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**Uncertainties in Counterfactuals:
The Determinants and Emotional Consequences of
Counterfactual Probability Judgments**

Qiyuan Zhang

Thesis submitted for the degree of Doctor of Philosophy

Durham University, Department of Psychology

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Declaration

I declare that the work presented in his thesis is my own and has been generated by me as the result of my own original research. None of the data or material presented in the thesis has been submitted previously or simultaneously for consideration for a degree in this or any other university.

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Signed.....

Date.....

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Abstract

Counterfactual representations refer to people's imaginations about the alternative possibilities to the actual world (i.e., what might have been). The present thesis embraces the notion that the psychological impacts of those representations are dictated by the degree of certainty or uncertainty people assign to them, namely, their *counterfactual probability judgments* (i.e., "How likely could things have been different?"). The thesis reports six experiments investigating the determinants as well as the emotional consequences of counterfactual probability judgments. Experiments 1, 2 and 3 found that both people's conditional and unconditional counterfactual probability judgments were heightened when a past outcome was physically or numerically proximate to its alternative. Experiments 4 and 5 found that people's counterfactual probability judgments were not only affected by the static proximity cue but also by its dynamic variations. When outcome proximity was equal, the shrinking physical distance towards a counterfactual outcome heightened one's subjective likelihood of that outcome, compared to if the distance stayed constant. Experiment 6 found that the effect of "shrinking distance" could manifest itself as an antecedent temporal order effect on people's counterfactual probability judgments. That is, a counterfactual outcome was deemed more likely if the factual outcome was preceded by a decisive event that occurred latter in the causal sequence rather than earlier. These results are broadly consistent with the theory of the *simulation heuristic* which posits that subjective probabilities are estimated by assessing the ease with which a relevant scenario can be mentally constructed.

The emotional consequences of counterfactual probability judgments were investigated within the theoretical framework of the Reflective and Evaluative Model of Comparative Thinking (REM). The evidence from Experiments 2, 3, 4 and 5 suggests that the effect of counterfactual probability judgments on emotions are contingent on people's temporal perspective – *affective assimilation* will be enhanced when future possibility is present (i.e., the outcome is indecisive or changeable) which encourages a *reflective* simulation while *affective contrast* will be enhanced when future possibility is absent (i.e., the outcome is decisive or unchangeable) which encourages an *evaluative* simulation. These findings suggest that the psychological impact of counterfactual thinking should be discussed in terms of a three-way interaction between its direction (upward or downward), probability (low or high), and simulation mode (reflection or evaluation).

Chapter 1 Introduction

1.1 The Role of Reference Points in Judgments of Affect

Our life consists of a stream of events. While some events are emotionally enhancing (e.g., getting admitted into a desirable university), others are aversive (e.g., losing loved ones). While some events are extreme and impactful (e.g., winning a lottery), others are mundane (e.g., having a cup of tea). The present thesis is aiming to give an insight into how people's emotional experiences towards past events are shaped. The discussion will revolve around the critical role of counterfactual reference points, especially the degree to which people believe that a past event or outcome could have turned out differently. To set the stage for the discussion, this chapter will begin with a brief review of the literature regarding a wide range of psychological reference points that people may use to reach affect judgments, before it narrows down the scope of discussion and focuses exclusively on counterfactual imaginations.

It seems convenient to assume that one's subjective experiences following an event should be an honest representation of its absolute valence and intensity. If this is true, winning £1 should always be more cheerful than losing £1 and getting a B in a math test should always be more pleasant than getting a C. However, recent research indicated that such a prediction has oversimplified real-life situations. Smiths and Kirby (2009), for example, made an important observation that "different individuals will often react to seemingly identical circumstances with very different emotions, and that the same individual will often react to very similar circumstances very differently at different times"(p. 1352).

This observation is consistent with the appraisal theory of emotions (Lazarus, 1991) which posits that one's emotional reactions to an event largely depend on the way that the event is appraised or evaluated. Contextual factors or individual factors that influence the results of the appraisal will influence the subsequent emotional experiences. A common characteristic of almost all the appraisal or evaluation processes is their susceptibility to comparison anchors or reference points. For example, according to adaptation level theory, one's past experiences with a perceptual stimulation form a psychological comparison anchor called adaptation level (or *AL*). The valence and the intensity of a subsequent similar stimulation will be judged on the basis whether it falls above or below the *AL* and by how much (Helson, 1947, 1964). The idea that the current sensory experience is relative to past experiences received support from a study by Sherif, Taub, and Hovland (1958), which demonstrated that, in a weight-lifting task, the same weight tended to be judged lighter if the judge had lifted a weight that was heavier than the weight being judged prior to the judgment, compared to if such an intervention was absent.

The adaptation level theory was applied by Brickman and Campell (1971) to research on happiness. They postulated that people's emotional reactions to good or bad events should follow the same principle as sensory experiences – the favourability of an event is judged on the basis of its discrepancy to past experiences. Based on this notion, they described what was called the *hedonic treadmill* – the tendency of one's affective well-being to regress to its neutral status after emotional events. For example, Brickman, Coates, and Janoffbulman (1978) found that former lottery winners did not rate their current happiness significantly higher than the general population. In addition, they also found that a set of everyday mundane activities were rated less pleasurable by the former lottery winners than the general

population. For a lottery winner, the experience of winning might raise the adaptation level of pleasure, which makes the subsequent positive stimulations look mundane and tasteless and negative stimulations more repulsive.

A reference point that is drawn to evaluate a past event or current state of affairs could also be a cognitive construct such as a desire/goal, belief, expectation or moral norm. Lazarus (1991), for example, identified goal congruence (or incongruence) as one of the primary appraisal components for emotions. That is, an event should be evaluated in relation to one's predetermined desire (what he/she wants) – "It either thwarts or facilitates personal goals" and "Goal congruence leads to positive emotions; goal incongruence to negative ones" (Lazarus, 1991, p. 150). For example, a high school student who has set a goal of being admitted into a prominent university and hence needs an A in a maths test to boost his/her average grade might be more upset with getting a B than a student who can get by with a C.

Another related but distinctive psychological construct is one's expectancy, which has been defined as "beliefs about a future state of affairs" (Olson, Roese, & Zanna, 1996, p. 211). Compared to aspirations, desires and goals, which concern what people need or wish for, expectations are relatively more realistic and rational (Festinger, 1942; Irwin, 1944; Irwin & Mintzer, 1942). For example, someone might want to get an A in a maths test but consider him/herself only likely to get a B. Expectations are specific predictions about the future and must be derived from one's prior beliefs or knowledge (Olson et al., 1996). A person who gets a B in a maths test and puts more effort in the subject since the test may expect to get a better mark next time. Such a prediction stems from the belief in the causal connection between "effort" and "academic performance". Expectancies have impacts on a wide

range of cognitive activities. Miller and Ross (1975) suggested that people are more likely to attribute an expected outcome internally (e.g., to one's own effort) but are more likely to attribute an unexpected event externally (e.g., to luck). Evidence also shows that an event will be more memorable and better recalled when it is inconsistent with prior expectations than when it is consistent (see Stangor & McMillan, 1992, for a review).

Expectancies also play important roles in people's attitudes towards past occurrences or status. Generally speaking, confirmations of subjective expectancies reinforce the notion that one's world is predictable and within one's control and thus induce positive emotions like satisfaction (Mandler, 1975). The consequences of disconfirmations or violations of subjective expectancies might, however, depend on the direction of the disconfirmation. According to Expectation Disconfirmation Theory (Oliver, 1977, 1980), a sense of satisfaction is derived from positive disconfirmation of an expectation (e.g., when the quality or the performance of a consumer product exceeds what is expected) while a sense of dissatisfaction is derived from negative disconfirmation of an expectation (e.g., when the quality or the performance of a consumer product falls short of what is expected). On the other hand, a disconfirmed expectancy is an indicator that one's environment is not fully understood and thus could induce feelings of insecurity or fear (Olson et al., 1996).

A comparison anchor can also be drawn on an inter-individual basis. The social comparison theory (Festinger, 1954) posits that people evaluate the validity or the appropriateness of their attitudes, beliefs or abilities by making peer comparisons. Comparing oneself with an individual who is superior in abilities or better off may give rise to a sense of deprivation or lowered self-esteem (Morse &

Gergen, 1970). On the other hand, comparing oneself with an individual who is inferior in abilities or worse off may give rise to complacency or increased self-esteem (Wills, 1981; Wood, Taylor, & Lichtman, 1985).

In summary, people's emotional reactions towards a past event or the current state of affairs are often shaped in relation to reference points or comparison standards such as desires, expectancies and other individuals. The present thesis, however, casts interest on another kind of reference point which has been drawing increasing attention by psychologists. Consider a student who got a B in his/her maths test but later found out that if he/she had got one more question correct, he/she would have got an A instead. Now consider an alternative scenario in which the student still got a B but later found out that if he/she had got one more question incorrect, he/she would have got a C instead. In the two cases, the objective status of the student would have been equal and he/she would have born equal prior expectations regarding the result of the test. However, we might ask ourselves: Would the student feel differently in the two scenarios? If yes, why so? To answer these questions, the concept of the counterfactual reference point will be introduced. The rest of this thesis will focus on this particular comparison anchor.

1.2 The Counterfactual Reference Point

1.2.1 Counterfactual Thinking – A Brief Introduction

An interesting phenomenon that has recently come to the attention of psychological researchers is that people are not only affected by what did happen but also by what did not happen. Miller, Turnbull, and McFarland (1990) sketched a scenario where a person A switched to a different flight only in the last minute before it took off and was killed as the plane crashed. The authors speculated that the

fate of this person would be considered somehow more tragic compared to another passenger B on the same flight who had booked his/her ticket some time ago, despite the fact that the final outcome is the same for the two individuals. It was argued that the different reactions to the stories of the two individuals could not be attributed to any pre-existing psychological comparison anchor like expectations because there is no reason to believe that passenger A who switched the flight in the last minute should have had a different probability judgment of an air accident from passenger B. To understand why people might act more strongly to the story of passenger A, a good starting point might be to explore the subject of counterfactual thinking.

Counterfactual thinking, as its name suggests, refers to imaginations about alternatives to reality, namely, what could or might have been (Kahneman & Miller, 1986; Roese & Olson, 1995). Perhaps what makes the story of passenger A, who switched to the doomed flight especially tragic is the compelling thought that “He/she would have survived if he/she had not changed the flight”. In this typical case of counterfactual thinking, both the real outcome (i.e., “being killed in a plane crash”) and one of its antecedents (i.e., “changing his/her flight”) are mutated to a counterfactual state (i.e., “surviving” and “not changing his/her flight”, respectively), which leads to an “if-then” conditional hypothetical statement. (i.e., “*If* he/she had not changed his/her flight *then* he/she would have survived”). Other examples include: “If I had brought an umbrella with me, (then) I would not have been soaked by the rain”; “I might have arrived at school on time if I had not overslept this morning”; “The US might not have entered the Second World War if Pearl Harbour had not been raided by Japan”; etc. However, a counterfactual statement does not always take a form of a conditional (e.g., “I could have finished my assignment earlier”). This is especially the case for a special branch of counterfactuals identified

by Kahneman and Varey (1990) called “close counterfactuals”, which typically take the format of “Something almost/nearly occurred”. A statement of this type does not specify any mutated antecedent but simply claims the fact that an alternative possibility could have easily been realised.

Counterfactual thinking is not only a pervasive psychological phenomenon but a powerful one as well. It plays important roles in a wide range of cognitive tasks and social judgments. For example, counterfactual thinking was found to be closely related to causal reasoning (Mandel & Lehman, 1996; Spellman, 1997; Wells & Gavanski, 1989). Wells and Gavanski (1989) found that an antecedent to a tragic accident was considered to be the cause only to the extent that the mental undoing of this antecedent led to the undoing of the tragic outcome. In one of their experiments, a woman was described to have eaten a meal ordered by her boss and to have died of a food allergy. Participants were informed that her boss had another option for her meal. It was found that the boss was considered to be the cause of this incident to a greater extent when the unselected meal did not contain the allergic ingredient than when it also contained it, presumably because the information in the latter case made it difficult for the participants to undo the outcome of the event by undoing the boss’s choice of meal.

Since causal inferences can be derived from imaginations about alternatives, it was believed that counterfactual thinking is an important tool for humans to learn from past experiences and regulate their behaviours in the future for the purposes of goal achievement. The functional theory of counterfactual thinking (Epstude & Roese, 2008; Roese, 1994, 1997) posits that upward counterfactual thinking (i.e., thinking how things could have been better) can help people identify behavioural

paths leading to future successes. For example, the counterfactual “If I had put more effort into my revision, I would have got a higher mark in the maths examination” pinpoints a causal relationship between “effort” and “academic performance”, which might lead to behavioural intention (e.g., “I will put more effort into my revision so that I can get a higher mark in the maths examination next time”). Upward counterfactual thinking could also motivate corrective behaviours by heightening one’s future expectancies for success and self-esteem (Gleicher et al., 1995; Nasco & Marsh, 1999; Roese, 1994, 1997, 1999; Roese & Morrison, 2009). For example, the counterfactual “I could have done better in the maths examination” highlights the possibility that “I can do better”. Such a self-inference might fuel the motivation for behavioural change (Epstude & Roese, 2008; Roese, 1994, 1997).

Downward counterfactual thinking (i.e., thinking how things could have been worse), on the other hand, is believed to be able to elicit feelings of complacency and thus serve an affect enhancing purpose (Markman, Gavanski, Sherman, & McMullen, 1993; Roese, 1994) and could help individuals cope with traumatic events (White & Leham, 2005). More recent research also suggests that downward counterfactual thinking sometimes serves as a warning alarm and helps prevent degenerative behaviours by flagging up the path to an undesirable state and eliciting negative emotions (e.g., “I could have failed the maths examination if I had not put this much effort in the revision. So I will work as hard in preparing for the examination next time.”) (McMullen & Markman, 2000).

To serve the purpose of this thesis, it is the role that counterfactual thinking plays in peoples’ emotional experience to a past outcome that is of the utmost interest. It is believed that a counterfactual world can serve as a reference point

against which reality is appraised (i.e., comparing what did happen with what could have happened) (Markman et al., 1993; Roese, 1997; Roese & Olson, 1995). However, unlike comparison anchors such as desires and expectancies, which are computed or established prior to the occurrence of an outcome, counterfactual comparison anchors are provoked after the occurrence (Kahneman & Miller, 1986), although the disconfirmation of prior desires or expectancies might facilitate the imagination of counterfactuals (Olson et al., 1996). It is important to understand when a counterfactual comparison standard is the most available and how it influences one's emotions. The following sections will give a brief review of the existing research regarding both the antecedents and the emotional consequences of counterfactual thinking.

1.2.2 Antecedents of Counterfactual Thinking

Virtually every occurrence or status has its alternatives. The alternative of the sky being blue would be the sky being red or white; Being born as a boy would be being born as a girl; Having sausage for breakfast would be having bacon. However, people don't spontaneously contemplate the alternatives to every past event and, even if they do, it is unlikely that they would exhaust all the alternative possibilities (E.P. Seelau, S.M. Seelau, Wells, & Windschitl, 1995). Some events seem to provoke thoughts about alternatives more readily and some alternatives seem to be easier to come to mind than others. Mutability and counterfactual availability are the terms frequently used by counterfactual researchers to describe the ease with which an event in reality can be mentally altered to a counterfactual state (e.g., Kahneman, 1995; Kahneman & Miller, 1986; Miller et al., 1990; Roese & Olson, 1995).

Norm theory (Kahneman & Miller, 1986) made the first attempt to explain what aspects of the reality are likely to be mutated and also to what state they are likely to be altered. It proposed that the occurrence of each event would provoke its own comparison anchor or “norm”. A norm can be retrieved from one’s past experiences or constructed by mental simulation, reflecting how things should be. If an event has provoked a norm that is dissimilar to itself, this event will be deemed “abnormal” and elicit a sense of surprise. It is this sense of “surprise” that motivates a mental alteration process to restore the abnormal event to its normal status. On the other hand, if an event has provoked a norm that is similar to itself, this event will be deemed “normal” and become resistant to mental mutations. One factor that influences the normality of an event is its exceptionality - that is, the extent to which an event deviates from daily routine. The plane crash scenario at the beginning of this chapter is a good illustration to how an exceptional antecedent (i.e., “switching flight”) leads people to consider an alternative outcome to the tragic event (i.e., “He/she could have survived.”).

Kahneman and Miller (1986) reported a study where participants were presented with a scenario, in which Mr Adams and Mr White were both described as being involved in an accident driving home from work. However, Mr Adams was on his typical route home when the accident occurred while Mr White was on an unusual route. Although the severities of the two accidents were described to be similar, 82% of the participants thought Mr White would feel more upset than Mr Adams, presumably because the unusual and hence abnormal action of Mr White made the tragic outcome more mutable for him than for Mr Adams. Miller and McFarland (1986) reported a similar finding. In one of their studies, participants were told a story in which a male was described as being injured by a gun-shot as a

result of a robbery during his visit to a convenience store. It was found that participants assigned a greater amount of monetary compensation to the victim if the convenience store where the robbery took place had been rarely visited by the victim than if it had been frequently visited. (for similar findings, see Johnson, 1986; Macrae, 1992; Macrae & Milne, 1992; Macrae, Milne, & Griffiths, 1993).

Evidence also indicates that events involving actions are more abnormal and thus more mutable than events involving inactions. In a scenario study reported by Kahneman and Miller (1986), Mr Paul and Mr George both invested in the stocks of company A and later found they would have earned \$1,200 more if they had invested in company B. However, Mr Paul was described as having owned shares in company A initially and decided NOT to switch to company B while Mr George owned shares in company B initially but decided to switch to company A. Despite the fact that the two men lost the same amount of money, the majority of the participants thought that Mr George, who switched his stock, would be more regretful than Mr Paul, who failed to switch his stock.

Roese and Olson (1995, 1997), on the other hand, proposed that the construction of the counterfactual world consists of two stages – *counterfactual activation* refers to “whether the process of counterfactual thinking is turned on or off” while *semantic content* refers to “the specific avenue by which a focal outcome is undone” (Roese & Olson, 1997, p. 5). For example, after taking a taxi to the airport but missing his/her flight, a person might start to wonder whether this adverse incident could have been prevented (i.e., “Could I have caught the plane?”). The person might come up with several counterfactual scenarios in which different aspects of the incident are mutated (e.g., “If I had not overslept this morning/If I had

used public transportation/If the taxi driver had taken a different route, I could have caught the flight.”). While counterfactual activation concerns the question of when a counterfactual outcome is considered, the semantic content of counterfactual thinking concerns the question of what element(s) of the reality are mutated in a counterfactual representation.

Based on this two-stage model of counterfactual construction, the two authors criticised the existing evidence for the normality-counterfactual availability relationship (as reviewed above). They pointed out that it was ambiguous from the results of those studies whether the normality of antecedents was influencing the dependent variables (i.e., negative emotions or victim compensations) by having an effect on the *activation* of counterfactual thinking or its *semantic content*, because none of those experiments had directly evaluated the cognitive process of counterfactual thinking in any way. By comparison, Roese and Olson (1996, 1997) presented a series of studies which measured the counterfactual activation and its semantic content separately. It was found that, while the antecedent normality has an effect on the content of the counterfactual thoughts that participants generated (i.e., abnormal antecedents were more likely to be mutated in the counterfactual thoughts), its effect on counterfactual activation (i.e., the number of counterfactual thoughts generated) was unreliable.

For example, in one of their studies, participants were asked to solve a series of anagrams, before which they made decisions about the configurations of the task (e.g., topic area, difficulty level, etc.). Normality was manipulated by providing participants with false feedbacks as to whether their decisions were typical (normal) or atypical (abnormal) of other participants. The extent of counterfactual activation

was inferred from participants' response time to a counterfactual proposition after the task (e.g., "My score could have been much different") (Roese & Olson, 1997, p. 21). Presumably, the greater the extent to which participants had engaged in counterfactual thinking, the faster they would respond "yes" or "no" to this proposition. The semantic content of counterfactual thinking, on the other hand, was measured by coding people's written counterfactual thoughts. It was found that the decisions which were believed atypical were more frequently mutated in participants' counterfactual thoughts than typical decisions. However, the manipulation of normality did not significantly affect participants' response time to a counterfactual proposition. These results suggest that the normality of antecedents only influences the semantic content of counterfactual thinking but not its activation.

In contrast, Roese and Olson (1997) demonstrated a potent effect of *affect* on counterfactual activation. In one of their studies, for example, participants read a scenario in which Sarah performed either well (Outcome valence: positive) or poorly (Outcome valence: negative) in an examination. More counterfactual statements were recorded in a thought-listing task from the participants who received the Outcome valence: negative version than those who received Outcome valence: positive version. As argued by Roese and Olson (1995), the reason why negative affect triggers counterfactual thinking could be because the events with negative outcomes may be treated as signals that the environment of an organism is not mastered and thus they are more attention drawing and more likely to receive close scrutiny than positive outcomes.

Outcome closeness is another potential factor that influences the mutability of a past outcome. Evidence suggests that emotional reactions to a negative outcome

will be intensified if the distance between the real outcome and its alternatives is short. For example, in one study by Kahneman and Tversky (1982), participants were given a scenario, in which Mr Crane and Mr Tees both arrived at the airport half an hour late for their scheduled flight. Mr Crane found that his flight had departed on time while Mr Tees was told that his flight had been delayed and just departed five minutes before. It was found that the majority of the participants (96%) thought that Mr Tees should be more upset than Mr Crane. Presumably, the short temporal distance between “catching the flight” and “missing the flight” made the counterfactual “I could have caught the plane” more available. Similar effects were documented by other research featuring temporal proximity (Macrae et al., 1993), spatial proximity (Johnson, 1986; Miller & McFarland, 1986) and numerical proximity (Medvec, Gilovich, & Madey, 1995; Medvec & Savitsky, 1997, Turnbull, 1981).

More direct evidence for the effect of outcome closeness on counterfactual availability comes from Meyers-Levy and Maheswaran (1992) and Roese and Olson (1996, Study 3). In both studies, participants wrote down more spontaneous counterfactual thoughts in a free-style thought-listing task after reading a story in which a factual outcome was temporally close to its alternative (e.g., apartment ravaged by fire three days, as opposed to six months, after someone signed up the insurance policy but forgot to send it), indicating outcome closeness triggered counterfactual simulation. The relationship between outcome closeness, counterfactual thinking and emotions will receive further scrutiny in this thesis. It is argued that, besides counterfactual activation, the degree of certainty or uncertainty in the counterfactual generated also plays an important part in the relationship

between outcome proximity and emotions. This point will be elaborated in Section 1.3

1.2.3 Emotional Consequences of Counterfactual Thinking

One of the reasons why psychologists are interested in counterfactual thinking is that, like those comparison anchors introduced in Section 1.1, counterfactuals can affect one's judgments and attitudes towards past events. Moreover, Markman and McMullen (2003) suggested that the introduction of a counterfactual comparison anchor can result in two opposing effects. "*Contrast effects* occur when judgments are displaced away from a comparison standard, whereas *assimilation effects* occur when judgments are pulled toward a comparison standard" (p. 245).

