theory (Kahneman & Tversky, 1979; Tversky et al., 2004), utility theory (Bell et al., 2007; Prelec & Loewenstein, 1991) and decision affect theory (Mellers et al., 1997; Mellers et al., 1999). We suggest that a parsimonious approach to cognitive functioning, a theoretical basis of efficiency and speed, made up of principles and mechanisms that can be applied to a broad range of cognitive tasks should be preferred to one that relies on constrained domain or rule-specific functioning, or one that requires an inefficient use of cognitive capacity such as the suppositional theory.

The materials tests used in Chapters 3 and 4 investigated the possibilities participants represented as the best betting options. These tests also doubled as a manipulation in which to impose a decision-focused perspective for the strategy group and an outcome perspective only for the control group. Across five of the six experiments, we showed that within the context of the experimental scenario employed, participants chose a risk seeking simple gains strategy. This was a robust finding in spite of no controls for individual differences in risk preferences (Bell et al., 2007; Li & Liu, 2008; Slovic, 1995, 2000).

Of the three choices of bet available, the majority of participants preferred the bet that provided the possibility of the greatest potential net gain. We predicted that this experimental context would produce what the decision-making literature has identified as the "peanuts effect" (Prelec & Loewenstein, 1991; Weber & Chapman, 2005). This is defined as a decrease in risk aversion as monetary amounts decrease. Our results are also consistent with the *isolation effect* and *elimination by aspects,* highlighted in decision-making literature as methods used to simplify choices (Kahneman & Tversky, 1979;

Tversky, 1972a, 1972b). These principles are similar to those advocated by the theory of mental models in that participants, depending on the function of their thoughts, focus on some aspects of possibilities while disregarding other aspects. Our suggested models of the possibilities participants used to represent the facts and counterfactual possibilities correspond to these principles also. We believe them to be in accordance with the principles of truth, parsimony, semantic and pragmatic modulation and together offer insight into the natural frugalities of human cognition in counterfactual thinking and decision-making.

The findings from these experiments support the assumption that the decision maker's rationality is bounded (Tversky, 1972a, 1972b) and their preference between choices is open to subjective influence (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981, 1986). On top of this level of subjectivity is the factor of emotional expectancies and goals (Markman & McMullen, 2003; Mellers, 2000; Mellers et al., 1997; Roese et al., 2005).

A further aspect of the decision-making literature for which our results may have potential implications is that of uncertainty. Early decision-making models presumed decision-makers were aware of all the strengths and weaknesses of their prospects. Tversky and Shafir (1992) illustrated that uncertainty makes it difficult for people to fully think about the implications of two alternatives. It is difficult to explicitly keep in mind two options along with the imagined or real consequences that follow from them (Legrenzi & Girotto, 1996; Mynatt et al., 1993). Conclusions may be reached on an initial representation of the decision and the choices preceding it, or a decision can be reached by searching for counterexamples that would suggest against it (Johnson-Laird, 1983; Johnson-Laird & Byrne, 1991; Legrenzi & Girotto, 1996). Further, decisions are easier to reach if there are fewer possibilities to represent, whereas breakdown occurs with too many (Johnson-Laird et al., 1992).

The materials tests for the experiments in Chapters 2, 3 and 4 investigated how participants dealt with 'either-or' options (i.e. the three bets). We found that they initially construct a simple model of their choice. For example, the control groups maintained a simple gains strategy throughout all the experiments indicative of initially neglecting to represent the possibility that the actor might lose. This may have led them to be more risk seeking in their choices. However, we were able to induce more risk-averse behaviour in the strategy group by having them keep in mind other possibilities through a manipulation of prior thinking. In accordance with the previous literature, we suggest that the availability of counterexamples to the initial representation of a simple gains strategy reduced a risk seeking approach.

Overall, the results indicate that dual processes noted as operating in counterfactual research may have implications for decision-making research. Researchers have long argued over why some people show a bounded rationality (Gigerenzer & Goldstein, 1996; Kahneman, 2003). In some cases people perform well in decision-making tasks but in others they perform badly. Our results suggest that in some cases people may only create simplified initial models of explicit possibilities, and these can lead to ill informed decisions. However, given further information or contextual cues, people can 'flesh out' other choices. This process indicates why people can appear to be more rational decision makers under certain circumstances.

Throughout this thesis we discussed the effectiveness of understanding the underlying models people use to represent possibilities in overcoming the problem of choice under uncertainty. We suggest that applying the mental model theory to research in decision making would be advantageous, especially in conjunction with other theories within the counterfactual literature such as Markman & McMullen's (2003) reflection-evaluation model of comparative thinking and functional theories of counterfactual thinking (Epstude & Roese, 2008; Roese et al., 2005). As decision-making involves the

choosing of one option over another or several others, examining the comparative processes individuals undertake and the possibilities they settle on would aid in understanding choice preferences.

For example, early economic examples did not account for the failure of a decision maker to avail of a prospect that would increase utility because of an earlier missed opportunity to avail of an even more attractive prospect (Tykocinski & Pittman, 1998). However, this can be addressed somewhat by mapping the possibilities people might represent, e.g. consider this scenario by examining these models of possibilities:

Missed Opportunity Model:	Factual:	10% discount
	Counterfactual:	50% discount
Simple Opportunity Model:	Factual:	10% discount

Models such as these highlight the perceived loss of 40% rather than the simple utility of a saving of 10%. As simple and basic as this example is, it underscores the qualities offered by such an approach.

Another illustration of the benefits of a mental model approach uses a phenomenon unearthed by Kahneman and Tversky (1979) termed the *reflection effect*. The effect identifies the trend of risk aversion with positive prospects changing to risk seeking with negative prospects. People avoid riskier options with gains and chose the riskier prospect with losses (Tversky et al., 2004). The awareness of the subjective processing involved in decision-making led to *summations* of outcomes based not on final end states but on a contextually relevant estimation of gains and losses measured by a reference point, usually the status quo (Markowitz & Dunlap, 1956; Tversky & Kahneman, 1986). This can be best illustrated through an examination of the models people generate. For instance, imagine a choice between two risky options:

Positive Prospect	Option A:	80% probability of winning €4,000
	Option B:	100% probability of winning €3,000

People might represent the possibilities as follows:

Option A:	*80%*	*€4,000*
	20%	*€0*
Option B:	*€3,000*	

The contrast between the two amounts makes Option B more attractive. The same can be explained for the *reflection effect*, a change from risk aversion to risk seeking:

Negative Prospect	Option Y:	80% probability of losing €4,000
	Option Z:	100% probability of losing €3,000

People can imagine the possibility of losing nothing and make Option Y more attractive:

Option Y:	*80%*	*-€4,000*
	20%	*€0*
Option Z:	*-€3,000*	

Overall theories of decision-making would be well served by understanding the way people represent and contrast possibilities, and this may be best served through the application of the mental model theory. This application can also have implications for theories on framing effects (Tversky & Shafir, 1992) and difficulties with uncertainty and risk, as highlighted already with its application in understanding the disjunction effect (Legrenzi & Girotto, 1996; Mynatt et al., 1993).

Limitations and Future Directions

In this fourth and final section, we consider some of the limitations of our research and we suggest some of the future directions indicated by the results of our experiments, and third, we draw some final conclusions.

Limitations

Our first note is in regard to our methodology. Counterfactual research has focused largely on pen and paper tasks that require participants to make judgments about an imaginary character's *if only* thoughts and in some cases, judgments about their emotions. The assumption that these tasks generalise to real world scenarios has recently become the focus of a number of investigations (Girotto et al, 2007; Pighin et al., 2009). Nevertheless, the use of this methodology throughout the field has shown its ability to record robust and important findings that have greatly added to the field of knowledge. One final aspect of this approach to highlight is the reliance on nonparametric statistical analysis for Experiment 1 to 7. This form of data, based namely on frequencies due to the categorical nature of counterfactual thinking, somewhat reduces the ability to extend claims about the generalisability of findings. Nevertheless, we feel that across the seven experiments that this form of analysis was used in, a clear and consistent picture has developed according to our specific predictions. We suggest this consistent series of results overcomes such methodological weaknesses, importantly contributing towards a greater understanding of counterfactual thinking.

A second potential limitation to our methodology in testing counterfactual thoughts was the repeated use in Experiments 2 to 7 of a single form of scenario, the card game scenario. We constructed this scenario to enable us to obtain objective measures of justified actions. The card game scenario describes a realistic and common situation and it

allows a rigorous and controlled presentation of relevant information. To test our hypotheses about the importance of antecedents that lead to better counterfactual outcomes, compared to exceptional or usual antecedents, and justified or unjustified antecedents, it was necessary to carry out detailed and systematic analysis within a single scenario. We showed that small and careful changes to the wording of this scenario could lead to large and robust changes in the counterfactual *if only* thoughts generated. Although it was beyond the scope of this thesis, it would be useful to generalise to other results. Nevertheless, we were specifically interested in how small changes to this context could greatly affect counterfactual thoughts. We believe that this made it necessary to remain with the same scenario for the experimental series.

A third limitation is illustrated by the results from Experiments 8 and 9, which highlight an issue raised in the previous literature (Byrne & Tasso, 1999; Thompson & Byrne, 2002), that indicative and subjunctive conditionals can bring similar possibilities to mind depending on the individual's interpretation. Reasoning research and the theory of mental models provide explanations about how most people interpret and reason, but it is acknowledged that in most experiments a small minority of participants appear to interpret and reason differently from the majority (e.g. Byrne, 2005). Some steps have been taken towards accommodating such individual differences of interpretation into theories, e.g. the suggestion that some people have a tendency to focus on the facts and others to focus on the conjecture in counterfactual thoughts (Byrne & Tasso, 1999). However, the contribution of these findings shows that the inclusion of *only* in an if-then form of subjunctive conditional reliably primes a counterfactual interpretation within reasoners' representation of possibilities and focuses them on the presupposed facts (not-A and not-B).