Recall an aforementioned study by Sherif et al. (1958), which found that the same weight tended to be judged lighter if the judge had lifted a weight that was heavier than the weight being judged prior to the judgment, compared to if such an intervention was absent. This finding illustrates a *contrast effect* following the introduction of a comparison anchor (i.e., the heavier weight). However, in the same study, it was also found that when the weight of the comparison anchor was close to (but still heavier than) the weight that was being judged, an opposite pattern would occur. That is, the same weight tended to be judged heavier when preceded with a heavier comparison anchor than when the anchor was absent. This finding illustrates an *assimilation effect*.

The two effects of a comparison anchor might also emerge in the context of social judgments. Markman and McMullen (2003) gave a vivid illustration that "a moderately attractive individual" among "highly attractive people" could be judged

either less attractive (contrast effect) or more attractive (the assimilation effect) (p. 245). In a similar way, the mental construction of counterfactual representations, could also result in these two effects, the evidence for which will be reviewed separately in the next two sub-sections

1.2.3.1 Contrast Effect

Section 1.1 has reviewed the psychological effects of several psychological reference points on one's retrospective evaluations and emotional experiences. Those effects reflect the general principle of the contrast effect. That is, the favourability of an event or status is judged higher when it surpasses a comparison standard and judged lower when it falls short. The early findings regarding the psychological consequences of counterfactual thinking concur with this principle. It was believed that the emotional reactions after counterfactual thinking could be understood by considering the direction of comparison (Roese 1994, 1997; Roese & Olson, 1995, 1997). While comparing reality to a more desirable alternative can worsen one's mood (upward counterfactual comparison), comparing reality to a less desirable alternative can improve one's mood (downward counterfactual comparison). To illustrate, getting a B in a maths test may look less attractive if someone realizes that he/she could have got an A instead, eliciting negative emotions like dissatisfaction or disappointment. By comparison, getting a B may look more attractive if someone realizes that he/she could have got a C instead, eliciting positive emotions like relief and gratefulness.

Direct evidence of the contrast effect comes from the study by Markman et al. (1993), in which the players of blackjack were found to report more negative affect after tying the dealer if a better alternative was made salient than if a worse

alternative was made salient. Similarly, in two experiments by Roese (1994), participants were asked to recall a negative event from their memory and half of the participants were subsequently instructed to imagine how things could have been better while the other half how things could have been worse. It was found that the participants in the former group reported poorer ratings on affect than the latter group.

Other evidence for the contrast effect comes from research on near-misses (Johnson, 1986; Kahneman & Tversky, 1982; Macrae et al., 1993; Meyers-Levy & Maheswaran, 1992; Miller & McFarland, 1986). Most notably, Medvec and her colleagues (Medvec et al., 1995; Medvec & Savitsky, 1997) demonstrated what was called the *satisfaction reversal*, where the people who objectively performed better in a sports competition or an academic examination did actually feel worse. For example, in two of their experiments (Medvec & Savitsky, 1997, Study 2 and 3), students who got an exam score that was close to the boundary for a higher grade reported lower levels of satisfaction than those whose score was in the same grade but close to the boundary for a lower grade. The two authors argued that this is because being close to a better grade provoked the students to think about how things could have been better while being close to a worse grade provoked the thinking about how things could have been worse.

1.2.3.2 Assimilation Effect

Despite the accumulating evidence for the contrast effect after counterfactual thinking, doubts have been casted on whether the contrast effect alone is adequate to explain the emotional reactions to counterfactual thinking (Markman & McMullen, 2003). Those doubts could be partly due to the evidence for the assimilation effect

found in other related areas of comparative thinking. For example, the Affective Expectation Model (AEM) (T.D. Wilson, Lisle, Kraft, & Wetzel, 1989) posits that the contrast effect only occurs when the discrepancy between the actual experience and a prior expectation is noticed. When the discrepancy between the two is trivial and unnoticed, the experience will be pulled toward prior expectations. That is, sometimes, people see what they expected to see. In one of their studies, it was found that people rated a cartoon video clip funnier if they had been led to believe that the cartoon was funny beforehand than if such an intervention was absent.

Similar findings also arose from research on attitude change, temporal comparison and social comparisons. For example, in their account of Social Judgment Theory, Sherif and Hovland (1961) postulated that when a persuasive message falls within the “latitude of acceptance”, it is more likely to be judged as being closer to one’s own viewpoint than it actually is (assimilation effect). However, if the message falls in the “latitude of rejection”, persuasion is unlikely due to the contrast effect. A.E. Wilson and Ross (2001), on the other hand, found that people can maintain a favourable self-image by “disparaging their distant and complimenting their recent past selves” (p. 572), presumably because a comparison anchor that is temporally far away from the present (distant self) is more likely to provoke the contrast effect while a comparison anchor that is temporally close to the present (recent self) is more likely to provoke the assimilation effect. It was also found that sometimes upward social comparisons (comparing oneself with other individuals that are better-off in social or economic status or superior in abilities) can be self-enhancing (Collins, 1996) and downward social comparisons self-deflating (Lockwood, 2002), both reflecting a quality of the assimilation effect.

Some real life observations also led researchers to question the single contrast effect prediction regarding the psychological impact of counterfactual thinking. Famously, McMullen (1997) cited the real life incident of the crash of USAir Flight 427. The researcher noted that those air passengers, who had bought tickets for that flight but didn't get on the plane, invariably expressed negative emotions like fear and anxiety when interviewed by the media after the incident. Those emotional reactions violated the principle of the contrast effect, which would predict that those lucky survivors of USAir Flight 427 should feel positive because a downward counterfactual comparison has been made salient to them (i.e., "I feel lucky because I could have been killed."). Instead, their emotional reactions seemed to indicate the prevalence of the assimilation effect ("I feel terrible because I could have been killed.").

In attempt to account for the psychological underpinnings of the contrast and assimilation effects in the presence of a comparison anchor, Mussweiler (2003) proposed the Selective Accessibility Model, which posits that evaluating a target (e.g., the athletic ability of the self) against a comparative standard (e.g., a highly athletic classmate) may render accessible in memory either the standard-consistent information relevant to the evaluation target (e.g., "Like him/her, I also have won a few races before") or the standard-inconsistent information (e.g., "I haven't won as many races as him/her did before"). The activation of the standard-consistent information gives rise to the assimilation effect, whereas the activation of the standard-inconsistent information gives rise to the contrast effect. While this model can explain why the assimilation and contrast effects can occur in the context of self evaluations or social comparisons, it is unable to account for why the two effects can arise in the context of counterfactual thinking - It is difficult to conceive how

constructing a counterfactual comparison standard (e.g., “I could have been killed in the air crash) can activate target-relevant information from memory.

Markman and McMullen (2003), on the other hand, proposed the Reflection and Evaluation Model of Comparative Thinking (REM), according to which the relative strengths of the contrast and assimilation effects are determined by the extent to which people engage in either a “reflection” mode of mental simulation or an “evaluation” mode. The argument follows that the assimilation effect will be enhanced (i.e., positive emotions following upward counterfactual thinking and negative emotions following downward counterfactual thinking) when people adopt a reflective or experiential “as if” mode of mental simulation which involves “vividly simulating that information about the comparison standard is true of, or part of, the self” (p. 248). On the other hand, the contrast effect will be enhanced (i.e., negative emotions following upward counterfactual thinking and positive emotions following downward counterfactual thinking) when people adopt an evaluative mode of mental simulation, which is characterized by “the use of information about the standard as a reference point against which to evaluate reality” (p. 248). Compared to the Selective Accessibility Model (Mussweiler, 2003), the REM makes the novel proposition that when evaluating the self or an event against a comparison standard, “standard-consistent cognitions need not be based in fact. Instead, they may be imagined” (p. 248). This proposition may explain why the affective experiences of the lucky passengers of the incident of USAir Flight 427 seemed to mainly reflect the quality of the assimilation effect. That is, instead of appreciating the difference between the reality and a worse possible world (e.g., “I could have been killed but I’m still alive!”), they immersed themselves in the imagination of what could have been (e.g., “What if I had been killed?”).

McMullen (1997) provided direct evidence for the REM by instructing participants to recall recent events from memory and think of either better or worse alternatives to those events. The assimilation effect was enhanced when participants were asked to focus on the counterfactual alone (reflection) while the contrast effect was enhanced when they were asked to focus on the difference between the real event and the counterfactual event (evaluation).

Some contextual factors can also influence the activations of the two simulation modes. For example, as predicted by the REM, reflective simulation should be more likely when the evaluation of one's performance is based on the quality of the process via which an outcome is achieved instead of the valence of the outcome itself. In a study by Markman and Tetlock (2000), participants were asked to make an investment decision between two stocks. They received feedback afterwards about the performance of the stock they had chosen in relation to the other stock. Evidence for the dominance of the assimilation effect was found when participants were told that the experimenter was going to evaluate the quality of their decision making by the *reason* they used to come to the decision (process accountable condition). Participants were in a better mood and more satisfied when the chosen stock was beaten by a small margin than by a big margin but they were in a worse mood and less satisfied when the chosen stock beat the unchosen stock by a small margin than by a big margin. However, this effect was not found when the participants were told that their decision was going to be evaluated on the grounds of the *performance* of their stock.

In summary, the existing research has demonstrated that counterfactual thinking is primarily activated by negative affect or outcome proximity while the

semantic content of counterfactual thinking is primarily determined by the normality of antecedents. What's more, counterfactuals might affect people's emotional reactions to past events via either a contrast effect or an assimilation effect, to the extent that people engage in an evaluative simulation or a reflective simulation. However, as noted by some recent research (e.g., Petrocelli, Sherman, & Tormala, 2011; Sanna & Turley-Ames, 2000), what seems to be missing from the current research is the notion that counterfactuals differ not only in the extent of their *activation* but also in their *strength*. The present thesis focuses on one potential factor that influences the strength of a counterfactual, which is the degree of certainty (or uncertainty) that people assign to a particular counterfactual possibility, namely, counterfactual probability.

1.3 Uncertainties in Counterfactual Thinking

1.3.1 Counterfactual Activation versus Counterfactual Certainty

Most of the previous research on the determinants of event mutability (or counterfactual availability) has exclusively focused on the factors that *activate* counterfactual thinking. For example, in a typical study that examined the antecedent of counterfactual thinking and its emotional consequences (e.g., Meyers-Levy & Maheswaran 1992; Roese & Olson, 1996, 1997), participants were firstly exposed to the manipulation of a potential variable that affects counterfactual generation (e.g., outcome closeness). Then their spontaneous thoughts were recorded in a free-style thought-listing task. The number of counterfactual thoughts generated by each participant were then counted and treated as an indicator of the extent to which the counterfactual simulation had been activated. However, questions have been raised whether the activation of counterfactual thinking process alone can fully account for

counterfactual availability. As Sanna and Turley-Ames (2000) have found out, people who generate the same amount of counterfactual representations do not necessarily experience equally intense emotions, suggesting that counterfactual representations may differ not only in the extent of activation but also in strength.

Research on *semi-factuals* also renders a similar indication. Compared to a typical counterfactual representation in which both the factual outcome and one of its antecedents are mutated to a counterfactual state (e.g., “If I had put more effort into my revision, I would have passed the examination.”), a semi-factual only mutates the antecedent, leaving the factual outcome in status quo (e.g., “Even if I had put more effort into my revision, I would still have failed the examination.”)(Byrne, 2007). Counterfactuals and semi-factuals both indicate a mental departure from reality, and hence, an activation of counterfactual thinking. However, they end up at completely different destinations – one confirms the mutability of a past outcome while the other disconfirms it. Further evidence suggests that inducing people to generate upward “even-if” semi-factual thoughts following a negative outcome could actually improve one’s psychological well-being (McCloy & Byrne, 2002), which is the opposite to what is expected from the generation of an upward “only-if” counterfactual representation.

Thus, it seems that the availability of a counterfactual can still be weak even if the counterfactual has been mentally constructed (i.e., counterfactual activation). There might be therefore some other properties of a counterfactual that contribute to the strength of its psychological impact. The metaphor of “distance” has been adopted by some philosophers (e.g., Bennet, 2003; Lewis, 1973) as well as psychologists (e.g. Kahneman, 1995) to describe the relationship between reality and

its counterfactual worlds. “There is a compelling intuition that some counterfactual alternatives are ‘closer’ to reality than others and that the close alternatives are more available and therefore more likely to evoke counterfactual emotions such as frustration or regret” (Kahneman, 1995, p. 385). As one might notice, there is an inherent connection between the conception of “distance” and the subjective certainty or probability. The expression of “a remote possibility” might bear the meaning that the possibility in question is improbable while “a close possibility”, on the other hand, might mean a very probable one. The two concepts are so closely related to each other in human reasoning that sometimes people directly infer probabilities from distances (Teigen, 1998, 2005). Thus, the strength of a counterfactual possibility could partly be determined by the degree of certainty or subjective probability that people assign to it.

Certainty has already been identified as an important property of the comparison standard of future expectancies (Olson et al., 1996). The way that people express their expectations often reflects a particular degree of belief (e.g., “It *will* rain tomorrow” reflects a higher degree of certainty or belief than “It *might* rain tomorrow”). Similarly, people can assign different levels of certainty towards counterfactuals, which might be important to the subsequent judgment of affect. It is worth noting that, like expressions of future expectancies, almost all counterfactual statements are probabilistic in nature and reflect different levels of belief. For example, the counterfactual thought “If I had studied hard in high school, I *would* have entered college” might reflect a higher certainty or a stronger belief in the counterfactual world than “If I had studied hard in high school, I *might* have entered college”.

Kahneman and Tversky (1982) argued that one of the primary functions of counterfactual simulation is to assess the credibility of counterfactual assertions. For example, to evaluate the credibility of the counterfactual assertion “If Nazi Germany had developed nuclear weapons, the outcome of World War II would have been changed”, people would need to run a mental simulation in which Nazi Germany has indeed developed nuclear weapons and the ease with which the factual outcome of the war can be undone is assessed. Thus, apart from the mental generation of a counterfactual, the credibility or the certainty that people assign to that counterfactual possibility is also important for the availability of the counterfactual. When pressed, one can use one’s imaginations to think of numerous alternative possibilities to a past outcome. However, it is those alternatives which are deemed probable or credible that may have the strongest implications for one’s emotional experiences.

The importance of the credibility in a counterfactual was stressed by Gleicher et al. (1990), who proposed that counterfactual thinking consists of four basic stages. Firstly, a negative or unusual outcome motivates people to contemplate on the alternative outcomes to reality. This stage clearly refers to the activation of the counterfactual simulation process. Secondly, possible routes which could lead to the alternative outcomes are imagined. In this stage, counterfactual representations are established. Thirdly, the likelihoods of the occurrence of the counterfactual outcomes are estimated. Finally, affective experiences are determined by the likelihoods of the counterfactuals. If the likelihoods of the counterfactual outcomes are high, the actual negative outcome will be deemed mutable and the initial emotional reaction to the negative outcome will be worsened. If the likelihoods of the counterfactual outcomes

are low, the actual negative outcome will be deemed inevitable and the initial emotional reactions will be attenuated.

To illustrate, consider the story of John (Roese & Olson, 1995, p. 10), who had a long night drinking and failed an exam the next day. The adverse outcome would motivate John to think about the alternative to the reality (i.e., “Could I have passed if I had done something differently?”). The exceptional antecedent of drinking would come forward as a likely candidate for mental mutation. However, the mental simulation does not end there. The plausibility of the counterfactual has not yet been evaluated. John may ask the question “If I had not got drunk the other night, would I have passed the exam?” The answer to this question could be crucial to his subsequent emotional reactions. Suppose John had a good record of academic performance and had been doing revision for the exam for weeks. In this case, it seems plausible to think he could have passed the exam if he had not got drunk. Thus, the actual outcome (i.e., failing the exam) will look mutable and the negative emotional reactions will be intensified. However, suppose John had a history of difficulty with the subject before or did not quite prepare for the exam. The thought “Even if I had not got drunk, I would have still failed” might easily slip into mind, which will make failing the exam look inevitable and the negative emotional reactions will be eased.

Although these early theorizations have emphasized the importance of the certainty in a counterfactual representation to the determination of its availability and emotional consequences, little research has followed these recommendations and provided empirical evidence, except for a recent study by Petrocelli et al. (2011), who proposed that the *counterfactual potency* of an “if-then” counterfactual

conditional is jointly determined by two likelihood judgments – the likelihood of the mutation of the antecedent (if-likelihood) and the likelihood of the mutation of the actual outcome, given the antecedent is mutated (then-likelihood). For example, the potency of the counterfactual “If I had not got drunk, I would have passed the exam the next day” would depend on the judgments about “How likely was it that I did not get drunk?” and “How likely was it that I could have passed the exam given that I had not got drunk?”.

In one of their experiments, participants read a tragic story of Mr Jones, who was severely injured in a traffic accident on his way home from work. They were then asked to write down one, three or five “if-only” thoughts, using the details provided by the story. More importantly, they rated the if-likelihood and the then-likelihood for each of the counterfactual conditionals they had generated. The counterfactual potency was then calculated by multiplying the two likelihoods. For participants who generated multiple counterfactuals, a combined counterfactual potency was calculated by averaging the counterfactual potencies for all counterfactuals. It was found that the counterfactual potency significantly predicts the judgment of affect for Mr Jones, (i.e., the higher the counterfactual potency, the more intensely Mr Jones was judged to experience negative emotions like regret, bitterness and disgust) but the number of generated counterfactuals did not. To our knowledge, their work provided the first piece of evidence that the degree of certainty in a counterfactual plays an important role in one’s subsequent emotional reactions.

However, Petrocelli et al. (2011) focused exclusively on the contrast effect when examining the emotional impacts of counterfactual potency. Also, it is still

unclear from their results how people actually make each of the two likelihood judgments. The present thesis addresses these limitations. More specifically, it provides a systematic investigation on the determinants and consequences of counterfactual certainty. However, as an indicator of counterfactual certainty, we favour the use of the term “counterfactual probability” which has been used in research on subjective probability by Teigen (1998) over the term “counterfactual potency”. We believe counterfactual probability better captures the uncertain nature of counterfactual thinking and in this thesis it is used to refer to either a conditional probability (e.g., “If I had studied hard, how likely could I have passed the exam?”) or an unconditional probability (e.g., “How likely could Brazil have won the 1998 world cup?”).

The remaining sections of the chapter will first give a brief introduction to counterfactual probability judgments and then review the theories and the findings regarding its determinants and consequences. New predictions will be developed based on those findings and the content of the next three experimental chapters will be sketched out.

1.3.2 An Introduction to Counterfactual Probability Judgments

Teigen (1998) has used the term counterfactual probability to refer to the subjective likelihood of an event or an outcome that did not actually happen. For example, for John who survived a train crash, the counterfactual probability judgment would be the likelihood of him being killed while in fact he survived. Counterfactual probability could either be conditional (e.g., “If John had missed that train, how likely could he have been killed in the train crash?”) or unconditional (e.g., “How likely could John have been killed in the train crash?”).

It is worth noting that to-date counterfactual probability judgment is a subject that has been rarely explored in psychology (for exceptions, see Over, Hadjichristidis, Evans, Handley, & Sloman, 2007; Teigen, 1998, 2005), probably because, as *retrospective* probability judgments, they are deemed less useful than *prospective* ones. Probability estimates regarding future occurrences can directly inform decision making. For example, knowing the probability of whether it will rain in the afternoon will help us with the decision whether or not to carry an umbrella heading out. In contrast, it is less obvious what benefit it would be to know today whether the probability of rain yesterday was high or low. Yesterday is now history and we already know whether it rained or it didn't and whether we got caught without an umbrella if it did. However, counterfactual probability judgments might be able to instruct decision making indirectly by influencing prospective probability judgments since future predictions are frequently based on past experiences (Feeney & Heit, 2007). Research on gambling has found that near-win outcomes encourage persistent gambling behaviour (Dixon, Nastally, Jackson, & Habib, 2009; Gilovich & Douglas 1986). This may be because the perception that "My likelihood of winning *was* high" can be translated into "My likelihood of winning *is* high" (McMullan & Markman, 2002). What's more, as argued in the last section, counterfactual probability judgments are crucial to the credibility and hence the emotional impact of counterfactual representations.

As a retrospective evaluation, counterfactual probability judgments may involve mental time travel (Over et al., 2007; Teigen, 1998). When people infer counterfactual probabilities, they might simply wind back the clock to a particular temporal position in the past and make prospective judgments as if the outcome of an event did not occur or was unknown. Thus, the statement "His/her probability of

being killed in the train crash was very high” while he/she actually survived simply means that at some point in the past, his/her probability of being killed was very high.

It can be practically difficult to make an accurate calculation of this type of probability. For example, to infer the counterfactual probability of a person A being killed in a train crash, one might need to firstly decide which temporal point one should mentally travel back to in order to make that judgment (e.g., before person A boarded the train or before person A chose a seat to sit down). Then, to make a prospective probability judgment at that particular temporal point might require one to consider the frequency of train crashes in the past as well as their death tolls. One might also need to list different possible scenarios in which person A was actually killed in the train crash as well as those in which person A actually survived, assign a probability to each of these scenarios and integrate those probabilities into a global evaluation. Nonetheless, counterfactual probability judgments in real life seem to occur frequently, quickly and effortlessly (Teigen, 1998), indicating that people’s judgments of this type of probability in everyday life mostly rely on intuitive estimations rather than deliberate calculations. As will be elaborated in the next section, estimations of counterfactual probability might be reached by the frugal strategy of mental simulation and they might be susceptible to event cues in the causal script of an outcome like proximity and progression.

1.3.3 The Determinants of Counterfactual Probability Judgments

We’ll start the discussion of the determinants of counterfactual probability judgments by introducing a type of event which has been fascinating researchers in counterfactual thinking for years. That is, the events that people refer to as “near-

misses” or “close-calls”, which often spawn “close counterfactuals” like “It *nearly* happened” or “It *almost* happened” (e.g., Kahneman & Varey, 1990; McMullen & Markman, 2002; Miller et al., 1990). One common characteristic of near-misses is that they always implicate a counterfactual outcome. To say “John was nearly killed in the train crash” implies that “John could have been killed if something different had happened”. Another characteristic of near-misses, which is the reason why it particularly interests the current thesis, is that they also indicate a high counterfactual probability. That is, a near-miss does not only indicate a possible alternative to the reality, it also indicates a very probable one. As argued by Kahenman and Varey (1990), the use of word “almost” or “nearly” must be backed-up by a high perception of propensity or probability of a focal outcome that did not happen. Thus, to say “John was nearly killed in the train crash” implies that it was very likely that John could have been killed. Hence, near-misses can be regarded as the “extreme cases” in counterfactual thinking, where counterfactuals are the most credible, robust and impactful. To understand how people establish counterfactual probability judgments, a natural first step is to examine when people qualify an outcome as a near-miss.