Future Directions

Counterfactual thinking can bring to mind possible solutions to a problem by priming a mind-set, which can generalise to unrelated tasks (Galinsky & Moskowitz, 2000). It has been found that exposure to counterfactual primes improved participants' ability to solve the problems and this has been extended to spontaneous counterfactual thoughts (Galinsky, Moskowitz, & Skurnik, 2000). Other research has suggested that counterfactual thinking is especially good at helping people consider relationships and associations among a set of stimuli, and this can generalise across independent tasks to improve performance (Kray, Galinsky, & Wong, 2006). In the card game experiments we had participants in the strategy group think about possibilities and this may have contributed to a greater representation of risky options. Getting people to think about counterfactual possibilities may reduce rigidity to one specific reference point in other decision tasks. For example the quality of decisions may be affected by a phenomenon such as group think, where group members fail to consider alternative viewpoints in order to maintain the status quo of the group's general consensus (Janis & Mann, 1977). Reducing these rigid viewpoints could be achieved by having people create counterfactual simulations of possibilities (Hertwig, Fanselow, & Hoffrage, 2003; Nario & Branscombe, 1995; Sevdalis & Kokkinaki, 2006). Taking into consideration counterfactual alternatives could alter causal attributions and imagined certainties pertaining to experienced outcomes from decisions. Further studies within this area may be beneficial.

A second fruitful avenue of research would be to examine the mental representations of possibilities leading to regret or disappointment, which would be an important application of the mental model theory. Our results suggest that regret might be high in cases where decision processes are focused on within models of possibilities, in which justified alternatives are explicitly represented. In contrast, disappointment might be

high where alternatives to outcomes are explicitly represented. A development of both the mental model theory and the reflective and evaluative model of contrastive thinking could serve to define further the differences in how these emotional consequences are related to counterfactual possibilities.

A final worthwhile future direction would be to examine further the relation of the focus on antecedents that lead to a better outcome in relation to other antecedents, such as controllable or uncontrollable antecedents. For example, the controllability effect could be manipulated by giving participants different information about the actors' level of control over antecedents to an outcome, and at the same time manipulating whether the antecedents lead to a better outcome or not.

Conclusion

Our findings from the experiments support our hypothesis that counterfactual thoughts are founded on the possibilities people explicitly represent and these possibilities are constrained by a number of factors. The counterfactual literature has implicated a number of important constraints, and we have focused on the exceptionality effect, the tendency to think, *"if only the actor had carried out his usual action"* (Kahneman & Tversky, 1982; Kahneman and Miller, 1986). Our experiments show that antecedents are undone in order to fulfil the goal of changing the outcome for the better. We suggest that counterfactual thinking contrasts possibilities of how the outcome could have been different (Markman and McMullen, 2003), and that it is functional in its make-up (Epstude & Roese, 2008; Roese et al., 2005). Once possibilities are represented from the context, counterfactual thoughts are the result of a comparative process that examines these represented possibilities. This analysis then leads to either a change in behaviour or the amelioration of affective consequences, depending on the context, through higher order goal states (Roese et al., 2005). Within this thesis we have focused on the principles and constraints that

define the possibilities that people represent. These possibilities are mediated by the context of the scenario, and from them counterfactual possibilities are created from information made available about how an outcome could have been better (Girotto et al, 2007; Markman & Tetlock, 2000; McMullen & Markman, 2000; Tversky & Kahneman, 1981).

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Appendix 1: Materials used in Materials Tests and Experiment 1 from Chapter 2.

Scenarios used in all three conditions in the Materials Test

Condition 1: Kahneman and Tversky's original Mr. Jones Route Scenario without death.
Mr. Jones is 47 years old, the father of three and a successful banking executive. His wife has been ill at home for several months.
On the day of the accident, Mr. Jones left the office at the regular time. He sometimes left early to take care of home chores at his wife's request but this was not necessary on that day.

Mr. Jones likes to unwind on his way home after his day's work. Mr. Jones did not drive home by his regular route: his regular route was through a plain, built-up urban area although it generally got him home in about a half an hour. Mr. Jones decided he would drive home along the shore: the day was exceptionally clear and there was a wonderful view to enjoy although it would take about an hour to get home.
The accident occurred at a major intersection. The light turned amber as Mr. Jones approached. Witnesses noticed that he braked hard to stop at the crossing, although he could easily have gone through. His family recognised this as a common occurrence in Mr. Jones driving.

As he began to cross after the light had changed, a truck charged into the intersection at top speed, and rammed Mr. Jones' car from the left. **Mr. Jones was seriously hurt, badly injuring his leg in the accident.** It was later ascertained that the truck was driven by a teenage boy, who was under the influence of drugs.

As commonly happens in such situations, Mr. Jones often thought and often said *if only* in the days that followed the accident. How did he continue this thought? Please write one or more likely completions.

Condition 2: Mr. Jones Route Scenario with added route information
Mr. Jones is 47 years old, the father of three and a successful banking executive. His wife has been ill at home for several months.
On the day of the accident, Mr. Jones left the office at the regular time. He sometimes left early to take care of home chores at his wife's request but this was not necessary on that day.