An important observation from Kahneman and Varey (1990) is that a close counterfactual can be justified by a high perception of propensity, which refers to people’s online judgments of the subjective probability of the occurrence of a target outcome as the causal episode unfolds itself. For example, a spectator of a football match may make judgments about the chance of his/her team winning during the course of the game. This perceived likelihood may go up and down depending on the events that occur during the game (e.g., the team taking a lead). According to the two authors, the propensity of the counterfactual outcome (e.g., “the team winning”) must be very high during the course of the development of the event for a statement

“Outcome X almost happened” to be valid. Two cues were proposed to be important to the perception of propensity – proximity and progression. It is speculated that the counterfactual probability should be closely related to the perception of propensity and its judgment should also be susceptible to these two event cues.

1.3.3.1 Proximity and Counterfactual Probability Judgment

There could be various factors underpinning people’s qualification of near-misses or close-calls. However, one important factor is indicated by the name itself. That is, an alternative must be “near” or “close” to the reality by some measure. As noted by Roese and Olson (1995), the psychological perception that “something was close to happening” can be derived from the physical or the temporal distance that separates the reality and its alternatives. For example, avoiding being hit by an incoming car by a few inches (physical proximity) and missing a flight by just a few minutes (temporal proximity) can both be qualified as near-misses. Other cues like numerical proximity (e.g., failing an examination by one point) could also give rise to the perception of closeness.

As mentioned in Section 1.2.2, proximity has already been identified as a factor in the activation of counterfactual thinking. It is possible, however, that proximity could also heighten counterfactual probability judgments and hence enhance people’s certainty in the counterfactuals that are constructed earlier in the process. This proposition has its theoretical roots in research on intuitive judgments. The heuristic and biases approach towards judgments in uncertainty (Gilovich, Griffin, & Kahneman, 2002; Kahneman, Slovic, & Tversky, 1982) posits that when people are asked to make judgment about a less accessible attribute (e.g., the probability of a specified outcome in a complex event), they often replace the

attribute in question with another more accessible attribute and use it as a proxy from which the assessment on the target attribute is inferred. This is called attribute substitution (Kahneman & Frederick, 2002) and the attributes being substituted are called heuristics. For example, as demonstrated by Lichtenstein, Slovic, Fischhoff, Layman, and Combs (1978), when making a judgment about the frequency of death from a specific cause (e.g., suicide), people may use what's called the *availability heuristic* and base their frequency judgments on how easily instances of death from that cause can be retrieved from memory. Thus, a person with a recent experience or being recently exposed to the media coverage about the death from that cause might rate the frequency quite high.

Instead of being retrieved from memory, the instances of a target event can also be constructed in mind via mental simulation. For example, in a risk-assessment, one might evaluate how likely it is that things will go wrong by assessing how easily a scenario can be imagined where things do go wrong. This evaluation strategy was called the *simulation heuristic* (Kahneman & Tversky, 1982). Carroll (1978) found evidence that asking participants to imagine the occurrence of an event (e.g., a person winning a presidential election or a football team performing well in a season) could raise their subjective probability of that event occurring (for similar findings see Gregory, Cialdini, & Carpenter, 1982). A more recent study by Sherman, Cialdini, Schwartzman, and Reynolds (2002) provided stronger evidence for the simulation heuristic, in which it was not only demonstrated that letting people imagine a scenario which is *easy* to imagine can heighten one's probability judgments regarding that scenario, but also that letting people imagine a scenario which is *difficult* to imagine can actually lower one's probability judgments.

The simulation heuristic might also be adopted in the case of counterfactual probability judgments, where the ease with which a counterfactual scenario can be imagined is used as a heuristic to the probability of the occurrence of that particular counterfactual scenario. For example, to evaluate the credibility of the counterfactual assertion “If I had not got drunk the night before the examination, I would have passed it”, people would run a mental simulation in which they indeed did not get drunk and the ease with which the factual outcome can be undone is assessed. The shorter the distance between the real outcome and the counterfactual outcome, the less effort people have to devote in order to mentally mutate the real outcome to its counterfactual states. Thus, proximity to a counterfactual outcome should be able to heighten retrospective probability estimates regarding that counterfactual outcome. In an aforementioned study by Kahneman and Tversky (1982), the majority of participants judged that a man who missed his flight by five minutes would be more upset than another man who missed by 30 minutes, despite the fact that their outcomes were identical and they both expected to miss the flight. It was argued by the author that it is easier to imagine how a man could have arrived at the airport five minutes earlier than 30 minutes earlier. More direct evidence for the proximity-counterfactual probability judgments relationship comes from a study by Tykocinski and Steinberg (2005), in which participants were presented with a story that was similar to the flight-missing scenario. It was found that the likelihood of arriving at the airport on time was judged higher if one missed the flight by 10 minutes rather than 50 minutes.

It should be noted that the assessment of the ease of the construction of a counterfactual does not require the observer to actually engage in the mental simulation. Event cues like outcome proximity could suffice the judgment about how

easy or difficult an imaginary world can be brought to mind. Teigen (1998, 2005) proposed what is called the *proximity heuristic*, which is a frugal strategy where people use information of outcome proximity to directly inform their counterfactual probability evaluation. In his studies, the proximity-counterfactual probability judgment relationship was still robust even if little detail was given to the participants regarding the development of a story other than the proximity of the final outcome. For instance, in one study, the following scenario was presented to the participants in one group:

Bjarne and Gunnar are top-level cross-country skiers who have competed for many years. It is difficult to say whether one is better than the other. Before an important race Bjarne feels especially energetic and on top form. It turns out that he wins the 30km race ahead of Gunnar by some tenths of a second. After the race he thinks:

What was my probability of being beaten by Gunnar today?

The participants rated the question on a 9-point scale and were then presented the second part of the story:

Suppose he had won with a margin of several minutes. Do you think he would have estimated the probability of being beaten by Gunnar as: lower/higher/the same.

Only 25% of the participants expressed that the chance would be the same, indicating that counterfactual probability judgments were affected by the information

of outcome closeness. Interestingly, the same study also found that the reliance on proximity cues seems to be a unique feature for counterfactual probability judgments because the participants in another group who were asked to estimate the probability of the factual outcome (i.e., likelihood of Bjarne beating Gunnar) exhibited a weaker susceptibility to the information of winning margins.

In his other study featuring numerical distances, participants were presented the results of a handball game between the national women's handball teams of Norway and Germany. It was found that participants gave higher ratings on counterfactual probabilities (i.e. Could have won/lost) when the team lost or won by a small margin (23-24/24-23) than by a large margin (20-25/25-20).

A limitation of existing research is that the judgmental tasks that were assigned to the participants featured only unconditional counterfactual probability judgments. It is expected that people should make conditional counterfactual probability judgments in a similar way because the simulation heuristic might be used in both types of judgments. However, empirical evidence for this speculation is undoubtedly needed. This limitation will be addressed by the research reported in Chapter 2. Another limitation, more importantly, is that the previous research has exclusively focused on how people infer probability from a single, static distance cue, while the possibility was left unexplored that people can also infer probability from the way the distance changes over time. This point is elaborated in the next section.

1.3.3.2 Progression and Counterfactual Probability Judgment

Research on the determinants of counterfactual probability judgments has been so far restricted to the situation where only a single cue of proximity is

available for the judgment of probability (e.g., in Teigen's 1998 experiment only the difference in the final results between the two skiers were given for people to infer counterfactual probability). However, in real life, as an event unfolds, the spectators or the experiencers may receive feedback that is far richer than the mere end results and that feedback may influence their perception of proximity and their counterfactual probability judgments as well.

As noted by Kahneman and Varey (1990), besides proximity, there is another cue which is very important for the judgment of propensity, which is the sense of progression towards the focal outcome. A sense of progression might be derived from variations in proximity. For example, shrinking distance might provoke a sense that one is moving towards the goal, which will inflate one's judgment of propensity and counterfactual probability. On the other hand, expanding distance might provoke a sense that one is moving away from the goal, which will deflate probabilistic judgments. For example, during the race of the two skiers in Teigen's (1998) experiment, the gap between them might have been increasing or decreasing. This dynamic feedback on their proximity throughout the race could also contribute to the perception that one skier almost or nearly won in the end.

The sense of progression can also be derived from the shrinking of causal distance. For example, if a gambler needs to draw five cards from a deck with identical suits in order to win, every card that's been drawn matching the suit of the previous card would provoke a the sense that the player is getting closer to winning. In the case of causal distance, the effect of progression could therefore manifest itself as a temporal order effect. That is, counterfactual probability estimates might be higher if the decisive event in the causal sequence comes later rather than earlier.

The effect of progression on counterfactual probability has not yet been tested by previous research and will be one of the focuses of the present thesis.

1.3.4 Emotional Consequences of Counterfactual Probability

The counterfactual probability judgment is believed to be an indicator of the credibility of a counterfactual. It is expected that a counterfactual with high probability should result in more intense emotional reactions compared to the same counterfactual with low probability. As noted in Section 1.3.1, Petrocelli et al. (2011) has provided evidence that counterfactual probability estimates are good predictors for one's negative emotional reactions to upward counterfactuals. However, as argued earlier, this finding only covers the situation when the contrast effect is dominating one's affective experiences.

The REM (Markman & McMullen 2003) discussed in Section 1.2.3.2 posits that either the contrast or the assimilation effect can dominate one's affective experience after counterfactual thinking to the extent that the evaluative (i.e., comparing the reality with what might have been) or the reflective (i.e., imagining what might have been as if it was true) simulation mode is adopted. In line with the proposition of the REM, we therefore adjusted the predictions regarding the emotional consequences of counterfactual probability judgments in the following way: An increase in counterfactual probability judgment should enhance both the contrast and the assimilation effect of a counterfactual comparison standard. When people take a *reflective* mode of mental simulation, the assimilation effect should be dominating one's affective experiences and thus counterfactual probability judgments should be *positively* related to one's emotional reactions in the case of *upward* counterfactual thinking but be *negatively* related to one's emotional

reactions in the case of *downward* counterfactual thinking. On the other hand, when people take an *evaluative* mode of mental simulation, the contrast effect should be dominating one's affective experiences and thus counterfactual probability judgments should be *negatively* related to one's emotional reactions in the case of *upward* counterfactual thinking but be *positively* related to one's emotional reactions in the case of *downward* counterfactual thinking.

1.4 Summary of Chapter 1 and Overview of the Experimental Chapters

The present thesis emphasizes the critical role of counterfactual reference points in people's appraisals of past events and their subsequent emotional reactions. We embrace the idea that the psychological impacts of counterfactuals are mediated by the counterfactual probability judgments that are assigned to them. The predictions regarding counterfactual probability judgments are summarised in Figure 1.1. Firstly, the two event cues that had been proposed by Kahneman and Varey (1990) to be crucial to judgments of propensity and counterfactual probability – proximity and progression, were examined by the present thesis. Higher counterfactual probability estimates were expected to be documented when (1) the real outcome is close to, rather than far away from an alternative state; and (2) when the event has been progressing, rather than not progressing towards a focal outcome.

Meanwhile, the emotional consequences of counterfactual probability judgments were examined in the framework of the REM (Markman & McMullen, 2003). Higher counterfactual probability judgments should lead to more intense contrast and assimilation effects in one's emotional reactions. The thesis tested people's *temporal perspective* as a potential moderator of the relative strengths of the two effects. According to the REM, the absence of future possibility (i.e., when an

outcome is decisive or unchangeable) should promote an *evaluative* simulation mode and therefore enhance the *contrast effect* whereas the presence of future possibility (i.e., when an outcome is indecisive or changeable) should promote a *reflective* simulation mode and therefore enhance the *assimilation effect* (the rationale behind this prediction is outlined in Section 2.1).

These propositions were tested in six experiments presented in the next three chapters. The experiments reported in Chapter 2 investigated the psychological consequences of being proximate to a counterfactual outcome. It was expected that the total effect of outcome proximity on emotions would be moderated by people's *temporal perspective*. More importantly, this moderated total effect should be partly explained by people's counterfactual probability judgments.

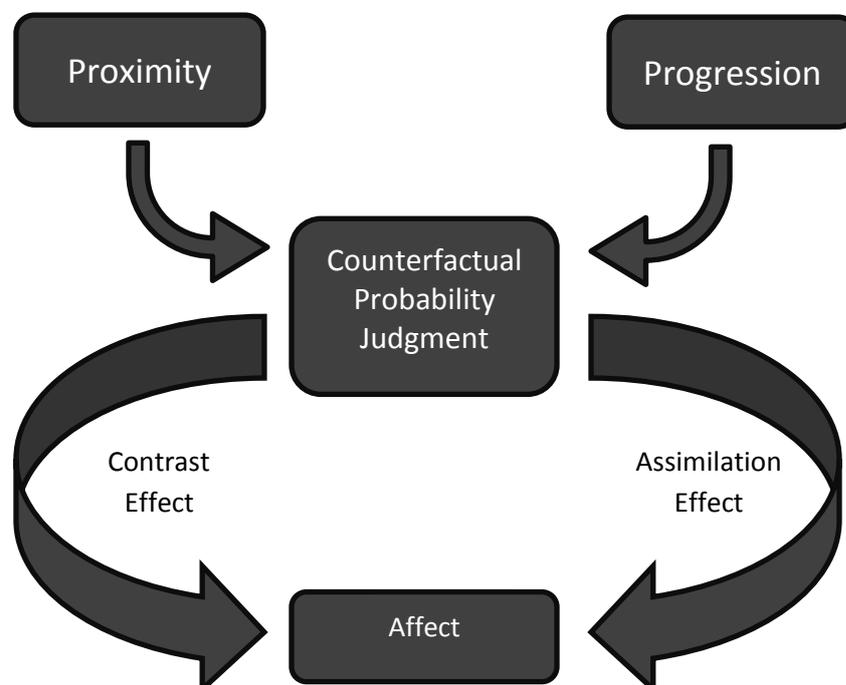


Figure 1.1 Summary of Predictions

The experiments reported in Chapters 3 and 4, on the other hand, investigated the impacts of progression on counterfactual probability judgments and emotions. Progression was operationalized in Chapter 3 by adjusting the pattern of the variation in the perceived proximity to a focal outcome over the course of an event and in Chapter 4 by altering the temporal position of the decisive antecedent in a causal chain. Again, the total effect of progression on emotions was expected to be moderated by people's *temporal perspective* and this moderated total effect should be partly explained by people's counterfactual probability judgments.

Chapter 2 The Effect of Proximity on Counterfactual Probability

Judgments and Emotions

2.1 Introduction

The research reported in the present chapter investigates the mediating role of the counterfactual probability judgment in the relationship between outcome proximity and emotions. The benefit of this investigation is two-fold: Firstly, it provides explanations to the existing findings regarding the emotional impact of outcome closeness from a probabilistic point of view. Secondly and more importantly to the research purpose of this thesis, the mediation analysis gives us an insight into the determinants and the emotional consequences of counterfactual probability judgments. This section will begin with a brief review of the literature on the subject of outcome closeness and emotions, which is followed by a discussion about the mediating role of the counterfactual probability judgment in this relationship. Relevant predictions as well as the layout of the experiments will be summarised at the end of this section.

2.1.1 Emotional Consequences of Being Close

The sense that “something was close to happening” is a powerful psychological phenomenon. A good illustration is the classic scenario study cited earlier in Section 1.2.2 from Kahneman and Tversky (1982), where Mr Tees, who missed his flight by five minutes, was judged by the majority of the participants to be more upset than Mr Crane, who missed his flight by half an hour. Other research also reported similar findings suggesting that people’s emotional reactions to a factual outcome will be worsened (or improved) when the outcome is temporally (Macrae et

al., 1993; Meyers-Levy & Maheswaran, 1992), physically (Miller & McFarland, 1986) or numerically proximate (Medvec & Savitsky, 1997) to a more (or less) desirable counterfactual state.

These findings were largely discussed and explained within the conceptual framework of counterfactual thinking. It was believed that being proximate to an alternative outcome prompts people to think about the counterfactual alternatives to the real world (see Section 1.2.2 for a review). These counterfactual representations, which are provoked as comparison standards against which the reality is being evaluated, give rise to the *affective contrast effect* (Markman et al., 1993; Roese, 1994, 1997; Roese & Olson, 1995). Thus, being close to a desirable but unrealized outcome, which encourages people to compare the reality to what could have been better (i.e. upward counterfactual comparison), worsens one's initial emotional reactions to the real outcome by bringing about negative emotions like frustration and disappointment. On the other hand, being close to an undesirable but averted outcome, which encourages people to compare the reality to what could have been worse (i.e. downward counterfactual comparison) improves one's mood, by bringing about positive emotions like relief and thankfulness. The early evidence reviewed in the previous paragraph is consistent with this general principle.

Nonetheless, more recent research and theorizing has highlighted an alternative way people may react emotionally to close counterfactuals – through the affective assimilation effect whereby people focus on the consequences or the implications of actually having experienced the counterfactual event (Markman & McMullen, 2003; Markman & McMullen, 2005, Markman, McMullen, & Elizaga, 2008; Markman, McMullen, Elizaga, & Mizoguchi, 2006; Markman & Tetlock,

2000; McMullen, 1997; McMullen & Markman, 2000; McMullen & Markman, 2002). In the aforementioned real life incident of USAir Flight 427 (McMullen, 1997), the emotional reactions of the lucky survivors of the air crash didn't seem to be dominated by happiness or relief derived from the downward counterfactual "I could have been killed". On the contrary, such a salient downward counterfactual seemed to have plunged them into a state of deep fear and anxiety, which indicates the prevalence of the affective assimilation effect.

As introduced in Section 1.2.3.2, the mental simulation processes underpinning the contrast and assimilation effects have been formalised by Markman and McMullen (2003) within the Reflection and Evaluation Model (REM). In this unified model of comparative thinking the contrast and assimilation effects are produced through two distinct forms of mental simulation – *evaluation* is characterized by "the use of information about the standard as a reference point against which to evaluate the reality" (p. 248) whereas *reflection* involves "vividly simulating that information about the comparison standard is true of, or part of, the self" (p. 248).

Within this framework, Markman and McMullen (2003) proposed a number of factors that influence the relative strength of the evaluative and reflective simulation processes including the *temporal perspective* - which is the focus of interest in this chapter. The temporal perspective refers to "whether an event is perceived as a final and completed event or as part of a series of events that will continue into the future" (p. 256). If an event or an outcome is perceived to be final, the future possibility to change the outcome is closed and people might be encouraged to focus on the *past implications* of a counterfactual, which is the

difference between the reality and the counterfactual comparison standard (e.g., “I could have got a higher/lower grade but I didn’t”). This should evoke *evaluative* simulation, enhance the contrast effect and bring about disappointment or relief. On the other hand, if an event is perceived as part of a series of events that will continue into the future, the future possibility to change the outcome remains open and people might be encouraged to focus on the *future implications* of a counterfactual, which are the possibilities that the counterfactual signals for the future (e.g., “I could have got a higher/lower grade and I will next time”) (Epstude & Roese, 2008; Gleicher et al., 1995; Nasco & Marsh, 1999; Roese, 1994, 1997, 1999; Roese & Morrison, 2009), which should evoke *reflective* simulation, enhance the assimilation effect and bring about hopefulness (Roese & Olson, 1995) or fearfulness (McMullen & Markman, 2000).

There is a small body of research which has shown that people’s temporal perspective, can influence counterfactual generation and have consequences for affect (Boninger, Gleicher, & Strathman, 1994; Markman et al., 1993; McMullen & Markman, 2002; Miller & Gunasegaram, 1990; Sanna, 1997). However, the findings have not provided definitive support for the predictions derived from the REM that contrast effects are weakened or reversed by assimilation effects when future possibilities remain open.

Markman et al. (1993) for example found that when the outcome of a blackjack game (tying the dealer) was not final and participants were given a chance to repeat the game they tended to generate upward “if-only” counterfactuals and were *less* satisfied with the outcome of the game, compared to if they had not been given a chance to repeat the game, in which case participants tended to generate

downward counterfactuals and feel *more* satisfied. The authors argued that people strategically generate upward counterfactuals to prepare for the future when possibility for future improvement is still present and generate downward counterfactuals to enhance emotions when possibility for future improvement is absent. A later analysis showed a negative correlation between emotions and the proportion of upward counterfactual statements participants generated, suggesting a strong contrast effect.

The reason why the assimilation effect was not found in the blackjack experiment could be that the counterfactuals in this case failed to raise people's expectations for future winning. Research by Sanna (1997) implied that the repeatability effect may depend upon people's expectations of performing well or poorly on the second try. In their study participants who had high self-efficacy towards an anagram task actually felt better by generating upward counterfactuals then downward counterfactuals when the anagrams were repeatable – a finding which is indicative of the affective assimilation effect.

Indeed, to trigger a strong assimilation effect in emotion, an event has to be perceived as being not only repeatable but also achievable. The blackjack game may have failed to provide a strong signal that the players had the potential to win subsequent rounds. Such a signal, however, can be compelling after close outcomes. As noted by McMullan and Markman (2002), a close counterfactual like “I almost did it” or “I almost failed” could be easily translated into “I will do it/I could fail next time”. This feature could make emotional reactions after close outcomes especially prone to affective assimilation.

In their second study, McMullen and Markman (2002) provided participants with a play-by-play account of a basketball game and were asked to imagine they were the supporters of one of the two teams. The two teams ended up either with very close scores (1-point difference) or scores that were far apart (15-point difference). A domination of affective contrast was observed when participants were told they were reading the account of the second half of the game (low future possibility) - the supporters of the losing (or winning) team reported worse (or better) moods if the scores were very close than if it was a blow out. However, the reverse pattern was found when the participants were told they were reading the account of the first half of the game (high future possibility), where a domination of affective assimilation emerged – the supporters of the losing (or winning) team reported worse (or better) moods if the scores were a blow out than if they were very close. Also intriguingly, they found that the assimilation effect at half-time was strong enough to cause the team which was one point ahead to feel worse than the team which was one point behind - an “assimilation-based satisfaction reversal”, as opposed to the “satisfaction reversal” caused by the contrast effect that has been found in the often cited studies by Medvec and her colleagues (Medvec et al., 1995; Medvec & Savitsky, 1997) (see Section 1.2.3.1).

Although the results of this study support the temporal perspective hypothesis, they are open to alternative interpretations. To be more specific, the assimilation effect found in the half-time condition might be the result of the confounding effect of the teams’ objective situations. Taking the losing team in the first half for instance, the fact that the players who were one point down at half time were judged to feel more positive than the players who fell behind by a lot could be simply due to that the players in the former case were *objectively* better off – they had smaller gap to

close between their score and the opponent's in the second half and, hence, *objectively*, had better chance to win the game than the players in the latter case.

This limitation is addressed in the three experiments presented in this chapter. The scenarios in those experiments (Experiment 1 – football (soccer) game; Experiment 2 – Job entry examination; Experiment 3 – TV game show) were configured in such a way that closeness did not indicate the *objective* chance of achieving a desirable or undesirable outcome in the future. More importantly, the previous findings are also developed by investigating the mediating role of counterfactual probability judgments in the predicted effects of proximity and future possibility on emotions, as elaborated in the next section.