Mr. Jones did not drive home by his regular route: **his regular route was through a plain, built-up urban area although it generally got him home in about a half an hour.** Mr. Jones decided he would drive home along the shore: **the day was exceptionally clear and there was a wonderful view to enjoy although it would take about an hour to get home.**

The accident occurred at a major intersection. The light turned amber as Mr. Jones approached. Witnesses noticed that he braked hard to stop at the crossing, although he could easily have gone through. His family recognised this as a common occurrence in Mr. Jones driving.
As he began to cross after the light had changed, a truck charged into the intersection at top speed, and rammed Mr. Jones' car from the left. Mr. Jones was seriously hurt, badly injuring his leg in the accident. It was later ascertained that the truck was driven by a teenage boy, who was under the influence of drugs.

As commonly happens in such situations, Mr. Jones often thought and often said *if only* in the days that followed the accident. How did he continue this thought? Please write one or more likely completions.

Condition 3: Mr. Jones Route Scenario with added route information and added goal
Mr. Jones is 47 years old, the father of three and a successful banking executive. His wife has been ill at home for several months.

On the day of the accident, Mr. Jones left the office at the regular time. He sometimes left early to take care of home chores at his wife's request but this was not necessary on that day.

Mr. Jones likes to unwind on his way home after his day's work. Mr. Jones did not drive home by his regular route: his regular route was through a plain, built-up urban area although it generally got him home in about a half an hour. Mr. Jones decided he would drive home along the shore: the day was exceptionally clear and there was a wonderful view to enjoy although it would take about an hour to get home.

The accident occurred at a major intersection. The light turned amber as Mr. Jones approached. Witnesses noticed that he braked hard to stop at the crossing, although he could easily have gone through. His family recognised this as a common occurrence in Mr. Jones driving.

As he began to cross after the light had changed, a truck charged into the intersection at top speed, and rammed Mr. Jones' car from the left. Mr. Jones was seriously hurt, badly injuring his leg in the accident. It was later ascertained that the truck was driven by a teenage boy, who was under the influence of drugs.

As commonly happens in such situations, Mr. Jones often thought and often said *if only*
in the days that followed the accident. How did he continue this thought?
Please write one or more likely completions.

Scenarios used in all three conditions in Experiment 1 with differences in bold

Condition 1: Usual Route Scenario
Mr. Jones is 47 years old, the father of three and a successful banking executive. His wife has been ill at home for several months.

On the day of the accident, Mr. Jones left the office at the regular time. He sometimes left early to take care of home chores at his wife's request but this was not necessary on that day.

Mr. Jones likes to unwind on his way home after his day's work. **Mr. Jones drove home by his regular route**: his regular route was through a plain, built-up urban area although it generally got him home in about a half an hour. Mr. Jones thought about driving home along the shore: the day was exceptionally clear and there was a wonderful view to enjoy although it would take about three-quarters of an hour to get home. Mr. Jones also thought about driving home via the picturesque villages on the outskirts of the town: the views were interesting although it would take about an hour to get home. **After some thought he decided to drive home by his regular route.**

The accident occurred at a major intersection. The light turned amber as Mr. Jones approached. As he began to cross after the light had changed, a truck charged into the intersection at top speed, and rammed Mr. Jones' car from the left. Mr. Jones was seriously hurt, badly injuring his leg in the accident.
It was later ascertained that the truck was driven by a teenage boy, who was under the influence of drugs.

Condition 2: Shore Route Scenario

Mr. Jones is 47 years old, the father of three and a successful banking executive. His wife has been ill at home for several months.

On the day of the accident, Mr. Jones left the office at the regular time. He sometimes left early to take care of home chores at his wife's request but this was not necessary on that day.

Mr. Jones likes to unwind on his way home after his day's work. **Mr. Jones did not drive home by his regular route**: his regular route was through a plain, built-up urban area although it generally got him home in about a half an hour. **Mr. Jones decided he would drive home along the shore**: the day was exceptionally clear and there was a wonderful view to enjoy although it would take about three-quarters of an hour to get home. Mr. Jones also thought about driving home via the picturesque villages on the outskirts of the town: the views were interesting although it would take about an hour to get home. **After some thought he decided to drive home by the shore route.**

The accident occurred at a major intersection. The light turned amber as Mr. Jones approached. As he began to cross after the light had changed, a truck charged into the intersection at top speed, and rammed Mr. Jones' car from the left. Mr. Jones was seriously hurt, badly injuring his leg in the accident.

It was later ascertained that the truck was driven by a teenage boy, who was under the influence of drugs.

Condition 3: Villages Route Scenario

Mr. Jones is 47 years old, the father of three and a successful banking executive. His wife has been ill at home for several months.

On the day of the accident, Mr. Jones left the office at the regular time. He sometimes left early to take care of home chores at his wife's request but this was not necessary on that day.