2.1.2 The Mediating Role of Counterfactual Probability Judgments

Although it has been widely accepted that outcome proximity influences people's emotional experiences through the mental process of counterfactual thinking (see Roese & Olson, 1995 for a review), it is not entirely clear in what way counterfactual thinking is linking outcome proximity and emotions. Indeed, participants were found to have written down more counterfactual thoughts after reading a story where the distance that separated reality and its alternatives was set to be short rather than far (Meyers-Levy & Maheswaran, 1992; Roese & Olson, 1996, Study 3). However, it is doubtful that the counterfactual activation alone could fully account for the emotional consequences of the outcome proximity because people could react strongly or weakly to the same counterfactual (Sanna & Turley-Ames, 2000).

As emphasized earlier in Section 1.3, one aspect of counterfactual thinking that seemed to be neglected by the previous researchers is that counterfactuals differ in *credibility* or *strength*. For example, the statements “If I had studied harder, I *might* have gone to college” and “If I had studied harder, I *would* have gone to college” implicate the same counterfactual world (i.e. “I went to college”) but they clearly reflect different degrees of belief and certainty in this counterfactual imagination. The emotional impacts of a particular counterfactual could partly rest on the degree of belief or certainty that people assign to it. For example, the counterfactual thought “I *would* have gone to college” should stir up more intense emotional reactions than “I *might* have gone to college”. Counterfactuals only indicate unrealized *possibilities*. Only those which are considered *probable* would have significant psychological impacts.

Thus, it is possible that the relationship between outcome proximity and emotions are mediated by counterfactual probability judgments. First of all, being proximate to an alternative outcome could heighten one’s counterfactual probability judgment regarding that outcome. As reviewed in Section 1.3.3.1, this proposition has already received support from Teigen (1998, 2005) as well as Tykocinski and Steinberg (2005), who observed increased counterfactual probability judgments when the actual outcome got temporally, physically, or numerically proximate to an alternative state.

Secondly, the heightened counterfactual probability judgment should have an effect on one’s emotional experiences. As introduced in Section 1.3.1, Petrocelli et al., (2011) have found in their studies that counterfactual probability judgments positively predicted participants’ judgments of negative affect (e.g., regret, disgust).

However, their results may have only shown one side of the coin. That is, they only demonstrated a contrast-dominant relationship between counterfactual probability judgments and emotions. According to the REM, the heightened estimates of counterfactual probability after a close outcome should have dual effects on one's affective experiences. On one hand, the past implications of a counterfactual will give rise to the contrast effect. That is, a high probability estimate regarding a desirable alternative outcome will be deemed as a sign of a lost opportunity and therefore worsen one's emotional experiences (e.g. "We had a good chance of winning but we lost!") and a high probability estimate regarding an undesirable alternative outcome will be deemed as a sign of an averted misfortune (e.g. "I had a big chance of being killed but I'm still alive!") and therefore improve one's emotional experiences. On the other hand, the future implications of a counterfactual will give rise to the assimilation effect. That is, a high probability estimate regarding a desirable alternative outcome signifies hopes and will therefore improve one's emotional experiences (e.g. "We had a good chance of winning and we will!") and a high probability estimate regarding an undesirable alternative outcome signifies threats (e.g. "I had a good chance of being killed and I will be!") and will therefore worsen one's emotional experiences.

Given a particular counterfactual, the rise in the counterfactual probability estimate should lead to the rise in the strengths of both the contrast effect and the assimilation effect. However, the net output of this counteraction, as predicted by the REM, should be determined by the level of future possibility. When future possibility is low, people should focus on the past implications of a counterfactual, in which case the contrast effect should be enhanced and dominate one's affective experiences as a result of the evaluative simulation. Thus, the probability estimate of

an upward counterfactual (downward counterfactual) should be negatively (positively) related to one's emotions. In comparison, when future possibility is high, people should focus on the future implications of a counterfactual, in which case the assimilation effect should be enhanced and dominate one's affective experiences as a result of the reflective simulation. Thus, the probability estimate of an upward counterfactual (downward counterfactual) should be positively (negatively) related to one's emotions.

2.1.3 Summary of Predictions

Overall, we have the following predictions regarding the emotional consequences of near-miss incidents and its underlying mechanisms, which are summarised by Figure 2.1 and 2.2. First of all, it was predicted that the overall effect of the perceived proximity to a focal outcome on affect (by path *c* in Figure 2.1) depends on the level of the perception of future possibility. The contrast effect will be enhanced and dominate one's affective experiences when the future possibility is low (i.e., being proximate to a desirable outcome should worsen one's mood while being proximate to an undesirable outcome should improve one's mood) while the assimilation effect will be enhanced and dominate one's affective experiences when the future possibility is high (i.e., being proximate to a desirable outcome should improve one's mood while being proximate to an undesirable outcome should worsen one's mood) This proposition was tested in all three of the experiments presented in this chapter. What's more, Experiment 3 also tested whether the "assimilation-based satisfaction reversal" (McMullen & Markman, 2002) would arise when future possibility is high as a result of the affective assimilation, where people who are objectively worse off but perceive themselves to be close to a

desirable state are predicted to feel better than those who are objectively better off but perceive themselves to be close to an undesirable state.

The predicted total effect of proximity on emotions should be explained in part by the mediating effect of counterfactual probability. This mediating effect, which should also be moderated by the perception of future possibility, was denoted by path *ab* in Figure 2.2. First of all, proximity to a focal outcome should heighten people's counterfactual probability estimates (path *a*, Figure 2.2). In turn, counterfactual probability estimates should exert effects on one's emotional experiences (path *b*, Figure 2.2), the nature of which should be determined by perceived future possibility.

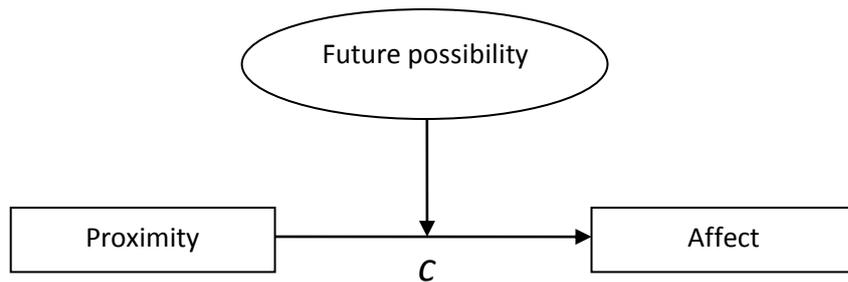


Figure 2.2 Total Effect of Proximity on Affect Moderated by Perceived Future Possibility

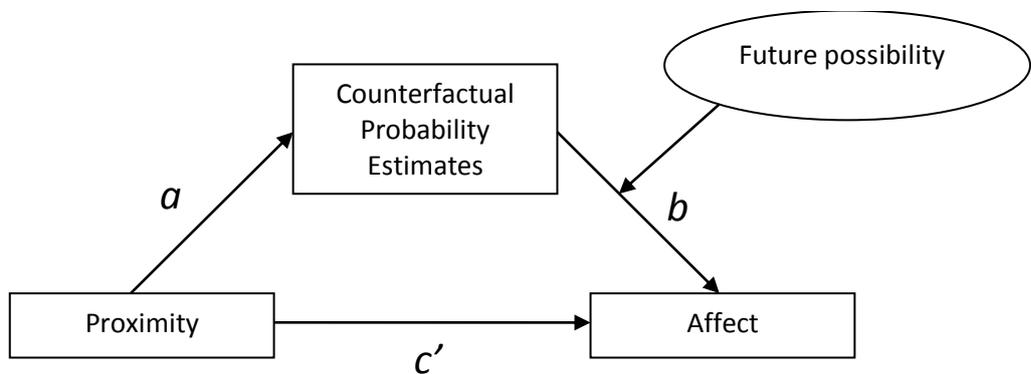


Figure 2.1 Mediating Effect of Counterfactual Probability Estimates Moderated by Perceived Future Possibility

More specifically, when the perception of future possibility is low, the contrast effect should dominate one's affective experience. Thus, the higher the counterfactual probability estimates regarding a more desirable alternative than the reality, the more negative the emotional reactions should be. In comparison, the higher the counterfactual probability estimates regarding a less desirable alternative than the reality, the more positive the emotional reactions should be. These patterns should be reversed when the perception of future possibility is high, where the assimilation effect is dominating one's affective experience. That is, the higher the counterfactual probability estimates regarding a more desirable alternative than the reality, the more positive the emotional reactions should be. In comparison, the higher the counterfactual probability estimates regarding a less desirable alternative than the reality, the more negative the emotional reactions should be. Finally, the path c' denotes the direct effect of proximity on affect, when the mediating effect of counterfactual probability estimates is controlled for. The mediating role of counterfactual probability estimates in the relationship between proximity and emotions (path ab in Figure 2.2) was partially tested in Experiment 1 and fully tested in Experiments 2 and 3.

Finally, Experiments 1 and 2 also tested the existence of an attention-switching mechanism, which is critical to the proposed moderating role of the perception of future possibility but has not been tested by the previous research. That is, after a near-miss incident, the presence of future possibility should divert people's attention from the past implications of a counterfactual (the difference between what could have happened and what did happen) to its future implications (What can happen in the future).

2.2 Experiment 1

This experiment tested the effect of perceived future possibility on people's emotional reactions to close outcomes. It also tested whether proximity to a focal outcome would heighten one's estimates of counterfactual probability and whether a future possibility encourages people to divert their focus from the past implications of the counterfactual after a near-miss incident to its future implications.

Participants were presented with a short story, which depicted a near-miss incident during a football (soccer) match – that is, one team gets very close to scoring a goal but fails to do it. Because the proximity to scoring (or conceding) a goal should heighten the counterfactual probability estimates of the players, it was predicted that the sense “things could have been better” (upward counterfactual thinking) should be more salient for the attackers who were close to scoring a goal while the sense “things could have been worse” (downward counterfactual thinking) should be more salient for the defenders who were close to conceding a goal.

The past implications of those probable counterfactuals would be a missed opportunity for the attacking team (“We could have scored a goal but we didn't!”) but an averted misfortune for the defending team (“We could have conceded a goal but we didn't!”). Meanwhile, those highly probable counterfactuals also have implications for the future. The sense “We could have scored a goal” should lead to the expectation that “We will score goals” and “We will win”, while the sense “We could have conceded a goal” should lead to the expectation that “We will concede goals” and “We will lose”.

The past implications of the probable counterfactuals should give rise to the affective contrast effect, bringing about negative emotions to the attackers (e.g., frustration) but positive emotions to the defenders (e.g., relief), while their future implications should give rise to the affective assimilation effect, bringing about positive emotions to the attackers (e.g., hopefulness) but negative emotions to the defenders (e.g., fearfulness). It was predicted that the degree to which the past-oriented contrast effect and future-oriented assimilation effect impacted on the emotional experiences of the players would depend upon the timing of the near-miss incident during the game. When the near-miss occurs at the end of the game (future possibility low - FP: Low), people should focus on the past implications of the near-miss and the emotional experiences of the players should be dominated by the contrast effect. Thus, participants should judge that the attackers (who almost scored a goal) would feel worse than the defenders (who almost conceded a goal). However, this pattern should be reversed when the near-miss incident occurs at the beginning of the game (future possibility high - FP: High), when people focus more on the future implications of the near-miss. In this case, the assimilation effect should be promoted and override the contrast effect.

2.2.1 Method

2.2.1.1 Design.

The experiment took a between-participant design in which the effect of the independent variable Future Possibility (FP: High/Low) on participants' judgments of affect was tested.

2.2.1.2 Participants

Thirty five Durham University students (16 males, 18 females and 1 failed to report gender) were recruited in the lounge of the university library. The experiment was run in a small group of two to five and participants were paid £3 to take part.

2.2.1.3 Materials and Procedure

At the beginning of the experiment, participants were given an oral briefing about the purpose and the basic procedure of the experiment. They were told that the experiment was to investigate how people respond to successes and failures and their task involved reading a short story and answering some questions afterwards. They were also offered opportunities to raise any questions before commencing the experiment. If they agreed to proceed, a questionnaire was handed to them, which consisted of a consent form as a cover page, a short story and some follow-up questions. Participants were asked to sign the consent form before they moved on to read the story.

There were two versions of the story corresponding to the two levels of the independent variable (FP: High/Low). Prior to the experiment, a random sequence was generated by a computer, consisting of two digits (0 and 1). The different versions of the questionnaires were distributed to the participants according to this random sequence, where 0 denoted FP: Low condition and 1 denoted FP: High condition. The story for FP: High condition read as follows:

The Brazilian National Championships Série A is the highest division of Brazilian football, which is composed of the 20 most competitive football clubs in the country. Football teams

Flamengo and Sao Paulo are both the top clubs in the championships. They are now confronting each other in the national stadium and the game is about to begin. It is hard to predict which team will win because both teams showed top form in previous matches against other opponents. According to the rules set by the Brazilian Football Confederation, the team who wins the match obtains 3 points and the team who loses obtains none. If the scores are tied at the end of the full time (90 minutes plus injury time), the game ends in a draw, in which case both teams obtain 1 point. Since Flamengo and Sao Paulo currently hold equal points in the championship ranking table and it is near the end of the season, the result of this match will be critical to both teams.

After kicking-off, both teams have managed to exert some pressure on the opponent's defense line but no real threat was caused by either team. *Now it is roughly eight minutes into the first half of game and the scores are still 0-0.*

Flamengo starts to build up their attack on the edge of the opponent's penalty area. They are showing excellent skills and teamwork. The defense line of Sao Paulo is torn apart while the Flamengo midfielder Lenon breaks into the penalty area with the ball. Lenon then passes the ball to his teammate Adriano (striker of Flamengo), who is currently in a good shooting position. Adriano gives it a powerful shot. But the ball hits the goal post

and is deflected back into the pitch. A Sao Paulo defender clears the ball. The scores remain 0-0.

The story in the FP: Low condition was the same in every aspect except for that the italicized part was replaced by “Now the game has entered injury time of the second half and it will be roughly two minutes before the referee ends the whole game. The scores are still 0-0.”

Immediately after reading the story, participants were asked to make a judgment of the global affective states of the players:

Which players do you think are in a better mood right now? _____

A) The players of Flamengo B) The players of Sao Paulo

Then participants were asked to provide open-ended reasons for their choices (which were coded according to whether they reflected a focus on the past or future implications of the near-miss):

Could you tell us why you think they are in a better mood?

Participants’ counterfactual probability estimates were measured by two questions:

At this moment, one of the players is thinking: “things could have been better.” Who do you think it is? _____

A) A player of Flamengo B) A player of Sao Paulo

At this moment, one of the players is thinking: “things could have been worse.” Who do you think it is? _____

A) A player of Flamengo

B) A player of Sao Paulo

To check whether the participants had a grasp of the key elements of the story, participants were asked to choose the players of which team would be more likely to think “we almost scored a goal” and which team would be more likely to think “we almost conceded a goal”.

The questionnaire also included some measures whose purpose digress from the main theme of the thesis and hence were not introduced in the main body of the thesis. However, a complete sample of the questionnaire can be found in Appendix A.

The experimenter left the participants to work on the questionnaires by themselves. After around 15 minutes, the experimenter returned and collected the finished questionnaires. Participants were debriefed in a written form and were paid and thanked for their contribution to the study.

2.2.2 Results

2.2.2.1 Comprehensibility Check

All participants ($N=35$) reported that the content of the story, the instructions as well as the questions were easy to understand. Moreover, 97% of the participants (34 out of 35) thought the players of Flamengo (the attacking team who nearly scored a goal) were more likely to think “We almost scored a goal” and 86% of the participants (30 out of 35) thought the players of Sao Paulo (the defending team who nearly conceded a goal) were more likely to think “We almost conceded a goal”. It was concluded that all participants understood the story quite well and no action was

taken to exclude any case from the analysis due to the problem of the comprehensibility of the story or the questions¹.

2.2.2.2 Affect

As predicted the results showed that participants' global affect judgments were significantly affected by the future possibility manipulation. A significantly higher proportion of participants thought Flamengo (the attacking team who nearly scored a goal) would be feeling better than San Paulo (the defending team who nearly conceded a goal) in the FP: High condition (goal nearly scored/ conceded 8 minutes into the first half of the game) than the FP: Low condition (goal nearly scored/ conceded 2 minutes from the end of the game): $\chi^2(1, N=35) = 5.04, p = .025, w = .38$. Moreover, the proportion of participants who chose San Paulo dropped from a significant majority of 76.5% (13 out of 17, $\chi^2(1, N=17) = 4.77, p = .029, w = .53$) in the FP: Low condition to a non-significant minority of 38.9% (7 out of 18, $\chi^2(1, N=18) = 0.89, p = .346, w = .22$) in the FP: High condition. The result therefore supports the suggestion that the contrast effect, which dominates the affective experience when the near-miss occurs at the end of the game, is cancelled out, although not overridden, by the rise of the assimilation effect when the near-miss incident occurs at the beginning of the game.

¹ Although there were a few participants gave erroneous answers to one of the two questions (e.g. chose Flamengo to be the team who are more likely to think "we almost conceded a goal"), all of these erroneous choices conflicted with their own for the other question (e.g. chose Flamengo as the team who is more likely to think "we almost scored a goal" and the team "we almost conceded a goal" at the same time). Thus, it was believed that the reason for those incorrect responses might be that the participants had difficulties in understanding the meaning of the phrase "conceded a goal" in the second question or other errors other than the poor understanding of the story. Since there was no participant giving incorrect answers to both of the two questions, it was concluded that all the participants understood the story quite well.

2.2.2.3 Counterfactual Probability Estimates

Because being proximate to a focal outcome would heighten one's counterfactual probability estimates regarding that outcome, being close to a desirable state should provoke the sense that "things could have been better", while being close to a undesirable state should provoke the sense that "things could have been worse". The results confirmed this prediction. Regardless of FP conditions, the majority of participants (28 out of 35 participants, 80%) thought the players of Flamengo were more likely to think "things could have been better" than of Sao Paulo, $\chi^2(1, N=35)=12.60, p<.001, w=.60$; On the other hand, the majority of participants (32 out of 35 participants, 91.4%) thought the players of Sao Paulo were more likely to think "things could have been worse" than of Flamengo, $\chi^2(1, N=35)=24.03, p<.001, w=.83$.

2.2.2.4 Attention Focus

One assumption that underlies the proposed effect of future possibility is that people's focus is switched from the past to the future implications of a highly probable counterfactual. Evidence for this attention-switching mechanism was obtained from participants' responses to the open-ended question, which were coded by the two authors into one of three categories (see Table 2.1 for examples): Past implication (what did happen or what could have happened in the past); Future implication (the impacts of the counterfactual on the players' confidence or their perceived chance of scoring or winning); Others (neither of the two former categories). The coders were blind to experimental conditions and their inter-coder reliability was high (Agreement = 91.4% and Cohen's Kappa = 85.5%). Disagreements were resolved by discussion.

Table 2.1 *Examples of Coding Categories used in Content Analysis*

Category	Examples
Past Implication	<p>Because they (Sao Paulo) nearly lost the game at the last minute but didn't. The Flamengo players will be annoyed they missed the last chance</p> <p>They (Sao Paulo) manage to get 1 point out of a game they could have lost</p> <p>Because they (Sao Paulo) were close to losing in the last few minutes and they stayed strong and defended.</p> <p>They (Sao Paulo) have weathered an offensive play without conceding a goal</p>
Future Implication	<p>They (Flamengo) gained the advantage, breaking the defense showing it can be done scoring the opponents. Though they missed, they know it can be done .</p> <p>Despite having narrowly missing the target their team (Flamengo) effort was successful at breaking through the defense and taking a shot. This would give confidence to try to do it again. Also Sao Paolo may be nervous from the near miss and frustrated because of being outmaneuvered by the opposition.</p> <p>Whilst most of the game was even, the slight edge in better play at the end for the Flamengo players will allow them to feel they are the better side and give a psychological boost going into other games, and for the remainder of this game</p> <p>Because they (Flamengo) shows promising signs of winning the match. Their team is on the offense and with high spirits may well have another attack</p>
Others	<p>Because they (Flamengo) are in the fighting mode, which makes Sao Paulo get in a panic</p> <p>They (Flamengo) are showing excellent skill and teamwork.</p>

It was predicted that a higher proportion of future-implication statements and a lower proportion of past-implications statements should be found in the FP: High condition compared to the FP: Low condition. The data supports this prediction – a significantly higher proportion of future perspective responses were found in FP: High (9 out of 18, 50%) than FP: Low (1 out of 17, 6%) ($\chi^2(1, N=35) = 8.34, p = .004, w = .49$), while a significant lower proportion of past perspective responses were found in FP: High (7 out of 18, 39%) than FP: Low (13 out of 17, 77%) ($\chi^2(1, N=35) = 5.04, p = .025, w = .38$).

2.2.3 Discussion

The experiment provided an initial demonstration of the moderating effect of perceived future possibility on the emotional reactions to close outcomes. In a football match, after one of the teams came close to scoring a goal, participants' judgments of affect regarding the players of the two teams were dependant on the temporal position in the game when the near-miss incident occurs – a domination of the contrast effect was only observed when the near-miss was said to have occurred at the late stage of the match (i.e., the perception of future possibility was low).

Some components of the proposed psychological mechanism behind the observed effect of future possibility were also put to test in the experiment. First of all, the proposition that proximity would lift one's counterfactual probability estimates received support from the results. Being close to a desirable state provoked the thought "things could have been better", while being close to an undesirable state provoked the thought "things could have been worse". Secondly, the presence of future possibility was found to have encouraged people to cast their eyes into the future. In participants' free responses, more statements reflecting future perspectives

and less statements reflecting past perspectives towards the close counterfactuals were recorded when the future possibility was high than low.

Nonetheless, there are a few limitations about the study that need to be noted. First of all, although the results indicate that the presence of future possibility enhanced the strength of the assimilation effect when the near-miss occurred at the beginning of the game, the effect did not seem to be strong enough to reverse the contrast-effect-dominated emotional experience when future possibility was low. However, this could be partly due to the low power of the chi-square test applied to our categorical data. Thus, higher level of measurements should be introduced in future experiments to allow for more powerful statistical tests to be applied. Secondly, participants' counterfactual probability estimates were not measured explicitly, which renders the results open to other interpretations. For example, there is ambiguity in the two questions measuring counterfactual probability judgments whether they actually measures counterfactual probability estimates or counterfactual activations. Finally, the mediating effect of counterfactual probability estimates has not been tested using formal statistical procedures. The applications of those statistical procedures will also require emotions and counterfactual probability estimates to be measured in a more refined manner.

2.3 Experiment 2

Experiment 1 provided an initial demonstration how the perception of future possibility moderates people's emotional reactions to outcome closeness. Evidence was also found that the proximity to a focal outcome (e.g. scoring a goal in a football match) lifted people's estimates of counterfactual probability and the presence of

future possibility switched one's focus from the past implications of a counterfactual following a near-miss incident to its future implications.

Experiment 2 aimed to replicate those findings and examine the proposed psychological mechanism under the moderating effect of future possibility more comprehensively. To be more specific, Experiment 2 employed more refined measures of emotions and counterfactual probability estimates (e.g., affective states were measured by multi-item scale with nine levels of measurement for each item), which allowed the mediating role of counterfactual probability estimates to be tested by a parametric statistical method. What's more, to fill a gap in existing research on the proximity-counterfactual probability relationship, this experiment investigated people's conditional, rather than unconditional, counterfactual probability judgments. For simplicity, the experiment exclusively focused on the situation where a desirable goal is narrowly missed and upward counterfactuals are prominent.