Mr. Jones likes to unwind on his way home after his day's work. **Mr. Jones did not drive home by his regular route**: his regular route was through a plain, built-up urban area although it generally got him home in about a half an hour. Mr. Jones thought about driving home along the shore: the day was exceptionally clear and there was a wonderful view to enjoy although it would take about three-quarters of an hour to get home. **Mr. Jones decided he would drive home via the picturesque villages on the outskirts of the town**: the views were interesting although it would take an hour to get home. **After some thought he decided to drive home by the village route.**

The accident occurred at a major intersection. The light turned amber as Mr. Jones approached. As he began to cross after the light had changed, a truck charged into the intersection at top speed, and rammed Mr. Jones' car from the left. Mr. Jones was seriously hurt, badly injuring his leg in the accident.

It was later ascertained that the truck was driven by a teenage boy, who was under the influence of drugs.

Appendix 2: Tables and Materials used in Experiments 2, 3 and 4 from Chapter 3

Materials used in the three experiments.

Consent Form (page 1)
I hereby give my consent to take part in a Thinking Experiment carried out by postgraduate student James Dixon, with the supervision of Prof. Ruth Byrne.

I understand I may withdraw my participation at any time. I understand that the data obtained through my participation is confidential and anonymous. It will be used only for the purposes of research. Under the Freedom of Information Act I may request access to any data stored under my name; however I understand that in this study the data are stored anonymously.

I will be informed of the general nature of the study before participating, and an explanation of the aims of the study will be provided after I have completed my participation, at which time any further questions will be answered.

I understand that I will not be requested to participate in any study that is detrimental to a person's well-being or circumstances. The study has received prior approval from the School of Psychology's Ethics Committee.

Instructions (page 2)
Thank you for agreeing to participate in this study. The booklet contains one story about an individual playing a card game. The story and associated tasks are about how people think in their daily lives and are not tests of intelligence. The story is followed by questions. Please read the story carefully and answer the questions according to the instructions presented with the questions. Please do not try to change your answers once you have written them.

On the final page of this booklet I have outlined the aim of the experiment. Please do not read it until you have completed all of the questions. Thank you again for agreeing to participate in this study.

Before you turn over this page, please record your age and gender below.

Age: _____
Gender: _____

Peter's Dilemma (The scenario: page 3)
Peter is faced with a dilemma when playing a game of cards. The cards given to him give him a great chance of winning the game, and with that, a great chance of winning money. Peter alone knows the values of the cards he holds. However, Peter can only win money if the other players in the game decide to play with Peter by matching the bet he makes. If none of the other players decide to play with Peter by betting, all the players will surrender their cards and receive new cards. Peter knows new cards will probably not give him such a great chance of winning.

Peter has good cards. Peter usually places a small bet. However, there are actually three choices available to Peter. Peter can bet small, medium, or large. These three values are related to how much money Peter is willing to bet in the game.

Peter is playing with three other players who each use three separate and distinct techniques for playing the game. These techniques have earned them the names of The Mouse, The Lion, and The Jackal. The Mouse only plays small bets, the Lion plays small and medium bets, and the Jackal plays small, medium and large bets. Each of the players' individual techniques means that they will each respond differently to Peter's betting actions.

Peter's cards are very good. However, how much Peter bets has consequences. Betting small, medium or large will affect the reactions of the three opposition players in different manners, as follows:

(Page 4)

1. If Peter bets small, his bet will be €10. This will result in probably all three opposition players matching his bet.
   (Peter's €10 matched by Mouse's €10 + Lion's €10 + Jackal's €10)

2. If Peter bets medium, his bet will be €20. This will result in probably only the Lion and the Jackal matching his bet.
   (Peter's €20 matched by Lion's €20 + Jackal's €20)

3. If Peter bets large, his bet will be €30. This will result in probably only the Jackal matching his bet.
   (Peter's €30 matched by + Jackal's €30)

(Question 1: Strategy Group only) Explain what you think is the best decision for Peter.

_____

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_____

(Page 4 for Control group, page 5 for Strategy group)
(Question 2: Both groups) What size of a bet do you think Peter places?

1: Small ☐ 2: Medium ☐ 3: Large ☐

Scenarios Used in Chapter 3: The decisions and outcomes used in the Experiments

Experiment 2: Medium bet (large bet would not win)
Decision described as follows:
Peter thought about his choices carefully. He considered betting small, a bet of €10, as he usually does. He then considered a large bet of €30. Then Peter considered the medium bet, he decided to go with the medium bet of €20.
Peter's medium bet meant that the Mouse decided not to play with him, so the Mouse did not place a bet. The Lion and the Jackal decided to play with Peter by matching Peter's bet of €20.
Outcome described as follows:
The Jackal had better cards than Peter and the Lion, so the Jackal wins the game and receives €60 (The Jackal €20 + the Lion's €20 + Peter's €20 = €60).

Experiment 3: Medium bet (large bet could *win)*
Decision described as above. Outcome described as follows:
The Lion had better cards than Peter and the Jackal, so the Lion wins the game and receives €60 (The Jackal's €20 + Peter's €20 + the Lion's €20 = €60).

Experiment 4: Medium bet (large bet would *win)*
Decision described as above. Outcome described as follows:
Peter had better cards than the Jackal, but the Lion had better cards than Peter and the Jackal, so Peter and the Jackal lose the game along with their bets of €20 (The Jackal's €20 + Peter's €20 + Lion's €20 = So Lion wins €60).

Appendix 3

Appendix 3.1: Materials used in Experiments 5, 6 and 7 from Chapter 4

Consent Form (page 1)
I hereby give my consent to take part in a Thinking Experiment carried out by postgraduate student James Dixon, with the supervision of Prof. Ruth Byrne.

I understand I may withdraw my participation at any time. I understand that the data obtained through my participation is confidential and anonymous. It will be used only for the purposes of research. Under the Freedom of Information Act I may request access to any data stored under my name; however I understand that in this study the data are stored anonymously.

I will be informed of the general nature of the study before participating, and an explanation of the aims of the study will be provided after I have completed my participation, at which time any further questions will be answered.

I understand that I will not be requested to participate in any study that is detrimental to a person's well-being or circumstances. The study has received prior approval from the School of Psychology's Ethics Committee.

Instructions (page 2)
Thank you for agreeing to participate in this study. The booklet contains one story about an individual playing a card game. The story and associated tasks are about how people think in their daily lives and are not tests of intelligence. The story is followed by questions. Please read the story carefully and answer the questions according to the instructions presented with the questions. Please do not try to change your answers once you have written them.

On the final page of this booklet I have outlined the aim of the experiment. Please do not read it until you have completed all of the questions. Thank you again for agreeing to participate in this study.

Before you turn over this page, please record your age and gender below.

Age: _____
Gender: _____

Peter's Dilemma (The scenario: page 3)
Peter is faced with a dilemma when playing a game of cards. The cards given to him give him a great chance of winning the game, and with that, a great chance of winning money. Peter alone knows the values of the cards he holds. However, Peter can only win money if the other players in the game decide to play with Peter by matching the bet he makes. If none of the other players decide to play with Peter by betting, all the players will surrender their cards and receive new cards. Peter knows new cards will probably not give him such a great chance of winning.

Peter has good cards. Peter usually places a small bet. However, there are actually three choices available to Peter. Peter can bet small, medium, or large. These three values are related to how much money Peter is willing to bet in the game.

Peter is playing with three other players who each use three separate and distinct techniques for playing the game. These techniques have earned them the names of The Mouse, The Lion, and The Jackal. The Mouse only plays small bets, the Lion plays small and medium bets, and the Jackal plays small, medium and large bets. Each of the players' individual techniques means that they will each respond differently to Peter's betting actions.

Peter's cards are very good. However, how much Peter bets has consequences. Betting small, medium or large will affect the reactions of the three opposition players in different manners, as follows:

(Page 4)

4. If Peter bets small, his bet will be €10. This will result in probably all three opposition players matching his bet.
   (Peter's €10 matched by Mouse's €10 + Lion's €10 + Jackal's €10)

   If Peter bets medium, his bet will be €20. This will result in probably only the Lion and the Jackal matching his bet.
   (Peter's €20 matched by Lion's €20 + Jackal's €20)

5. If Peter bets large, his bet will be €30. This will result in probably only the Jackal matching his bet.
   (Peter's €30 matched by + Jackal's €30)

(Question 1: Strategy Group only) Explain what you think is the best decision for Peter.

_____

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_____

_____

(Page 4 for Control group, page 5 for Strategy group)
(Question 2: Both groups) What size of a bet do you think Peter places?

1: Small	2: Medium	3: Large
☐	☐	☐

(Page 5 for Control group, page 6 for Strategy group)

Decisions and outcomes described as follows;

Experiment 5: Large Loss Outcome
Decision described as follows;
Peter thought about his choices carefully. He considered betting small, a bet of €10, as he usually does. He then considered a medium bet of €20. Then Peter considered the large bet, he decided to go with the large bet of €30.
Outcome described as follows;
Peter's large bet meant that The Mouse and The Lion decided not to play with him, so neither The Mouse nor the Lion placed a bet. So the Jackal decided to play with Peter by matching Peter's bet of €30.
The Jackal had better cards than Peter, so the Jackal wins the game and receives €60 (The Jackal's €30 + Peter's €30 = €60).

Experiment 6: Large Win Outcome
Decision described as follows;
Peter thought about his choices carefully. He considered betting small, a bet of €10, as he usually does. He then considered a medium bet of €20. Then Peter considered the large bet, and he decided this time to go with the large bet of €30.
Outcome described as follows;
Peter's large bet meant that The Mouse and The Lion decided not to play with him, so neither The Mouse nor the Lion placed a bet. Only the Jackal decided to play with Peter by matching Peter's bet of €30.
As it turned out, Peter had better cards than the Jackal so Peter won the game and received €60 (The Jackal's €30 + Peter's €30 = €60).

Experiment 7: Small Loss Outcome
Decision described as follows;
Peter thought about his choices carefully. He considered betting medium, a bet of €20. He then considered a large bet of €30. Then Peter considered betting small, as he usually does. He decided to go with the small bet of €10.
Outcome described as follows;
Peter's small bet meant that The Mouse and The Lion and the Jackal decided to play with Peter by matching Peter's bet of €10.
The Jackal had better cards than Peter and the Lion and the Mouse. So the Jackal wins the game and receives €40 (The Mouse's €10 + The Lion's €10 + The Jackal's €10 + Peter's €10).