In the experiment, participants were asked to imagine themselves as a graduate student who spends his/her whole evening in a bar and fails a job-entry examination the day after. Note that the exceptional antecedent (i.e., "drinking in the bar") featured in the story would enable us to phrase the question regarding the counterfactual probability judgment as a conditional one (e.g., "How likely could you have passed the examination if you hadn't spent so much time in the bar"). Proximity was manipulated by varying the numerical distance between the student's marks and the passing benchmark (1 point versus 45 points). The perception of future possibility was manipulated by granting or not granting a chance of resit in the story.

An interaction between proximity and future possibility on the student's emotional experiences was predicted. More specifically, a domination of the contrast effect should be observed when future possibility is low. That is, the student should be judged to feel worse if he/she failed the examination by 1 point than if he/she failed by 45 points. However, this pattern should be reversed when the future possibility is high, where the assimilation effect should override the contrast effect and the student should be judged to feel better if he/she failed the examination by 1 point than if he/she failed by 45 points.

It was also predicted that the counterfactual probability estimates (i.e., the likelihood of passing the examination if not drinking) should mediate the effect of proximity on emotions and the nature of this mediation should be contingent on people's perception of future possibility. Firstly, overall, probability should be judged higher if the student failed the examination by 1 point than 45 points. Secondly, this probability judgment should be negatively correlated with emotions (contrast-dominant) when future possibility is low but positively correlated with emotions (assimilation-dominant) when future possibility is high. This moderated mediation was tested by a method recommended by Preacher, Rucker, and Hayes (2007), the detail of which will be given in the results section.

Finally, consistent with the finding of Experiment 1, it was predicted that the presence of future possibility should divert people's focus from the past implications of the counterfactual (e.g. "I could have passed the examination but I didn't") to its future implications (e.g. "I can pass the examination").

2.3.1 Method

2.3.1.1 Design

The experiment investigated the effects of two independent variables – proximity and perceived future possibility (FP) on counterfactual probability judgments and emotions. It adopted a 2 (Proximity: Close/Far) × 2 (FP: High/Low) between-participant design.

2.3.1.2 Participants

A total of 115 psychology undergraduates of Durham University were recruited to take part in the experiment. The experiment was run in three separate sessions on three different occasions. The sample for the first session consisted of 64 first-year psychology undergraduates, who were recruited as participants during their induction lecture at the beginning of one academic term. The other two sessions took place one week later at two second-year research methods lectures, with 20 and 30 psychology undergraduates respectively. All participants received participants' credit in return and the ones in the last two sessions received additional monetary incentive (£3) for their contributions. One participant failed to respond to any question in the questionnaire and was excluded from the analysis, which left the sample with 114 participants.

2.3.1.3 Materials and Procedure

In the experiment, participants completed a questionnaire which consisted of (a) a consent form as the cover page and (b) two short stories with questions following each².

The first story depicted a graduate student who gets drunk in a bar and fails a job-entry examination the day after. Participants read one of the four versions of the story depending on conditions. Here is the story for the Proximity: Close/FP: Low condition:

Please **vividly imagine** that you were applying for a job that you have been longing for. After the job interview, you were told that you had won the eligibility for the final entrance test. You would have to score at least 80 out of 100 points or your job application would be rejected.

You only have one chance to pass the test.

You had been preparing for the test for the whole month and you were planning to revise the whole material one last time the night before the test to “recharge” yourself. However, in the afternoon before the day of the test, you came across an old friend you hadn’t seen for quite a while on your way home from the library. You decided to buy him or her a drink in the local bar. Being aware that you would have a test the very next morning, you promised yourself to get back home no later than 7pm so you

² The second story and its questions pertained to the experiment reported in Chapter 3.

could do some study before going to bed. However, you two were having such a good time that neither of you were ready to call it an end until very late. It was already midnight when you eventually got home. Being too tired to study, you slammed yourself into bed.

You got up a little bit late the next morning. You grabbed your stuff and rushed out. You managed to arrive at the test venue on time and dashed onto your seat only seconds before the test began. You regained your breath and started working on the questions. Two hours later, you finished the test.

You got the results one week later by mail. [You opened the mail only to find you've got 79 on your result sheet – you failed the test by 1 point.] *Therefore your job application would be rejected.*

In the Proximity: Far condition, the words in square brackets were replaced by “You opened the mail only to find you've got 35 on your result sheet – you failed the test by 45 points”. In the FP: High condition, the two italicised sections were replaced in order by “You have two chances to pass the test. If you fail the test on your first attempt you will have a chance to resit the test 2 weeks later” and “But you would have a chance to take the resit 2 weeks later”.

The story was followed by a number of questions. To measure participants' temporal perspective (i.e., the extent to which their thoughts were oriented to the past implications of the counterfactual as opposed to its future implications), an open-ended question was presented to participants where they were prompted to list five

thoughts that most easily came to their mind regarding what had happened in the story.

Participants' emotional responses were then measured by asking them to rate on 9-point scales (1=Not at all, 9=Extremely) the extent to which each of the following emotions had described their feelings after receiving the result of the exam: "happy", "satisfied", "pleased", "delighted", "content", "relieved", "glad", "proud", "determined", "annoyed", "frustrated", "miserable", "sad", "depressed", "gloomy", "disappointed", "guilty", "regretful". The ratings were rescored from 0 (1=not at all) to -8 (9=extremely) for the negative emotions and 0 (1=not at all) to +8 (9=extremely) for the positive emotions. Hence, on both positive and negative scales, 0 represents a lack of emotion (neutrality) with higher scores representing better moods and lower scores worse moods.

Afterwards, to provide complementary measures of people's temporal perspective, the participants were presented with six statements and were asked to rate on 9-point scales how likely each of those thoughts would come to their mind given what had happened in the story (1=Extremely unlikely, 9=Extremely likely). As Table 2.2 demonstrates, among those statements, three reflected a focus on the past implications of the counterfactuals. The other three reflected a focus on their future implications. These thoughts were picked from the free-responses of a different group of participants in a pilot study conducted earlier which adopted the same scenario.

Table 2.2 *Items for Measuring Temporal Perspective*

Category	Statements
Past-Implications	1: If only I had studied the night before the test instead of having so many drinks.
	2: Why did my friend have to show up the night before the test?
	3: I shouldn't have gone out with my friend.
Future-Implications	1: I nearly passed the test this time and I believe I will have a very good chance if a resit opportunity is given.
	2: It's good to know I've got the potential to pass the test and I'm competent for the job.
	3: I feel bad because I don't seem to be competent for the job.

Participants' counterfactual probability estimates were measured by asking them to rate on a 9-point scale as to "How likely you think you would have passed the test if you hadn't spent so much time in the bar the night before?" (1=Extremely unlikely, 9=Extremely likely).

To check if the manipulation on proximity was successful, participants were asked to rate how close or far away they were to passing the test (1=Extremely far away, 9=Extremely close)³.

The questionnaire also included some measures whose purpose digress from the main theme of the thesis and hence were not introduced in the main body of the thesis. However, a complete sample of the questionnaire can be found in Appendix B.

³ Only the participants in the last two sessions (N=50) were presented with this question.

In all three sessions, the experimenter walked into the classroom at the end of a lecture and gave a brief introduction to the class as to the purpose (which was said to investigate how people respond to success and failure) and the procedure of the study. Then a questionnaire was handed out to each participant. After signing the consent form on the front page, participants moved on to read the first story. Participants were randomly assigned to four different conditions (Proximity: Close/Far x FP: High/Low) in a similar way as in Experiment 1. All participants worked on the questionnaire at their own paces. After they had all finished and handed in the questionnaire, the experimenter gave the whole class an oral debriefing about the theoretical background of the study.

2.3.2 Results

2.3.2.1 Manipulation Check

To check if the manipulation on proximity was successful, 50 participants in the last two sessions rated how close or far away they were to passing the test (1=Extremely far away, 9=Extremely close). A proximity × future possibility (FP) two-way ANOVA revealed a significant main effect of proximity on participants' ratings ($F(1,46) = 104.77, p < .001, r = .83$). As Figure 2.3 demonstrates, the participants in the Proximity: Close condition perceived that they had been closer to passing the examination ($M = 8.36, SD = 0.95$) than those in the Proximity: Far condition ($M = 4.45, SD = 1.99$).

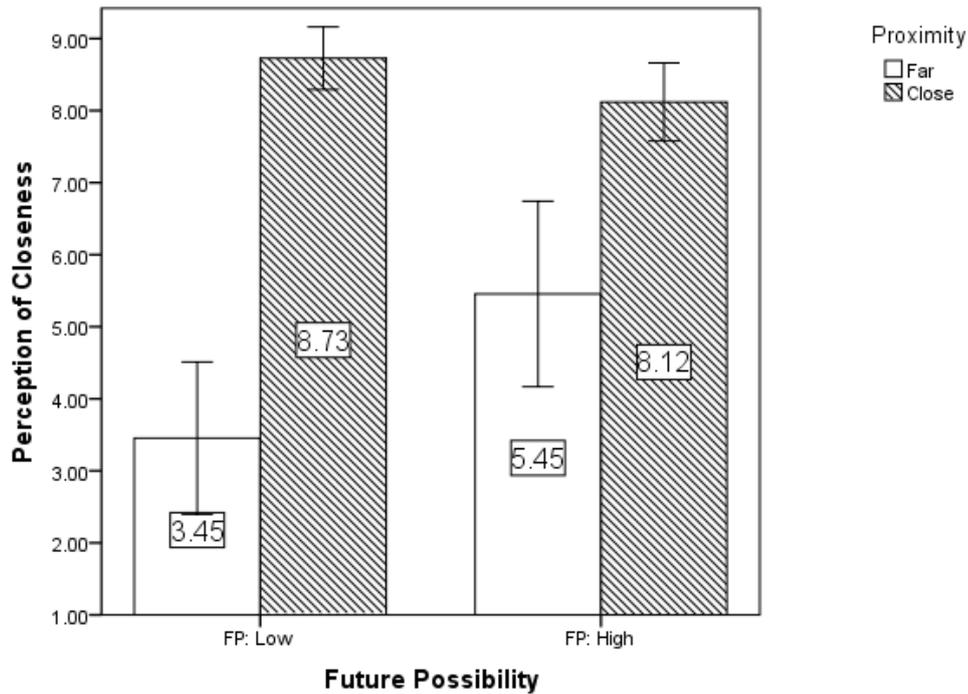


Figure 2.3 Mean (with error bars representing 95% CIs) Perception of Closeness across all Conditions

Surprisingly, while the main effect of FP was not significant ($F(1,46) = 3.22$, $p = .080$, $r = .26$), the analysis found a significant interaction ($F(1,46) = 11.33$, $p = .002$, $r = .45$). As Figure 2.3 depicts, the difference in perceived closeness between the Proximity: Close and Far conditions was bigger in the FP: Low condition ($F(1, 20) = 105.79$, $p < .001$, $r = .92$) than in the FP: High condition ($F(1, 20) = 22.60$, $p < .001$, $r = .68$). A simple main effect analysis further revealed that while participants' perception of closeness in the Proximity: Close/FP: High condition did not significantly differ from that in the Proximity: Close/FP: Low condition ($F(1, 26) = 2.94$, $p = .098$, $r = .32$), the ratings in the Proximity: Far/FP: High condition was significantly higher than that in the Proximity: Far/FP: low condition ($F(1, 26) = 7.16$, $p = .015$, $r = .51$). The reason for this interaction was unclear but it was

speculated that some participants in the FP: High condition might have misinterpreted the question. That is, while the question was intended to measure their perception of closeness to passing the just-finished examination, they might have interpreted the question to be about their perceived closeness to passing the whole test, in which case the closeness to passing the resit might also be taken into account. This should have caused the overall ratings in the FP: High condition to be higher in the FP: Low condition. However, the ratings in the FP: High/Proximity: Close condition had already hit the upper end of the scale and thus could not be raised further due to a ceiling effect. Therefore, a significant interaction was observed. Overall, the manipulation of proximity was deemed to be successful because on each level of future possibility, proximity had significant effect on people's perception of closeness.

2.3.2.2 Counterfactual Probability Estimates

Confirming the prediction, a two-way ANOVA revealed a significant main effect of proximity on counterfactual probability estimates ($F(1,110) = 5.15, p = .025, r = .21$) (see Figure 2.4). More specifically, participants reported higher counterfactual probability estimates (i.e., chance of passing) when they read that they failed the test by 1 point ($M = 7.51, SD = 1.36$) than if they failed by 45 points ($M = 6.89, SD = 1.46$). Figure 2.4 suggested an interaction between proximity and FP – the effect of outcome proximity on counterfactual probability judgments appeared to be weaker in FP: Low than in FP: High condition. However, analysis revealed that this interaction was not significant ($F(1,110) = 1.03, p = .312, r = .09$). What's also within expectation is that the main effect of FP was not significant ($F(1,110) = 0.06, p = .813, r = .03$).

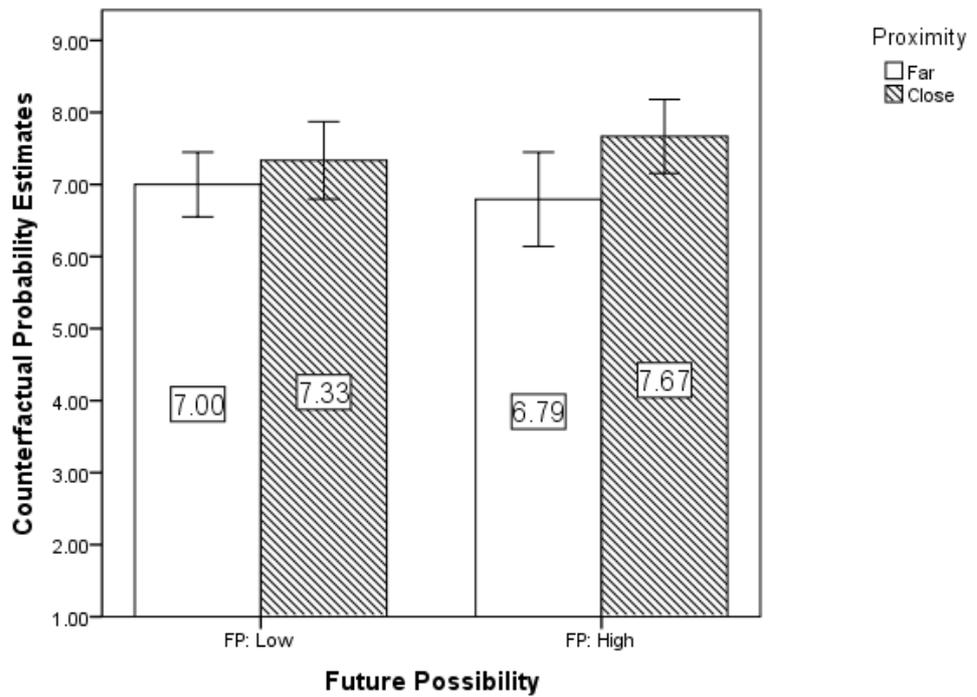


Figure 2.4 Mean (with error bars representing 95% CIs) Counterfactual Probability Estimates across all Conditions

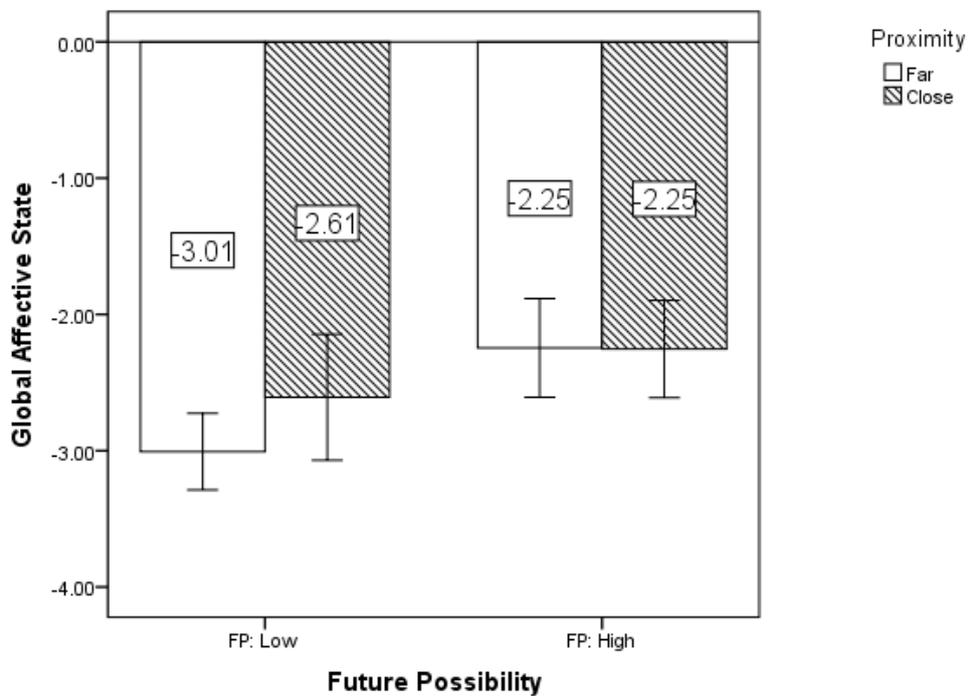


Figure 2.5 Mean (with error bars representing 95% CIs) Affect Ratings across all Conditions

2.3.2.3 Affective States

The 18-item affect measures yielded a high internal reliability (Cronbach's $\alpha = .86$). However, the item "determined" was found to be poorly correlated to the total score ($r = .06$) and was excluded from the scale. As a result, the internal reliability was improved (Cronbach's $\alpha = .88$). The scores of the remaining items were averaged as a measure of the global affective state of each participant. Figure 2.5 shows the average levels of the global affective states across the four conditions. A two-way ANOVA revealed a significant main effect of future possibility ($F(1,110) = 9.60, p = .002, r = .28$). That is, overall, participants reported better mood when a chance of a resit was rendered ($M = -2.25, SD = 0.95$) than when it was not ($M = -2.81, SD = 0.98$). This is unsurprising because generally, the failure in the FP: high condition should not be perceived as severe as in the FP: Low condition and thus should cause less intense emotional reactions.

However, as shown by Figure 2.5, the data displays a pattern of interaction that is inconsistent with the prediction. When FP was low, instead of reporting worse mood as predicted, participants in the Proximity: Close condition reported better mood ($M = -2.61, SD = 1.17$) than those in the Proximity: Far condition ($M = -3.01, SD = 0.73$). When FP was high, on the other hand, instead of reporting better mood as predicted, participants in the Proximity: Close condition reported nearly as bad mood ($M = -2.25, SD = 0.96$) as those in the Proximity: Far condition ($M = -2.25, SD = 0.95$). Nevertheless, the analysis showed that this interaction was not significant ($F(1,110) = 1.28, p = .261, r = .10$). In fact, the mean affect ratings did not significantly differ with respect to the proximity manipulation in either the FP: Low ($F(1,110) = 2.34, p = .132, r = .20$) or the FP: High condition ($F(1,110) < .01, p = .974, r < .01$). The main effect of proximity on affect was not significant, either

($F(1,110) = 1.18, p = .280, r = .10$). These results therefore fail to support the hypothesis that the presence of future possibility would enhance affective assimilation and the absence of future possibility would enhance affective contrast. Separate analyses on the means of positive emotions and negative emotions as well as on each individual emotion yielded the same pattern of results and hence they are not reported here. This is also the case for all other experiments reported in the thesis which use multi-item affect measure.

2.3.2.4 The Mediating effect of Counterfactual Probability Estimates

Because the overall effect of proximity on emotions was not significant in either the FP: Low or the FP: High condition, the hypothesis that counterfactual probability estimates mediates the effect of proximity on emotions was not supported. Thus, from this point on, counterfactual probability estimates will be treated as a potential *intervening* variable instead of *mediating* variable. As pointed out by Preacher and Hayes (2004, p. 719), “A mediated effect is usually thought of as the special case of indirect effects when there is only one intervening variable.” However, an independent variable (e.g., proximity) could exert *indirect* effects on a dependent variable (e.g., emotions) through several paths or intervening variables. Those indirect effects are not necessarily operating in the same directions and they could dilute the effects of each other and result in a null overall effect. Thus, in the present experiment, it is still possible that proximity did exert an indirect effect on emotions via the intervening variable of counterfactual probability estimates but this effect was washed out by other unidentified intervening variables. This possibility was examined by the strategy of coefficient product verified by bootstrapping, which is recommended by Preacher et al. (2007) as a method of testing conditional indirect effects (the indirect effect examined in our experiment is “conditional” because it

was predicted to be contingent on the different level of FP). Before this conditional indirect effect was tested, participants' proximity conditions were coded as 0 (far) or 1 (close) and their FP conditions were coded as 0 (FP: High) and 1 (FP: Low).

Firstly, path *a* in Figure 2.2 was examined by running a simple regression on the proposed mediator (i.e., counterfactual probability estimates) with outcome proximity as the predictor. Confirming the earlier results of the two-way ANOVA analysis, it was found that outcome proximity significantly predict the counterfactual probability estimate ($\beta = .21, t = 2.32, p = .022$). Secondly, to investigate path *b*, a multiple regression was conducted on the dependent variable (i.e., emotions) with outcome proximity, counterfactual probability estimates, FP as well as the product of counterfactual probability estimates and FP as the predictors. The results in Table 2.3 show that the product of counterfactual probability estimates and FP significantly predicted emotions, which implies an interaction between counterfactual probability estimates and FP on emotions. This also indicates that there was a conditional indirect effect of outcome proximity on emotions via counterfactual probability estimates.

Table 2.3 *Regression on Emotions*

Predictor	β	<i>t</i> value	<i>p</i> - value
Constant	-	-2.83	0.006
Proximity	0.15	1.77	0.080
CTP	0.19	0.75	0.453
FP	0.71	1.60	0.114
CTP × FP	-1.14	-2.29	0.024

Note: Key: CTP = Counterfactual Probability Judgments; FP = Future Possibility

Thus, we continue to examine the indirect effect on each level of FP. Those indirect effects (path ab) are tested by comparing the ratio of ab and SE_{ab} (i.e., the standard error of ab) to a critical value in the standard normal distribution given an alpha level. The Analysis revealed that the indirect effect was only significant in the FP: Low condition ($Z = -2.01, p = .045$; Bootstrap (5000 samples) 95% CI: $\{-0.5155, -0.0427\}$) but not in the FP: High condition ($Z = -1.41, p = .159$; Bootstrap (5000 samples) 95% CI: $\{-0.2754, 0.0121\}$). Further analyses show that this conditional indirect effect was caused by the fact that, when controlling for outcome proximity, counterfactual probability estimates only have a negative effect on emotions in the FP: Low condition ($\beta = -.55, t = -4.89, p < .001$) while this effect was reduced to a non-significant level in the FP: High condition ($\beta = -.21, t = -1.53, p = .131$).