(Question 3: Both groups)
Peter thinks to himself after the game, "Things could have been different if…"
Please complete Peter's sentence in the space provided.

_____

_____

_____

_____

Information sheet (last page)
Thank you for your participation. This study aims to examine the way people think about how outcomes could have turned out differently and how these thoughts help people to

prepare for future events. One group of participants were given a story and asked to pick the best decision for Peter who was playing a game of cards and another group were given a story without being asked to pick the best decision for Peter. This study aims to see if thoughts about what might have been are affected by judgements about future behaviours. Thank you for your participation. If you have any further questions please ask the experimenter.

Appendix 3.2: Table of Possible Strategies

The potential gains and losses for three bets, small, medium and large in the card game scenario used in the Experiments, and the means to establish the large bet as unjustified and the medium bet as justified.

	Usual	Exceptional	
	Small	Medium	Large
1. Bet (potential loss)	10	20	30
2. No. players match bet	3	2	1
3. Bets placed by others	10+10+10	20+20	30
4. Win (potential gain)	30	40	30
5. Win plus bet	40	60	60
Best bet?			
6. risk averse	*		
7. risk seeking		*	
8. risk amalgamation		*	*
9. risk modulation	*		

Appendix 4: Materials used in Experiments 9 and 10 from Chapter 5.

Appendix 4.1: Conditional Statements in the Indicative Mood

Positive

1. If Dave went to Caherciveen, then Linda went to Ballymena.
2. If Mark went to Knock, then Susan went to Gort.
3. If Ellen went to Lucan, then Tom went to Kildare.
4. If Mike went to Fermoy, then Barbara went to Arklow.
5. If Helen went to Wicklow, then Steve went to Kanturk.
6. If Sarah went to Newtownards, then Rik went to Balbriggan.
7. If Jim went to Omagh, then Rachel went to Shankill.
8. If Bob went to Swords, then Dawn went to Nass.
9. If Kim went to Athlone, then Ted went to Rosslare.
10. If Kathy went to Bray, then Ross went to Tuam.
11. If Doug went to Tralee, then Kristen went to Spiddal.
12. If Wendy went to Kells, then Curtis went to Youghal.

Negative

1. If Dave did not go to Caherciveen, then Linda did not go to Ballymena.
2. If Mark did not go to Knock, then Susan did not go to Gort.
3. If Ellen did not go to Lucan, then Tom did not go to Kildare.
4. If Mike did not go to Fermoy, then Barbara did not go to Arklow.
5. If Helen did not go to Wicklow, then Steve did not go to Kanturk.
6. If Sarah did not go to Newtownards, then Rik did not go to. Balbriggan.
7. If Jim did not go to Omagh, then Rachel did not go to Shankill.
8. If Bob did not go to Swords, then Dawn did not go to Nass.
9. If Kim did not go to Athlone, then Ted did not go to Rosslare.
10. If Kathy did not go to Bray, then Ross did not go to Tuam.
11. If Doug did not go to Tralee, then Kristen did not go to Spiddal.
12. If Wendy did not go to Kells, then Curtis did not go to Youghal.

Conditional Statement in the Subjunctive Mood

If Dave had gone to Caherciveen, then Linda would have gone to Ballymena.

Appendix 4.2: Conditional Arguments Task used in Experiments 9 & 10.

Inferences scored as accepted when a reasoner chose the option marked with an asterix.

Mary says that: If Sarah went to Newtownards, then Rik went to Balbriggan.

(a) John says that: I know that Sarah went to Newtownards. (MP)

What, if anything, can they infer about Rik's whereabouts?

(a) Rik went to Balbriggan.*
(b) Rik may or may not have gone to Balbriggan.
(c) Rik did not go to Balbriggan.

Appendix 4.3: Consistency Task used in Experiment 9

John says that: If Dave went to Caherciveen, then Linda went to Ballymena.

Which combination of events would be consistent with John's statement? Which would be inconsistent?

Dave went to Cahirciveen and Linda went to Ballymena. (TA-TC)
Dave did not go to Cahirciveen and Linda went to Ballymena. (TA-TC)
Dave went to Cahirciveen and Linda did not go to Ballymena. (TA-TC)
Dave did not go to Cahirciveen and Linda did not go to Ballymena. (TA-TC)

Appendix 4.4: Implications Task used in Experiment 9

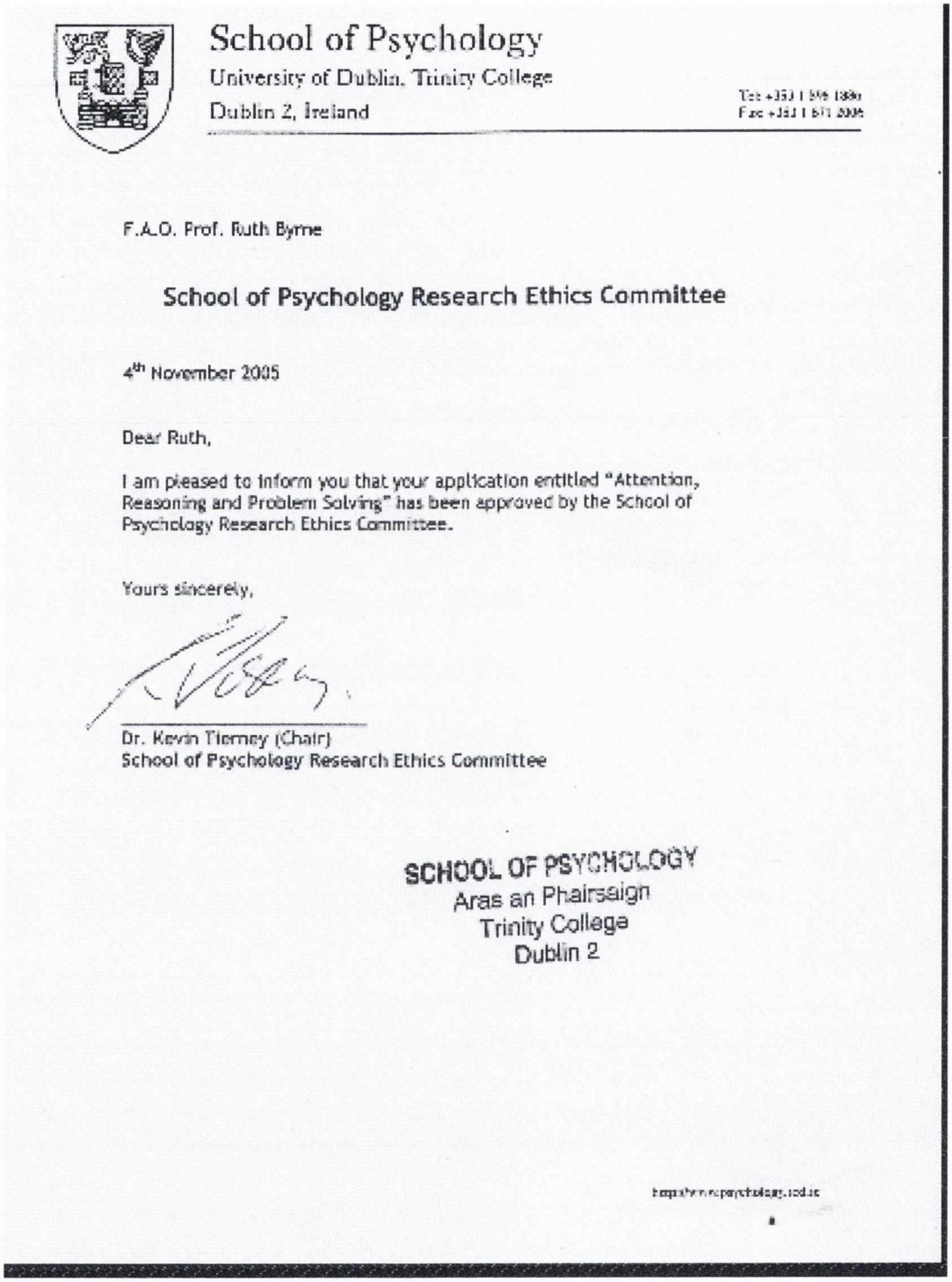
Mary says that: If Ellen went to Lucan, then Tom went to Kildare.

What, if anything, do you think that Mary meant to imply? Choose as many of them as you think appropriate:

(a) That Ellen went to Lucan. (TA)
(b) That Ellen did not go to Lucan. (FA)
(c) That Tom went to Kildare. (TC)
(d) That Tom did not go to Kildare. (FC)
(e) Nothing was implied.

Appendix 5

Ethics



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F.A.O. Prof. Ruth Byrne

School of Psychology Research Ethics Committee

4th November 2005

Dear Ruth,

I am pleased to inform you that your application entitled "Attention, Reasoning and Problem Solving" has been approved by the School of Psychology Research Ethics Committee.

Yours sincerely,

Dr. Kevin Tierney (Chair)
School of Psychology Research Ethics Committee

SCHOOL OF PSYCHOLOGY
Aras an Phairsaigh
Trinity College
Dublin 2

http://www.psychology.tcd.ie

Appendix 6

List of Publications

Dixon, J. E., & Byrne, R. M. J. (2009). If only counterfactuals and the exceptionality effect. In N.A. Taatgen & H. van Rijn (Eds.), *Proceedings of the 31th Annual Conference of the Cognitive Science Society* (pp.2860-2865). Austin, TX: Cognitive Science Society.

Dixon, J. E., Guttentag, R., & Byrne, R. M. J. (2009). Counterfactual 'if only' conditionals [Abstract]. In N.A. Taatgen & H. van Rijn (Eds.), *Proceedings of the 31th Annual Conference of the Cognitive Science Society* (p. 327). Austin, TX: Cognitive Science Society.