Overall, these results suggest that outcome proximity has an indirect effect on emotions via counterfactual probability estimates and this indirect effect is moderated by the perception of future possibility. While counterfactual probability estimates influenced emotions in the direction of the contrast-domination when future possibility is low, this effect seemed to be cancelled out, although not reversed, by the enhancement in the assimilation effect when future possibility is high.

2.3.2.5 Attention Focus

To measure participants' temporal perspective, their free responses to the thought listing task were coded as to whether they reflected a focus on the past implications of the counterfactuals or their future implications. The coding scheme followed similar protocols as in Experiment 1 and the inter-coder reliability was high (Agreement percentage = 98%; Cohen's Kappa = 86%). Examples for the statements that reflected a past perspective are: "Should have been prepared"; "Annoyed that I

was only 1 point away” and “Disappointed with my test performance – I probably could have done better”. Examples for the statements that reflected a future perspective are: “Hopeful for next time”; “Happiness that I scored so well even though I had not prepared. Probably a good sign for the resit” and “You can still get the job”.

Table 2.4 summarises the number of past and future-perspective statements generated by participants in the two future possibility conditions. It is noticeable that only a small proportion of the total statements can be categorised as either past or future oriented statements. For example, participants in FP: Low condition only generated four future-perspective statements all together and most participants in this condition generate no such statements. This rendered the parametric tests on the average number of past/future-perspective statements per case inappropriate. Thus, the non-parametric Chi-square test was conducted on the total number of statements in each category. In total, participants generated a slightly smaller proportion of past-perspective statements in the FP: High condition (34 out of 291, 11.7%) than in the FP: Low condition (40 out of 267, 15.0%), although this difference was not significant ($\chi^2(1, N=558) = 1.32, p = .251, w = .05$). On the other hand, participants generated a bigger proportion of future-perspective statements in the FP: High condition (47 out of 291, 16.2%) than in the FP: Low condition (4 out of 267, 1.5%). This difference was significant ($\chi^2(1, N=558) = 36.00, p < .001, w = .25$).

Ratings were also obtained towards statements which reflected either a focus on the past implications of the counterfactual or its future implications. The ratings on the three past-perspective statements displayed a good inter-item reliability (Cronbach's $\alpha = .70$). Against the prediction, a two-way ANOVA revealed no

significant main effect of future possibility ($F(1,110) = 0.22, p = .641, r = .04$). That is, the amount of past-implication statements generated in the FP: Low was not significantly more ($M = 6.87, SD = 1.95$) than in the FP: High condition ($M = 7.02, SD = 1.52$). However, a two-way ANOVA revealed a significant main effect of future possibility on the ratings of future-perspective statements (Cronbach's $\alpha = .71$) ($F(1,110) = 11.79, p = .001, r = .31$). On average, participants rated the three future-implication statements higher in the FP: High condition ($M = 6.07, SD = 1.60$) than the FP: Low condition ($M = 5.04, SD = 2.04$), indicating that the participants in the FP: High condition were more future-oriented than those in the FP: Low condition.

Thus, consistent with the findings of Experiment 1, the results from both participants' free written responses and their ratings on the past and future-implication statements confirmed the proposition that the presence of future possibility encouraged people to focus more on the future implications of a counterfactual.

Table 2.4 *The Number of Past and Future-perspective Statements Generated by Participants across FP: Low and FP: High condition*

Category	FP: Low (N = 55)	FP: High (N = 59)
Future-perspective	4 (0.07)	47 (0.8)
Past-perspective	40 (0.73)	34 (0.58)
Total	267 (4.85)	291 (4.93)

Note: Figures in brackets in row 2, 3 and 4 indicate the average number of statements per participant in that particular category and condition.

2.3.3 Discussion

The experiment failed to demonstrate the predicted interaction of proximity and future possibility on emotional responses. In fact, the manipulation of proximity had non-significant effects on emotions both when the perception of future possibility was low and high. This finding not only fails to support the hypothesis regarding the moderating effect of future possibility on emotional reactions to close outcomes, but also contradicts the findings of previous research which demonstrated a domination of the contrast effect after being close to a focal outcome (Johnson, 1986; Kahneman & Tversky, 1982; Macrae et al., 1993; Medvec et al., 1995; Medvec & Savitsky, 1997; Meyers-Levy & Maheswaran, 1992; Miller & McFarland, 1986). Despite the non-significant total effect of outcome proximity on emotions, analyses show that outcome proximity did have an indirect effect on emotions via counterfactual probability estimates. More importantly, being consistent with the prediction, the nature of this indirect effect was moderated by perceived future possibility. The examination on this indirect effect renders some indications why those null effects were obtained, as will be elaborated below.

Proximity-Probability Relationship Confirming the findings of Experiment 1 and previous research (Teigen, 1998, 2005; Tykocinski & Steinberg, 2005), the present experiment demonstrates that outcome closeness has an effect on counterfactual probability estimates. Failing a test by merely 1 point provoked higher estimates of the chance of passing than failing by 45 points. The present experiment also extended the previous findings by showing that *conditional* counterfactual probability judgments are also susceptible to outcome proximity in a similar manner as *unconditional* probability judgments. However, it should be noted that the effect

found in the present experiment was quite weak compared to previous research (e.g., $r = .21$ in the present experiment compared to $r = .56$ in one study reported by Teigen (1998, Study 2)) – it might not be strong enough to be translated into any difference in people’s emotional reactions.

This weak effect highlights the possibility that besides proximity, one’s conditional counterfactual probability estimates might be influenced by other factors. It was speculated that the perceived impact of undoing the antecedent on the factual outcome might also be taken into account when probabilities are computed. For example, for a person who missed the train by half an hour, the thought “If I had not been stuck in the traffic jam, I would have caught the train” might sound more plausible if he/she was stuck in the traffic for half an hour than for 15 minutes. In the two cases, proximities to catching the train were equal. It is the higher impact of the mutation of the antecedent in the former case (i.e. advancing the journey by half an hour) that boosts the counterfactual probability estimation. More importantly, it is possible sometimes that the mutation of an antecedent is considered so impactful on the factual outcome that it overshadows the effect of proximity. For example, if someone was stuck in a traffic jam for as long as an hour, the estimate of the conditional counterfactual probability will be high whether he/she missed the train by five minutes or half an hour. In the same way, in our examination scenario, the impact of the mutation of the exceptional antecedent (i.e. “not drinking in the bar”) might have been considered so big on the factual outcome that the effect of proximity was diluted.

What’s more, the between-participant setup of the experiment might also have weakened the effect of proximity. In one study by Teigen (1998, Study 2), the

effect of physical proximity on counterfactual probability estimates was only found to be significant in a within-participant setup but not in another study adopting the same scenario but using a between-participant setup. This suggests that the counterfactual probability judgments might be more sensitive to the manipulation of proximity in a within-participant design than in a between-participant design, presumably because the variation in proximity is more salient in the former case.

Probability-Affect Relationship As predicted, counterfactual probability estimates were negatively correlated with emotions in the FP: Low condition, exhibiting a quality of the domination of the contrast effect. However, this correlation was reduced to a non-significant level in the FP: High condition, which supports the proposition that the emotional consequences of counterfactual probability judgments are contingent on the perception of future possibility. Also, the nature of the observed moderation was consistent with the prediction of the REM that the absence of future possibility enhances the contrast effect and the presence of future possibility enhances the assimilation effect. This principle also received some support from the examinations on people's temporal perspectives in the two future possibility conditions. Confirming the findings of Experiment 1, evidence from both participants' free written responses and their ratings on future and past-oriented statements indicates that people focused on the future implications of a counterfactual to a greater extent when future possibility was high than it was low.

However, it seems that although the presence of future possibility has promoted the affective assimilation effect, it only managed to cancel out the contrast effect – it failed to override it. For the strength of the assimilation effect to exceed that of the contrast effect, the perception of future possibility might need to be very

high. In the present experiment, the student in the story in the FP: High condition had only one more chance to take a resit, which might not be able to provoke a perception of future possibility that was strong enough to make the assimilation effect dominate one's emotional experiences.

What's more, the effects of counterfactual probability judgments on emotions might have been dampened by the existence of the exceptional antecedent. Drinking before examinations might be deemed to be socially unacceptable or morally wrong, which could have provoked negative emotions like shame and guilt which were unrelated to counterfactual thinking. These negative emotions might have dominated one's affective experiences and made the effects of counterfactual probability judgments fail to stand out.

To sum up, the experiment successfully demonstrated that (1) outcome proximity has an effect on conditional counterfactual probability judgments; and (2) the emotional consequences of these judgments are contingent on the perception of future possibility. However, the experiment failed to demonstrate the predicted interaction of proximity and future possibility on people's emotional experiences. This could be due to: (1) the impactful antecedent in the story and the between-participant setup dampened the effect of proximity on participants' counterfactual probability estimates; and (2) the manipulation of future possibility was not strong enough to cause the assimilation effect to override the contrast effect; and (3) participants' affective experiences were dominated by the negative emotions arising from participants' moral judgments towards the abnormal behaviour (i.e., drinking) and thus the effects of counterfactual probability judgments were washed out. Those methodological limitations were addressed in Experiment 3. Finally, it should also

be noted that the observed effect of numerical proximity on probability judgments in this experiment is subject to alternative interpretations. That is, the reason why participants who failed the examinations by a small margin gave higher counterfactual probability ratings than by a big margin could be simply because they got higher score in the former case (79 versus 35). A similar criticism could be raised regarding Teigen (1998)'s study 3, which used a similar manipulation of numerical proximity. This limitation was also addressed in Experiment 3.

2.4 Experiment 3

Experiment 3 continued to examine the moderating effect of future possibility on the emotional consequences of close outcomes and the mediating role of counterfactual probability judgments. Compared to its predecessor, the present experiment made the following adjustments: (1) To eliminate the unwanted effect of impactful antecedents on people's counterfactual probability judgments and emotions, the present experiment exclusively concentrated on unconditional counterfactual probability estimates and employed a new scenario where exceptional antecedents were excluded; (2) The present experiment treated proximity as a within-participant variable to enhance its effect on probability judgments; (3) A special score arrangement was used by the present experiment to rule out the confounding effect of the absolute value of scores; (4) The manipulation of future possibility was enhanced by increasing the number of opportunities to mutate the final outcome; and (5) This experiment tested the hypotheses more thoroughly than Experiment 2 by examining both situations where people get close to a desirable outcome as well as get close to an undesirable one. This would also enable us to test the "assimilation-based satisfaction reversal" demonstrated by McMullen and

Markman (2002), where being objectively better off but close to an undesirable state could lead to worse mood than being objectively worse off but close to a desirable state, as a result of the affective assimilation effect.

In this experiment participants were presented with a short story where two contestants were taking part in a TV game show competition to win big monetary prizes. Proximity was manipulated by varying the numerical differences between the contestants' scores in the game (Proximity: Close/Far). Participants were asked to focus on either the loser or the winner of the game (Outcome: Lose/Win) and provide judgments of counterfactual probability and affect ratings.

The perception of future possibility (FP) was manipulated by varying the decisiveness of the result of the game to the final outcome of the contest. The perception of future possibility would be high if the final outcome of the contest was determined by the results of several games put together and the players had only finished the first game (FP: High). In comparison, the perception of future possibility would be low if the final outcome of the contest was determined by this one game alone (FP: Low). Overall, a moderating effect of perceived future possibility on people's emotional reactions to outcome closeness was predicted. More specifically, when the result of the game was decisive (FP: Low), the loser (or the winner) of the game should be judged to be feeling worse (or better) if the difference between the scores was small rather than large. However, this effect should be reversed when the result of this particular game was not decisive (FP: High). The "assimilation-based satisfaction reversal" was tested by comparing the emotions of the winners and losers in the FP: High/Proximity: Close condition. In this condition the winners should be judged to be feeling worse than the losers.

The degree to which the counterfactual probability estimates can explain this pattern of results was tested by examining the mediating effect of counterfactual probability estimates in the relationship between proximity and emotions in the FP: Low and the FP: High conditions. First of all, proximity to a focal outcome should increase the counterfactual probability estimates regarding that outcome in all conditions. Secondly, counterfactual probability estimates should be able to predict emotions. In the FP: Low condition, such a relationship should be reflecting the domination of the contrast effect. That is, the higher the counterfactual probability estimates, the worse the mood for the losers but the better the mood for the winners. By comparison, in the FP: High condition, such a relationship should be reflecting the domination of the assimilation effect. That is, the higher the counterfactual probability estimates, the better the mood for the losers but the worse the mood for the winners.

2.4.1 Method

2.4.1.1 Design

The experiment investigated the effects of three independent variables (outcome valence, proximity and future possibility) on people's counterfactual probability estimates and emotions. It employed a 2 (Outcome: win/lose) \times 2 (Proximity: close/far) \times 2 (FP: high/low) mixed design with outcome valence and future possibility being treated as between-participant variables and proximity as a within-participant variable.

2.4.1.2 Participants

A total of 96 undergraduate students (74 females and 22 males) of Durham University participated in the study. Among them, 35 students were recruited from the Department of Psychology, who took participant credits as an exchange for their participation. The remaining 61 were recruited in the lounge area of the university library, each of whom received a £2 monetary reward for their contribution.

2.4.1.3 Materials and Procedure

Participants were randomly assigned to read and answer questions on one of the four versions of a story about a TV game show. The four versions varied according to whether the contestant they were asked to focus on was a winner or a loser of the game (Outcome: Win/Lose) and whether or not there was a future possibility of changing the final outcome of the show (FP: High/Low). There were two sections of the story. Participants answered questions in sections one and two about two different players – one who had won or lost by a small margin (Proximity: Close), the other who had won or lost by a large margin (Proximity: Far). The order in which participants were exposed to “close” and “far” treatments was counterbalanced.

Section one started with the following background story:

“Split Second” is an evening TV game show in America, which features a rich variety of mental and physical challenges in which the contestants try to outperform and eliminate their opponents in order to win big monetary prizes. Each episode of “Split Second” often features more than one arena. Those arenas are located in

different cities across the country. The competitions in different arenas go on separately yet at the same time. At the end of each episode, one winner will be born in each arena and those winners will advance to the next stage of the competition.

In this episode of “Split Second”, 12 contestants will be competing in two separate arenas located in Los Angeles and Philadelphia respectively (six in each arena). The winner of each arena will win a cash prize of \$50,000 and advance to next week’s show, with the potential to win an additional \$100,000. The losers will leave empty-handed.

Here is what happened in the Los Angeles Arena:

After the first few rounds of competition, two contestants, Kelly and Susan, who have the highest scores among the six, stay in the game. Now, the two contestants are facing their final challenge. They have to beat their opponent in this challenge to be the Los Angeles winner of this episode of “Split Second”.

In the final challenge, a basketball shooting machine is introduced to the contestants (as pictured below), which has two bottomless baskets bolted side-by-side on a metal panel at one end of the machine. When the whistle goes off, the two contestants race 15 metres to the machine, pick up balls from the pool and start shooting the balls at the basket which has been pre-assigned to them. They score one point for each ball they throw in. If they

accidentally throw a ball into the wrong basket, their opponent will score one point instead of them. The objective is to outscore their opponent within the time limit of two minutes.

The story was illustrated using a picture of a basketball shooting machine (see Appendix C). The manipulation of future possibility came on a separate page.

FP: Low - The two contestants will play just one round of this game. The contestant who outscores their opponent in this single round will be the winner of Los Angeles Arena in this episode of “Split Second”.

FP: High - The two contestants will play up to five rounds of this game. The contestant who outscores their opponent in 3 of these rounds will be the winner of Los Angeles Arena in this episode of “Split Second”.

Then, on a separate page, the scores of the round were presented, which revealed that Kelly was defeated by Susan. In the Proximity: Close versions one of three pairs of scores with a difference of 1 point was randomly presented (21-22, 17-18 or 13-14 in Outcome: Lose; 28-29, 24-25 or 20-21 in Outcome: Win). In the Proximity: Far versions one of three pairs of scores with a difference of 15 points was randomly presented (21-36, 17-32 or 13-28 in Outcome: Lose; 14-29, 10-25 or 6-21 in Outcome: Win). Please note that in the Outcome: Lose conditions, the absolute scores of the losers are the same across the Proximity: Close and Far conditions (i.e. 21, 17 or 13). Likewise, in the Outcome: Win conditions, the absolute scores of the winners are the same across the Proximity: Close and Far

conditions (i.e. 29, 25 or 21). Thus, any difference in counterfactual probability estimates as well as the emotional reactions found between the two proximity conditions can only be attributed to the closeness of the scores rather than their absolute values.

All the questions that followed concerned either the loser of the game (Kelly) or winner of the game (Susan) depending on whether the questionnaire was an Outcome: Lose or Outcome: Win version.

Judgments of affect were measured by both a single-item and a multi-item affect scale, the purpose of which was to check if two types of measures would produce the same pattern of results. Thus, participants were firstly asked to make judgments about the global affective states of the contestant by rating on a 9-point scale about how negative or positive they thought the contestant would be feeling after the game” (1=extremely negative, 9=extremely positive).

In the multi-item affect measure, participants were asked to rate the extent to which the contestant experienced each of 12 emotions (“happy”, “annoyed”, “satisfied”, “frustrated”, “pleased”, “miserable”, “content”, “relieved”, “disappointed”, “proud”, “elated”, “discouraged”) on 9-point scales (1=not at all, 9=extremely). Like in Experiment 2, the ratings were rescored from 0 (1=not at all) to -8 (9=extremely) for the negative emotions and 0 (1=not at all) to +8 (9=extremely) for the positive emotions. Hence, on both positive and negative scales, 0 represents a lack of emotion (neutrality) with higher scores representing better moods and lower scores worse moods. Then positive and negative affect indices were established by averaging the positive emotions (Cronbach’s $\alpha = .97$ for both Proximity: Close and Far conditions) and negative emotions (Cronbach’s $\alpha = .95$ for

Proximity: Far and .94 for Proximity: Close). An average was then taken of the positive and negative affect indices to establish a Global Affect Index (Cronbach's α = .93 for the Proximity: Far condition and .91 for the Proximity: Close condition).

Counterfactual probability estimates were measured by eliciting ratings of how likely they thought that Kelly (or Susan) could have won (or lost) the round that had just finished (1=extremely unlikely, 9=extremely likely).

As a manipulation check, participants' perceptions of closeness were measured by asking them to rate how close or far away they thought that Kelly (or Susan) had been from winning (or losing) the finished round (1=Extremely far away, 9=extremely close)

The questionnaire also included some measures whose purpose differs from the main theme of the thesis and hence were not introduced in the main body of the thesis. However, a complete sample of the questionnaire can be found in Appendix C.

Section two told a story about another pair of contestants:

Meanwhile, in the Philadelphia Arena, Fiona and Christina are the two contestants who have the highest scores among the six in their group and make it to the final challenge. They take on the same challenge as Kelly and Susan do in the other arena.

Again, a table followed which presented the result of this round. The configurations for the Proximity: Close and Far conditions were the same as in section one. However, the participants who received the Proximity: Close treatment in section one received the Proximity: Far treatment in section two (and vice versa). The questions asked were the same as in section one.

2.4.2 Results

2.4.2.1 Manipulation Check

Because the questions for the participants in the Outcome: Lose and Win conditions were different in that they concerned different outcomes, all the analyses were done separately for the two outcome conditions. A 2 (Proximity) \times 2 (Future possibility) mixed ANOVA was conducted on both the ratings in the Outcome: Lose and Win conditions and revealed significant main effects of proximity on people's perception of closeness in both conditions ($F(1, 46) = 179.82, p < .001, r = .89$ in the lose condition; $F(1, 46) = 334.89, p < .001, r = .94$ in the win condition). That is, in the lose condition, participants thought the loser had been closer to winning when the scores were close ($M = 7.90, SD = 1.52$) rather than when they were far apart ($M = 3.38, SD = 1.51$). Likewise, in the win condition, participants thought the winner had been closer to losing when the scores were close ($M = 7.79, SD = 1.17$) rather than when they were far apart ($M = 3.06, SD = 1.21$). These results suggested that the manipulation of proximity was successful in both outcome conditions. As expected, the analyses did not find significant main effect of future possibility ($F(1, 46) = 0.28, p = .600, r = .08$ in the lose condition; $F(1, 46) = 0.20, p = .654, r = .06$ in the win condition), or proximity \times future possibility interaction ($F(1, 46) = 2.02, p = .162, r = .20$ in lose condition; $F(1, 46) = 0.01, p = .936, r < .01$ in win condition).

2.4.2.2 Global Affect

Participants' ratings on the single-item and multi-item affect scales produced the same pattern of results. Thus, only the analyses on the multi-item affect ratings are reported here. Figures 2.6 and 2.7 show the mean (with 95% CIs) of the global affect index measure for the losers and winners in the FP: Low/High and Proximity: Close/Far conditions.

A mixed ANOVA on the loser's affect revealed an unsurprising significant main effect of future possibility ($F(1, 46) = 5.10, p = .029, r = .32$). The loser was judged to be feeling better when the result of the game was not decisive to the final outcome of the episode ($M = -1.24, SD = 2.69$) than when it was ($M = -2.02, SD = 2.69$). Also, as expected, the main effect of proximity was not found to be significant ($F(1, 46) = 0.02, p = .895, r < .01$). More importantly, being consistent with the prediction, the analysis revealed a significant interaction ($F(1, 46) = 5.81, p = .020, r = .33$). As Figure 2.6 illustrates, when the result of the round was decisive (FP: Low), the losers of the game were thought to be feeling worse if the scores were close than if they were far apart, indicating a dominance of the contrast effect. However, when the result was not decisive (FP: High), a reversed pattern surfaced - those who lost by 1 point were considered to be feeling better than those who lost by 15 points. It should be noted however that these cross-over effects were not large enough to produce statistically significant simple main effects - $F(1, 23) = 3.35, p = .080, r = .36$ and $F(1, 23) = 2.50, p = .127, r = .31$ in the FP: Low and FP: High respectively.

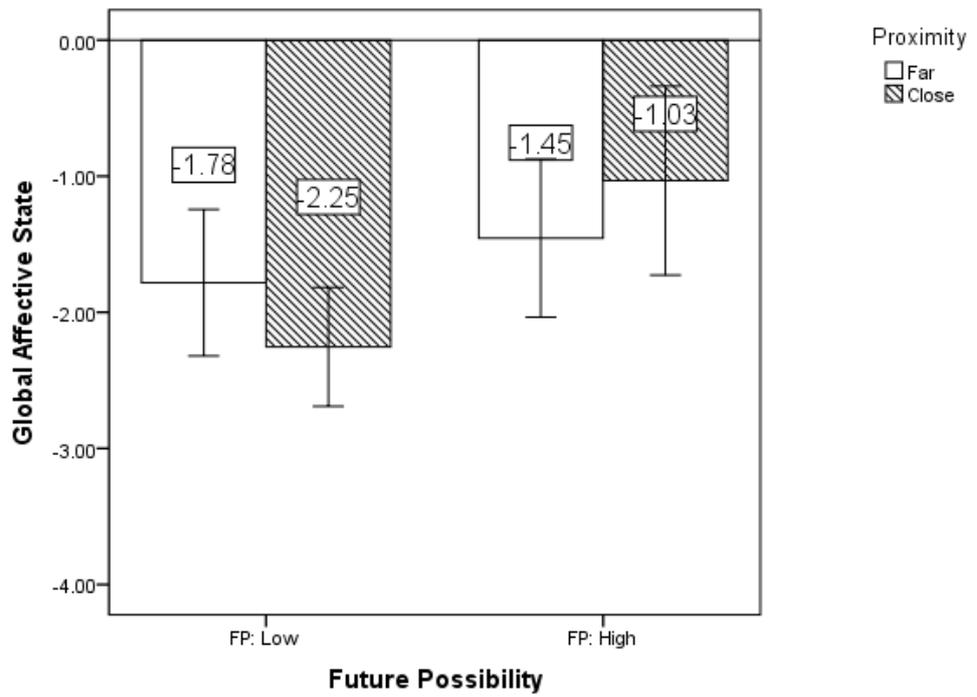


Figure 2.6 Mean (with error bars representing 95% CIs) Affect Ratings in Outcome: Lose Condition

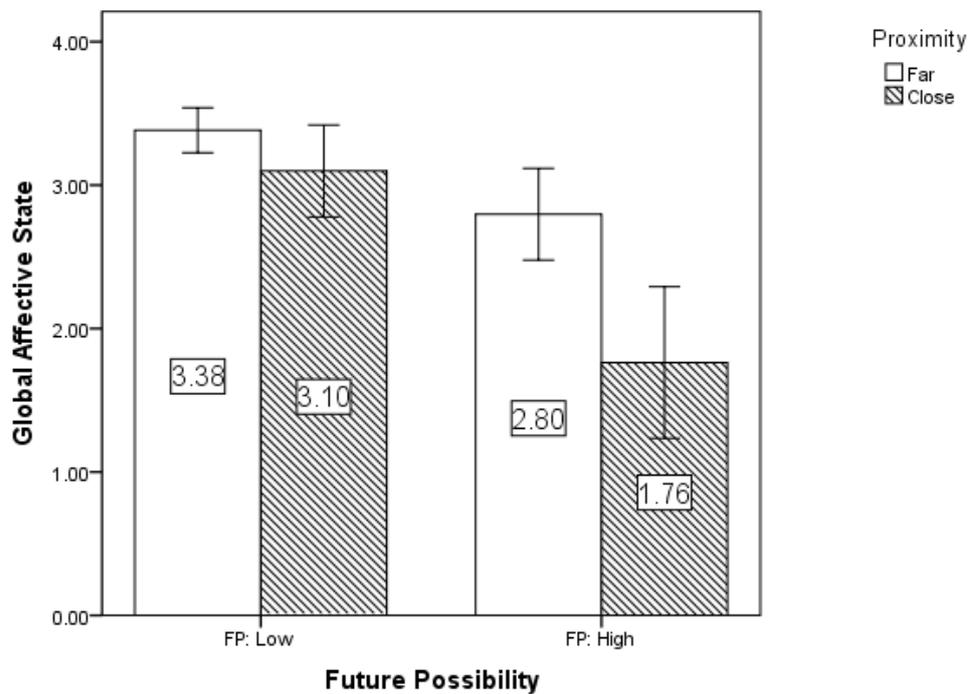


Figure 2.7 Mean (with error bars representing 95% CIs) Affect Ratings in Outcome: Win Condition

A significant main effect of future possibility was also found for the winner's affect ($F(1, 46) = 20.55, p < .001, r = .56$). The winner was judged to be feeling better when the result of the game was decisive to the outcome of the episode ($M = 3.24, SD = 1.08$) than when it was not ($M = 2.28, SD = 1.08$). The main effect of proximity was also significant which was not expected ($F(1, 46) = 29.91, p < .001, r = .63$). The winner was judged to be feeling better when the scores were far apart ($M = 3.09, SD = 0.66$) than when the scores were close ($M = 2.43, SD = 1.23$). However, under the surface of these main effects the proximity \times FP interaction was also significant although it did not fully fit the expected pattern ($F(1, 46) = 9.69, p = .003, r = .42$). As Figure 2.7 illustrates, in both future possibility conditions, winning by 15 points (Proximity: Far) was judged to be better than winning by 1 point (Proximity: Close) – although this difference was smaller and not quite statistically significant when the result of the game was decisive - $F(1, 23) = 4.25, p = .051, r = .40$ in the FP: Low condition; $F(1, 23) = 27.34, p < .001, r = .74$ in the FP: High condition. There is therefore no evidence that the smaller difference in scores increased the winner's pleasure when the game was decisive, although as shown in Figure 2.7, it did reduce their pleasure when the game was not decisive. This latter effect is therefore consistent with our expectations that the affective assimilation effect would be stronger when the perception of future possibility is high.

What's more, an "assimilation-based satisfaction reversal" would predict that when the future possibility was high and the scores were close, the losers should be judged to feel better than the winners. This prediction was not however supported by the results. On the contrary, the results revealed an opposite pattern: in the FP: High and Outcome: Close condition the winners were judged to feel significantly better

($M = 1.76$, $SD = 1.25$) than the losers ($M = -1.03$, $SD = 1.64$) - $F(1, 46) = 43.94$, $p < .001$, $r = .70$.

2.4.2.3 The Mediating effect of Counterfactual Probability

It was hypothesized that counterfactual probability estimates would mediate the relationship between proximity and emotions and that the nature of that mediation would depend upon the perception of future possibility. Following the recommendation by Judd, Kenny, and McClelland (2001), counterfactual probability estimates would be deemed as a mediator between proximity and emotions if the following criteria were satisfied: (1) Proximity has effects on counterfactual probability estimates; (2) Proximity has effects on emotions; (3) Counterfactual probability estimates were related with emotions in each proximity condition; and (4) The difference in emotions between the two proximity treatments (close/far) could be predicted by the difference in counterfactual probability estimates. These four criteria were examined in order. The predictions derived from these four criteria for the FP: Low condition and the FP: High condition were summarised in Tables 2.5 and 2.6 respectively.

Table 2.5 *Predictions and Results regarding the Four Criteria to Identify Counterfactual Probability Estimates as Mediating Variable (FP: Low condition)*

Criterion	Prediction	Lose Condition		Win Condition	
		Descriptives	P-value	Descriptives	P-value
1	$C_C > C_F$	$C_C > C_F$	< .001	$C_C > C_F$	< .001
2	$A_C > A_F$	$A_C > A_F$	= .080	$A_C < A_F$	= .051
3	C_C predicts A_C	$\beta = -0.14$	= .518	$\beta = -0.06$	= .787
	C_F predicts A_F	$\beta = -0.24$	= .267	$\beta = -0.05$	= .812
4	C_D predicts A_D	$\beta = -0.32$	= .151	$\beta = -0.14$	= .531

Note: The prediction was made on the basis that the affect ratings in the lose condition has been reversely coded to keep the predicted effects of proximity on counterfactual probability estimates and emotions on the same direction.

Key: A = Affect Ratings, C = Counterfactual Probability Estimates

Key for subscript letters: C = Close Condition, F = Far Condition, D = Difference between Close and Far Condition

Table 2.6 *Predictions and Results regarding the Four Criteria to Identify Counterfactual Probability Estimates as Mediating Variable (FP: High condition)*

Criterion	Prediction	Descriptives	p-value
1	$C_C > C_F$	$C_C > C_F$	< .001
2	$A_C > A_F$	$A_C > A_F$	< .001
3	C_C predicts A_C	$\beta = 0.34$	= .017
	C_F predicts A_F	$\beta = 0.37$	= .009
4	C_D predicts A_D	$\beta = 0.14$	= .349

Note: The prediction was made on the basis that the affect ratings in win condition has been reversely coded to keep the predicted effects of proximity on counterfactual probability estimates and emotions on the same direction.

Key: A = Affect Ratings, C = Counterfactual Probability Estimates

Key for subscript letters: C = Close Condition, F = Far Condition, D = Difference between Close and Far Condition

First of all, the relationships between proximity and counterfactual probability estimates were examined. Figures 2.8 and 2.9 show the mean counterfactual probability estimates (with 95% CIs) assigned to the losers or winners in the FP: Low/High and Proximity: Close/Far conditions. Our expectation that counterfactual probability estimates would be higher in the Proximity: Close than the Proximity: Far condition was confirmed. Significant main effects of proximity were found in both the Outcome: Lose ($F(1, 46) = 117.16, p < .001, r = .85$) and Outcome: Win conditions ($F(1, 46) = 129.07, p < .001, r = .86$). In the Outcome: Lose condition participants thought the loser had been more likely to win if the scores were close ($M = 7.23, SD = 1.46$) than far apart ($M = 3.92, SD = 1.53$). Likewise, in the Outcome: Win condition, participants thought the winner had been more likely to lose when the scores were close ($M = 6.92, SD = 1.49$) rather than far apart ($M = 3.56, SD = 1.38$).

However, while there was no significant interaction between proximity and future possibility in the Outcome: Win condition ($F(1, 46) = 0.12, p = .726, r = .05$), the interaction was close to significance in the Outcome: Lose condition ($F(1, 46) = 3.90, p = .054, r = .28$). However, simple main effects tests confirmed that participants still gave significantly higher counterfactual probability ratings to the losers when the scores were close rather than far apart in both future possibility conditions – although the differences were larger in the FP: Low condition ($F(1, 23) = 103.48, p < .001, r = .90$) than in the FP: High condition ($F(1, 23) = 32.40, p < .001, r = .76$). Thus, overall, the first criterion of mediating effect was satisfied.

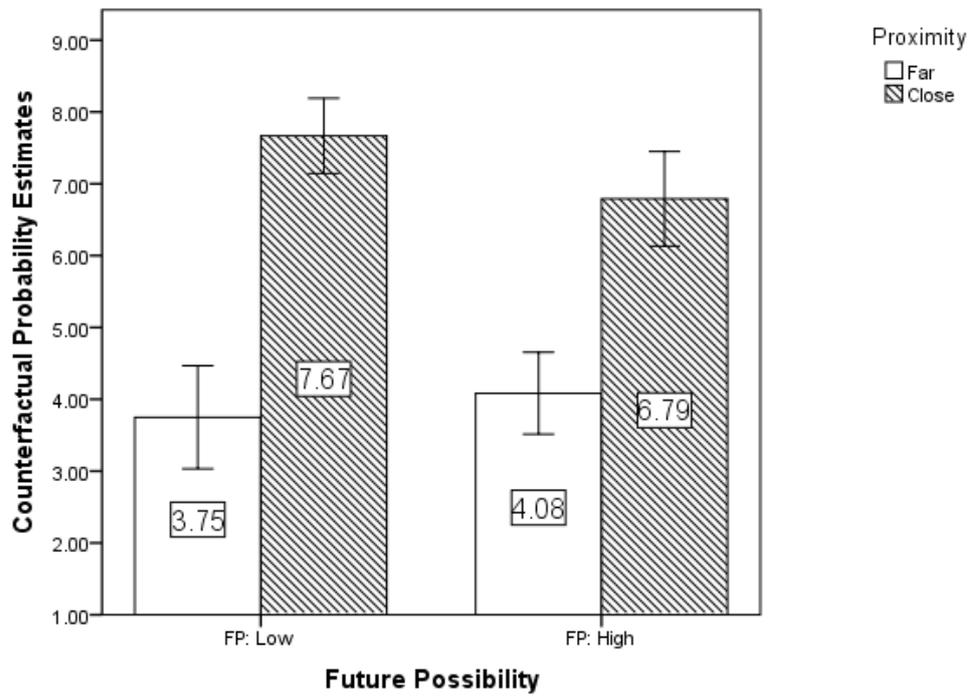


Figure 2.8 Mean (with error bars representing 95% CIs) Counterfactual Probability Estimates in Outcome: Lose Condition

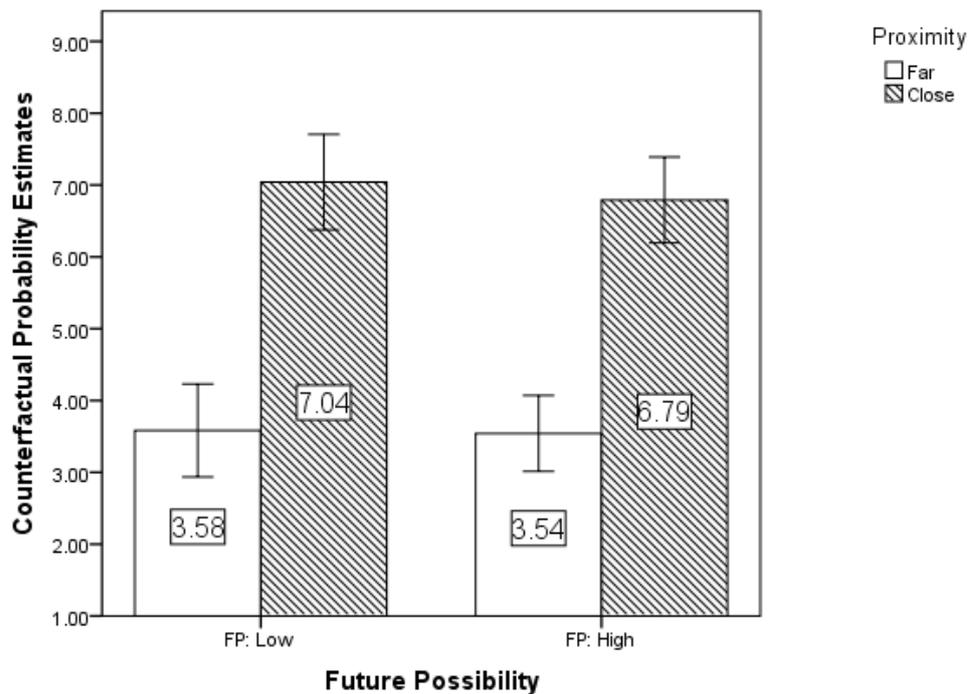


Figure 2.9 Mean (with error bars representing 95% CIs) Counterfactual Probability Estimates in Outcome: Win Condition

Because future possibility was expected to moderate the effect of proximity and the counterfactual probability estimates on emotions. The last three criteria were examined separately for the FP: Low and the FP: High condition.

FP: Low

The affect scores in the Outcome: Lose condition were reversely scored so that the predicted effect of proximity on affect ratings and the counterfactual probability estimates would be in the same direction, as in the Outcome: Win condition. Thus, overall, proximity to a focal outcome should increase the affect ratings, reflecting a domination of contrast effect. However, the results show that the ratings on emotions were not found to differ significantly between the close and far conditions ($F(1, 47) = 0.37, p = .574, r = .09$). This could be because the difference in the affect rating in the win condition was in an unexpected direction (which is opposite to that in the lose condition) and diluted the global effect of proximity on emotions in the FP: Low condition. Thus, it is believed to be the most sensible to examine the mediating effect of counterfactual probability estimates in the lose and the win conditions separately.

Lose Condition The earlier analysis has revealed that the total effect of proximity on emotions was not significant (see Table 2.5), which violates criterion 2. However, mediation analysis was still carried on because the total effect was close to reach a significant level. Regressions were run in both the close and the far condition with A_f (Affect – far condition) or A_c (Affect – close condition) as the dependent variable and C_f (counterfactual probability estimates – far condition) or C_c (counterfactual probability estimates – close condition) as the predictor. As a result,

C_f was not found to significantly predict A_f and C_c was not found to significantly predict A_c , either (see Table 2.5).

In accordance with Judd et al. (2001), a regression was also run with the difference in the affect ratings between the close and far condition as the dependent variable (A_d) and the difference in counterfactual probability estimates (C_d) as the predictor. It was found that C_d did not significantly predict A_d (see Table 2.4). Those results indicate that in the FP: Low/Outcome: Lose condition, counterfactual probability estimates were not mediating the effect of proximity on emotions.

Win Condition As Table 2.5 shows, contrary to the prediction, the effect of proximity on emotions reflects a domination of the assimilation effect and was marginally significant. Mediation analysis was still carried on because the total effect was close to reaching a significant level. However, in line with the direction of the total effect found in this condition, it was expected that counterfactual probability estimates should negatively predict the affect ratings. Same regressions were run in the win condition as in the lose condition. In individual proximity conditions, C_f was not found to significantly predict A_f and C_c was not found to significantly predict A_c (See Table 2.5), either. What's more, C_d did not significantly predict A_d (See Table 2.5), indicating that in the FP: Low/Outcome: Win condition, counterfactual probability estimates were not mediating the effect of proximity on emotions.

To sum up, in the FP: low condition, counterfactual probability estimates did not mediate the relationship between proximity and emotions, the reason being that counterfactual probability estimate had no significant effect on people's emotional experiences.

FP: High

The affect scores in the Outcome: win condition were recoded so that the predicted effect of proximity on emotions and the counterfactual probability estimates would be in the same direction, as in the Outcome: lose condition. That is, proximity should increase the affect ratings. This time, such a relationship would reflect a domination of the assimilation effect. Overall, in the FP: high condition, proximity had significant effect on emotions ($F(1, 47) = 18.30, p < .001, r = .53$). Unlike the FP: Low condition, the effects of proximity on emotions were in the same direction in both lose and win conditions. Therefore, the data from the two conditions was pooled and submitted to the mediation analysis. In individual proximity conditions, C_f was found to significantly predict A_f and C_c was found to significantly predict A_c (see Table 2.6), indicating that counterfactual probability estimates were related with emotions in each proximity condition and those correlations reflect a quality of the assimilation effect.

However, surprisingly, the differences in those variables between the close and the far condition were not significantly related - C_d did not significantly predict A_d (see Table 2.6). Also, this correlation coefficient is not significantly different from that of the FP: Low/Outcome: Lose condition ($Z = 0.64, p = .522$) or that of the FP: Low/Outcome: Win condition ($Z = 0.01, p = .992$). It is notable that the affect ratings in the far condition and those in the close conditions were highly correlated ($r(48) = .65, p < .001$), indicating that at an individual level, participants' affect ratings in the far condition shared much common variance with those in the close condition. Thus, the non-significant results could be caused by the restricted range in the dependent variable (the difference in the affect ratings between the close and the

far condition) (Range = 4 on the scale from 0 to 16, when excluding three outliers). This could be due to the inherent nature of the within-participant design, where individual differences were controlled between the two measures of affect and thus the difference between the two measures lacks variance. This problem would be the most prominent if the effect of proximity on emotions was consistent in magnitude across different individuals.

Thus, although the results indicate that counterfactual probability estimates in the FP: High condition were influencing the emotions in the direction of the assimilation effect, no definitive evidence was found that counterfactual probability judgments mediate the relationship between proximity and emotions in the FP: High condition. The reason could be that the difference in the affect ratings between the close and the far condition lacks variation because of the within-participant design.

2.4.3 Discussion

Confirming the finding of Experiment 1, a moderating effect of future possibility on people's emotional reactions to close outcomes was demonstrated by the present experiment. After losing or winning a basketball throwing game in a TV game show, the effect of the closeness of the scores on emotions was found to be dependent on the decisiveness of the game. For the losers, an indication of the contrast effect domination was found when the game was decisive (future possibility was low) but an indication of the assimilation effect domination was found when the game was not decisive (future possibility was high). For the winners, an indication of the assimilation effect domination was found when the game was decisive (future possibility was low) but this effect was enhanced to an even greater extent when the game was not decisive (future possibility was high). Although the interaction of

proximity (closeness of the scores) and future possibility displayed different patterns across the lose and win conditions, the predicted common principle of the effect of future possibility was confirmed: a high level of future possibility promotes affective assimilation while a low level of future possibility promotes affective contrast.

Indicative evidence was also found that counterfactual probability estimates were mediating the effect of proximity on emotions and the nature of the mediation was moderated by the perception of future possibility. While proximity to a focal outcome was found to increase one's counterfactual probability estimates in all conditions, the effect of counterfactual probability estimates on emotions appeared to depend on the perception of future possibility. When the future possibility was high, counterfactual probability estimates significantly predicted participants' emotions in the direction that reflected a domination of the affective assimilation, in both the close and far conditions. Note that this was the first time that evidence has been found that people's counterfactual probability judgments can influence one's emotional experiences in the direction of the assimilation effect. On the other hand, when the future possibility was low, counterfactual probability estimates had no significant effect on emotions, either in the far or close condition. Although counterfactual probability estimates did not influence emotions in a contrast-effect-dominant direction as predicted, the null results do suggest that in this condition, the strength of the contrast effect was promoted and cancelled out the assimilation effect - it's just that the contrast effect did not seem to be enhanced to a point where it was strong enough to overcome the assimilation effect and dominate one's emotional experiences as predicted.

It should also be noted the results in the FP: High condition only provided suggestive, rather than definitive evidence for the mediating role of counterfactual probability estimates because not all criteria to identify a mediation effect were fulfilled. Although on a between-participant basis, counterfactual probability estimates were found to influence emotions in each of the two proximity conditions, on a within-participant basis, the difference in the counterfactual probability estimates between the far and close conditions did not significantly predict the difference in the affect ratings. As argued earlier, this could be caused by the restricted range of the dependent variable (difference in affect ratings) because of a within-participant design. The effect of counterfactual probability estimates on emotions should receive further examinations in experiments using between-participant layout.

2.5 General Discussion

2.5.1 The Total Effect of Proximity on Emotions

Narrowly missing a goal could be frustrating and narrowly escaping from a misfortune could be relieving. The early research on counterfactual thinking confirmed those beliefs by demonstrating the affective contrast effect after near-miss incidents. However, more recent research has amassed increasing evidence of affective assimilation, indicating that narrowly missing a goal could also be uplifting and narrowly escaping from a misfortune could also be alarming. Consistent with the Reflective and Evaluation Model (REM), McMullen and Markman (2002) demonstrated that emotional experiences after a near-miss depended upon temporal perspective – i.e., whether people perceived a future possibility to mutate the

outcome of an event. The results of Experiment 1 and 3 provide additional evidence for this proposition.

Our results are more convincing than previous research because they ruled out the confounding effect of objective situations on people's emotions – in both scenarios, being close to an outcome did not increase the actual chance of achieving that outcome in the future and thus did not affect one's objective situation (e.g., in Experiment 3 being close by one point to beating the opponent in a basketball-throwing game would not affect the player's objective chance of winning in future games, although it was expected to lift their subjective expectation for future winning).

In summary, Experiment 1 and 3 found that the impact of a near-miss incident on people's emotions was contingent upon their perception of future possibility. Moreover, those effects were broadly consistent with our expectation that an affective contrast effect was more likely to be dominant when people were past-oriented (i.e., if a goal was nearly scored or conceded at the end of the football game or if the basketball throwing game was decisive to the final outcome of the competition), whereas an affective assimilation effect was more likely to be dominant when people were future-oriented (i.e., if the goal was nearly scored or conceded at the beginning of the football game or the basketball throwing game was not decisive to the final outcome of the competition).

More specifically, in Experiment 1, we demonstrated that people's judgments of the global affective experiences of the two teams in a football match after one team got close to scoring a goal depended on the temporal position of this near-miss incident. The majority of participants thought the attackers who almost scored a goal

should feel worse than the defenders who almost conceded a goal, but only if the near-miss incident occurred near the end of the game, when the perception of future possibility was low. Similarly, Experiment 3 demonstrated that the effects of proximity on emotions were contingent upon future possibilities. If the loser of a basketball-throwing game lost by only a point they did not feel so bad about it if that game was not decisive to the final outcome of the competition whereas the winner of that close game felt less enjoyment in their win. The effect was not however strong enough to cause an “assimilation-based satisfaction reversal”. That is, the losers of the game did not feel better than the winners when the game ended with close scores and was not decisive – they just felt less bad than they would have done if the game had been decisive.

It is worth noting however that the interaction patterns in the win and lose conditions did not exactly mirror one another. In particular in the win condition the differences in mean global affect ratings between the proximity conditions were indicative of a domination of the assimilation effect in *both* future possibility conditions – not just when the future possibility was high (although the assimilation effect was bigger in this condition). In comparison, in the lose conditions the differences in mean ratings between the proximity conditions were indicative of either a domination of the contrast effect in the low future possibility condition, or a domination of the assimilation effect in the high future possibility condition.

This asymmetric pattern indicates that downward counterfactuals, provoked by getting close to an undesirable outcome in the win condition, are more prone to the assimilation effect and less prone to the contrast effect than upward counterfactuals, provoked by getting close to a desirable outcome in the lose

condition. This pattern is consistent with the speculation of McMullen and Markman (2002). The reason they provided for this asymmetry is that negative outcomes, which are often the contents of the imagination of downward counterfactuals, are more attention grabbing than positive outcomes. A considerable number of literatures have demonstrated that people allocate disproportionately more mental resources to negative stimuli than to positive or neutral stimuli (see Taylor, 1991, for a review). C.H. Hansen and R.D. Hansen (1988), for example, found that it is quicker and more accurate for people to identify an angry face among a crowd of happy faces than to identify a happy face among angry faces, presumably because negative stimuli are more likely to come to one's attention.

Similarly, with downward counterfactuals, people could be more likely to focus on the message of what *can* happen instead of what *did* happen than with upward counterfactuals, which will in turn make them more prone to the assimilation effect. Despite the speculation, their results did not show an asymmetrical pattern as ours, the reason for which is unclear. However, a potential cause of the asymmetry in our results could be that the scenario used in our experiment featured a more severe outcome (i.e., losing \$50,000) and thus were even more attention grabbing than theirs (i.e., losing a college basketball game).

2.5.2 *The Mediating Effect of Counterfactual Probability Judgments*

The presented chapter also investigated the determinants and the emotional consequences of the counterfactual probability judgment by examining its mediating role in the relationship between outcome proximity and emotions. All three experiments provided evidence that people's counterfactual probability estimates mediate the emotional consequences of near-misses and the nature of the mediation

depend on the perception of future possibility. First of all, the proximity to a focal outcome was found to boost one's counterfactual probability estimates in all three experiments. Those results confirm and advance the previous demonstration of the effect of proximity on counterfactual probability judgments by showing that both conditional and unconditional counterfactual probability judgments are affected by proximity cues. Also, Experiment 3 ruled out the potential confounding of the absolute value of scores in the effect of numerical proximity on probability judgments.

However, the effect of proximity on counterfactual probability estimates was quite weak in Experiment 2, where participants were asked to do a conditional counterfactual probability estimation (i.e., "How likely you think you would have passed the test if you hadn't spent so much time in the bar the night before?"). This highlights the possibility that other factors (e.g., the perceived impact of the mutation of antecedents) will also be taken into account and interact with outcome proximity in determining the probability of a conditional counterfactual.

Secondly, in Experiment 2 and 3, evidence was found that counterfactual probability estimates influence one's emotions and those influences can be moderated by the level of the future possibility. More specifically, in Experiment 2, when future possibility was low, the counterfactual probability estimates were found to exert impacts on one's emotional experiences. This reflects a contrast-dominant quality (i.e., higher counterfactual probability estimates regarding passing the examination led to worse mood). However, the counterfactual probability estimates had no significant effect on emotions when future possibility was high. In comparison, in Experiment 3, the counterfactual probability estimates had no

significant effect on emotions when perceived future possibility was low. However, evidence suggests that, when perceived future possibility was high, counterfactual probability estimates can exert impact on one's emotional experiences which reflects an assimilation- dominant quality (i.e., higher counterfactual probability estimates regarding winning or losing a game led to worse or better mood).

Although the results in neither experiment fit the prediction perfectly - that the variation of the future possibility should be able to reverse the effect of counterfactual probability estimates on emotions, they did show that (1) counterfactual probability judgments can influence one's emotional experiences in either the direction of the contrast-effect-domination (Experiment 2) or the assimilation-effect-domination (Experiment 3), which is an important development from the finding of Petrocelli et al. (2011); and (2) the moderation of future possibility follows the proposed general principle of the REM that a low level of future possibility promotes the affective contrast effect while a high level of future possibility promotes the affective assimilation effect. This finding was also backed up by the evidence from Experiment 1 and 2 that participants paid attention to the future implications of a counterfactual to a greater extent when future possibility was high rather than low.

2.5.3 Summary

To conclude, our results are consistent with the proposition of the REM that the perception of future possibility would moderate the effect of outcome closeness on emotions – the presence of future possibility promotes the assimilation effect while the absence of future possibility promotes the contrast effect. However, no definitive evidence was found that the effect of future possibility can be strong

enough to reverse one's emotional reactions to outcome proximity from being contrast-dominant to assimilation-dominant or vice versa.

Suggestive evidence was also found that the moderated total effect of proximity on emotions can be accounted for by the mediating factor. First of all, outcome proximity was found to have an effect on both conditional and unconditional counterfactual probability estimates. Secondly, evidence suggests that the effect of counterfactual probability judgments on emotions is contingent on the perception of future possibility. The observed moderating effect was also consistent with the principle of the REM. However, like the total effect of proximity, the effect of counterfactual probability estimates on emotions was not found to be able to be reversed by the level of future possibility from being contrast-dominant to assimilation-dominant or vice versa, although evidence for the contrast domination and the assimilation domination was found in two separate experiments.

The discussion so far concerning the effect of proximity on counterfactual probability and emotions has been restricted to the situation where only the information regarding the proximity of the final outcome is available. In real life, however, it is often the case that people receive multiple feedbacks of proximity during the episode of an event before the final outcome is revealed. This issue will be addressed in the next two chapters.

Chapter 3 Multiple Proximity Cues: The Effect of Progression on Counterfactual Probability Estimates and Emotions

3.1 Introduction

Chapter 2 examined the effect of proximity on counterfactual probability judgments and emotions. However, the discussion so far has been restricted to the situation where people's perception of closeness and counterfactual probability estimates were derived from only one cue of proximity, which is the proximity of the final outcome. For example, in Experiment 1, the perception of closeness was provoked by the final physical distance by which the football missed the goal; in Experiment 2, it was provoked by the numeric distance between a student's final result of an examination and the passing benchmark; and in Experiment 3, it was provoked by the difference in the final scores of the two players in a basketball throwing game.

Like in most of the previous studies investigating the psychological consequences of outcome proximity, the setup of those scenarios, as pointed out in Section 1.3.3.2, might have oversimplified real life situations where people may be exposed to multiple proximity cues. This is especially likely to be the case if an outcome is preceded by a prolonged causal episode and the experiencer is looking for a particular target outcome or a goal. For example, in the TV game scenario featured in Experiment 3, although only the proximity of the final scores was made available to participants, in real life, the elements that constitute this event could be far richer than the mere final scores. For instance, during the game, one player could be consistently in the lead or the two players could be neck-and-neck throughout. Elements such as these could also potentially contribute to people's overall

perception of the closeness and counterfactual probability judgments regarding the whole event.

As introduced in Section, 1.3.3, Kahneman and Varey (1990) identified two event cues that are critical to the perception of propensity and the validation of close counterfactuals – “the temporal or causal proximity of the focal outcome and indications of rapid progress through a causal script” (p. 1102). While the first cue reflects an emphasis on the effect of a single, static cue of proximity, the second cue reflects an emphasis on the effect of the perception of trend, which can be derived from multiple, dynamic proximity cues, on people’s judgments of propensity. To illustrate this second cue of propensity, consider two glass marbles sitting close to the edge of a table. Marble A has been sitting at the same place all along while Marble B was rolling towards the edge but stopped at the same distance to the edge as Marble A. Although the static proximities of the final results are the same (i.e., the distance between the marble and the edge was equal in the two cases), it is argued that the sense that “Marble B almost or could have fallen off the table” is somewhat stronger than “Marble A almost or could have fallen off the table” because the motion of Marble B displayed a trend toward traveling over the edge of the table while such a trend was weak for Marble A.

The reason why the perception of progression towards a focal outcome would heighten one’s judgments of propensity and counterfactual probability could be that the perception of progression, like the perception of proximity, facilitates mental simulations. As mentioned earlier, according to the theorization of the simulation heuristic (Kahneman & Tversky, 1982), the factors that facilitate the mental construction of a counterfactual world will also heighten counterfactual probability

estimates. As demonstrated in Chapter 2, proximity to a focal outcome heightens counterfactual probability estimates, presumably because it made the mutation of the reality to its alternative less effortful. In a similar manner, it might be easier to construct a counterfactual world in which the development of an event has retained its trend from the real world than a counterfactual world in which the development of an event suddenly possesses a new trend or dispossesses a trend that it had before because less mental mutation is required in the former case.

The perception of progression, derived from the identification of the trend of multiple proximity cues, could exert huge impacts on counterfactual probability estimates and emotional experiences. However, most of the previous research has adopted a static view and focused exclusively on the effect of the static proximity of the end results on counterfactual probability judgments. For example, in a series of studies presented by Teigen (1998) examining what is called the *proximity heuristic*, participants' perceptions of closeness were manipulated by (1) varying the winning margin in a ski race; (2) varying the distance between the loaded chamber and the empty chamber at which the revolver has stopped in a Russian roulette game and (3) varying the distance between one's car and the car crushed in a rockslide. Those manipulations were all concerned with the proximity of end results.

Notably, a study in the same article (Study 3) which featured a scenario about a handball game did supply the participants with more than one proximity cue – participants were exposed to the information about both the half-time results and the full time results. It was found that given the same full time results, a handball team which lost the game was judged more likely to win if it had been in the lead at half time than if it had been trailed behind. It could be argued that this finding goes

against the proposition regarding the effect of progression, which would have predicted that the team which lost the first half should be judged to be more likely to win because it closed the gap in scores faster in the second half and thus demonstrated stronger progression towards winning. However, the establishment of the perception of progression might need to be fed by multiple proximity feedbacks. That is, the more feedbacks are provided during the development of an event, the easier a trend can be identified. For example, a basketball fan who follows a live game minute by minute might be more likely to obtain a perception of a trend of the game (e.g., the team is winning/losing) than another person who does not commit his/her full attention to the game and only peers at the scoreboard every five minutes. Thus, it is argued that the information provided about the variations in the scores in the handball game experiment might be insufficient for a perception of progression to be formed.

Most of the research on the emotional consequences of near-misses has also failed to address the impact of multiple proximity cues. For example, in one aforementioned study by Medvec and Savitsky (1997), proximity was manipulated by varying the numerical closeness of a student's examination mark and the boundary of a different grade (for similar examples, see Johnson, 1986; Kahneman & Tversky, 1982; Macrae et al., 1993; Meyers-Levy & Maheswaran, 1992; Miller & McFarland, 1986). In some studies, even when information about the variations in proximity was provided, this information was not part of the manipulation. For example, in one study by McMullen and Markman (2002, Experiment 2), participants were asked to read a play-by-play account of a basketball game. They were assigned to one of the two closeness conditions with respect to the proximity of the final scores. The play-by-play account of the game did not only contain the

information about the final results but also about how the scores had changed over the course of the game. That is, the development of the game was either described to have been a neck-and-neck situation throughout the game or to have been dominated by one team (i.e., one team took a lead in the beginning and that lead was enhanced throughout the game). However, because the close (end results) condition was always paired with the “neck-and-neck” account and the far (end results) condition was always paired with the “domination” account, the net effect of the two types of trends on emotions could not be separated from the effect of proximity.

A similar case is a study by Markman and Tetlock (2000), in which participants were asked to choose to invest in one of the two stocks which they thought would beat the other after a period of time. They then monitored the stocks’ performance on a graph displayed on a computer screen, which sketched out the fluctuation in the values of both stocks over time. Again, the effect of progression could not be separated from that of proximity because a “catching up” trend was always paired with a close condition while a “trailing off” trend was always paired with a far condition.

To fill this empirical gap, the effects of perceived progression on counterfactual probability estimates and emotions were tested in the present chapter. The predictions regarding those effects are summarized in Figure 3.1 and 3.2 and will be examined within the context where a desirable outcome is perceived to be close.

Firstly, in accordance with Kahneman and Varey (1990), when the proximity of the final outcome is held constant, counterfactual probability estimates should be higher if the outcome is preceded by a causal episode with multiple proximity cues

which display a tendency of the progression towards its alternative outcome (i.e., shrinking distance), in comparison with when such a tendency is absent. This effect is denoted as Path *a* in Figure 3.1.

Secondly, in accordance with the REM (Markman & McMullen 2003), counterfactual probability estimates should have an effect on emotions, whose nature depends on the perception of future possibility (path *b* in Figure 3.1). When future possibility is absent, the contrast effect was expected to be enhanced and dominate one's affective experiences as a result of the evaluative simulation. In the context where a desirable outcome is perceived to be close, this would mean that a higher counterfactual probability estimate should lead to a *worse* mood. In comparison, when future possibility is present, the assimilation effect was expected to be enhanced and dominate one's affective experiences as a result of the reflective simulation, in which case a higher counterfactual probability estimate should lead to a *better* mood.

Thirdly, if both of the hypotheses above stand, a total effect of progression on affect should be observed (path *c* in Figure 3.2) and this effect should be moderated by the perception of future possibility. In the context where a desirable outcome is perceived to be close, when future possibility is absent, the perceived progression to a focal outcome should worsen one's mood (contrast-effect-domination). In comparison, when future possibility is present, the perceived progression to a focal outcome should improve one's mood (assimilation-effect-domination). Of course, this total moderated effect should be mediated by one's counterfactual probability judgments (path *ab*).

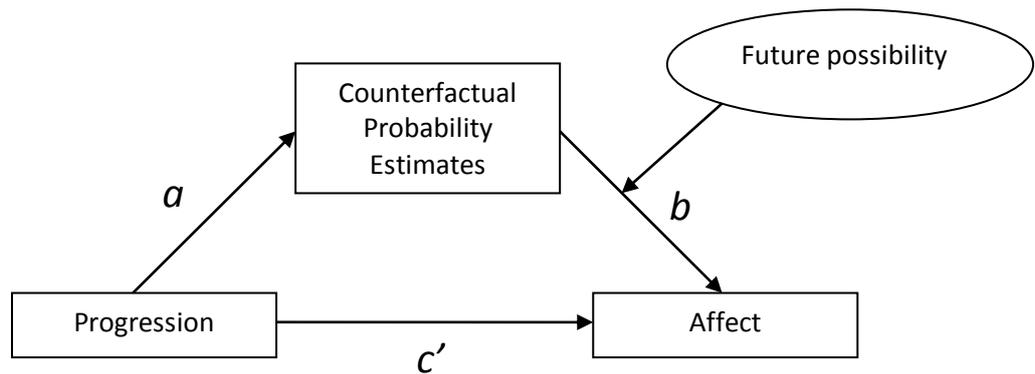


Figure 3.1 Mediating Effect of Counterfactual Probability Estimates Moderated by Future Possibility

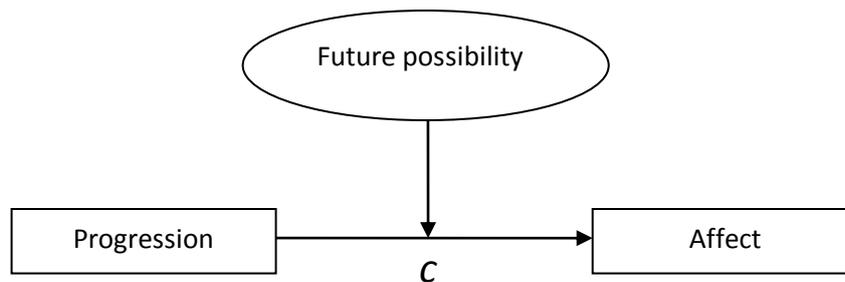


Figure 3.2 The Total Effect of Progression on Affect Moderated by Future Possibility

Finally, in line with the REM, the moderating effect of future possibility should operate via an attention-switching mechanism. It was predicted that the presence of future possibility should divert people's attention from the past implication of the highly probable counterfactual (the difference between what could have happened and what did happen) to its future implications (what can happen in the future).

These hypotheses were tested in the two experiments (Experiments 4 and 5) presented in this chapter in the context of horse racing, where the sense of

progression was operationalized as the variation in the physical distance between the horses. It was believed that a shrinking distance between the target horse and the leader would provoke a stronger sense that “the horse is winning” during the race and that “the horse could have won” after the race than if the distance keeps constant.

3.2 Experiment 4

In this experiment, participants were presented with a story about a horse race and were asked to imagine they were betting on one of the horses, which was depicted to have stumbled right before the finishing line and finally came second in the race. It was predicted that the participants’ subjective probability of the horse winning the race (when in fact it lost) would be heightened if the horse had been gaining rapidly on the leader before stumbling rather than being consistently behind the leader throughout the race, because the causal script in the former case provoked a stronger sense of progression towards the target outcome (i.e., winning the race).

The emotional consequences of this sense of progression should be moderated by the perception of future possibility (FP), which was manipulated by varying the decisiveness of the race. That is, the contrast effect should be enhanced and dominate one’s affective experiences (i.e., worse mood if the horse had been catching up rather than following consistently behind) when the gamblers’ winning or losing money was determined by the result of the just-finished race alone (i.e., FP: low), while the assimilation effect should be enhanced and dominate one’s affective experiences (i.e., better mood if the horse had been catching up rather than following consistently behind) when the gambler did not lose money unless the horse also lost a second future race (i.e., FP: high). What’s more, this interaction between

perceived progression and future possibility should be able to be partly accounted for by one's counterfactual probability estimates

The attentional-switching mechanism was also tested by this experiment. It was expected that participants should focus less on its past implications (i.e., what could have happened in the just-finished race) and more on the future implication of a counterfactual (i.e., what can happen in the future races) if the race was not decisive than if it was.

3.2.1 Method

3.2.1.1 Design

The experiment investigated the effects of two independent variables - perceived progression and future possibility (FP) - on counterfactual probability estimates and emotions using a 2 (Progression: Present/Absent) × 2 (FP: High/Low) between-participant design.

3.2.1.2 Participants

The 114 psychology undergraduates of Durham University who had read and answered questions regarding the job entry examination scenario in Experiment 2 constituted the sample (see Section 2.3)

3.2.1.3 Materials and Procedure

After they finished answering the question about the story in Experiment 2, participants were prompted to continue to read a second story. They were randomly re-assigned to one of the four conditions. Here is the story for Progression:

Present/FP: Low condition:

Please vividly imagine that you are now at Doncaster Racecourse and are in the middle of the horse racing event *Racing Post Trophy*. The upcoming race is a 5-furlong (1 kilometre) flat race consisting of 8 horses. **You've bet £50 on the horse *Captain Dunne* to win the race. The horse you bet on was considered to have a moderate chance of winning and if it does win, you will get your stake of £50 back plus a bonus of £50. If the horse does not win, you will lose the total stake of £50.** Now, all the 8 horses are ready in the stalls and the race is about to begin.

[The gates were opened and the horses set off! Your horse *Captain Dunne* had a fairly weak start and was in 5th place at the half way point (500 metres), 7 metres short of the leading horse *Cosmic Sun* (in racing terminology about '3 lengths'). However, your horse *Captain Dunne* started to increase its pace at the beginning of the second half of the race. It overtook its opponents one after another and advanced rapidly to the leading horse *Cosmic Sun*. The leading horse was losing its advantage at a fast and steady rate – 6 metres, 4 metres, 2 metres – and 100 metres from the finishing line, your horse *Captain Dunne* was in 2nd place and just 1 metre short of the leader *Cosmic Sun* (in racing terminology about 'half a length').] But suddenly the horse in 3rd place went out of control and ran into the back of your horse *Captain Dunne*. This incident caused your

horse *Captain Dunne* to lose its step and stumble slightly. Although your horse was not injured and the jockey responded quickly and succeeded in avoiding a total fall over, your horse *Captain Dunne* clearly lost pace and lost ground on the leading horse. As a result, your horse finished 2nd about 3 metres (one and a half lengths) behind the winner *Cosmic Sun*. **You lost your £50 stake.** It was also reported that the horse which had caused the incident was severely injured and would not be able to run any race for at least a month.

In the FP: High condition, the two parts of the story in bold were replaced in order by “Those horses will be competing in the same race again one week later at the same venue. You’ve bet £50 on the horse *Captain Dunne* to win at least one of the two races. The horse you bet on was considered to have a moderate chance of winning and if it does win one or both of the two races, you will get your stake of £50 back plus a bonus of £50. If the horse does not win at least one of the two races, you will lose the total stake of £50. You are not allowed to switch your bet to other horses once the first race begins.” and “Now your horse needs to win the second race to stop you from losing your £50 stake”

In the Progression: Absent condition, the text in the square brackets was replaced by “The gates were opened and the horses set off! From the start of the race your horse *Captain Dunne* was in 2nd place and 1 metre short of the leader *Cosmic Sun* (or in racing terminology about ‘half a length’). *Cosmic Sun* sustained the advantage throughout the first half of the race and at the half-way point (500 metres),

your horse *Captain Dunne* was still 1 metre short. The finishing line was getting closer and this 1 metre deficit remained constant. 100 metres from the finishing line, your horse *Captain Dunne* was still in 2nd place and 1 metre short of the leader *Cosmic Sun*.”

The story was followed by a number of questions. To measure participants’ temporal perspective (i.e., the extent to which their thoughts were oriented to the past implications of a counterfactual as opposed to its future implications), an open-ended question was presented to participants where they were prompted to list five thoughts that most easily came to their mind regarding what had happened in the story.

Participants’ emotional responses were then measured by asking them to rate on a 9-point scales (1=Not at all, 9=Extremely) the extent to which the following emotions described their feelings after the race: “happy”, “satisfied”, “pleased”, “delighted”, “content”, “relieved”, “glad”, “proud”, “determined”, “annoyed”, “frustrated”, “miserable”, “sad”, “depressed”, “gloomy”, “disappointed”, “guilty”, “regretful” . The ratings were rescored from 0 (1=not at all) to -8 (9=extremely) for the negative emotions and 0 (1=not at all) to +8 (9=extremely) for the positive emotions. Hence, on both positive and negative scales, 0 represents a lack of emotion (neutrality) with higher scores representing better moods and lower scores worse moods.

To provide complementary measures of people’s temporal perspective, the participants were presented with six statements and were asked to rate on 9-point scales how likely each of those thoughts would come to their mind given what had happened in the story (1=Extremely unlikely, 9=Extremely likely). As Table 3.1 demonstrates, among these statements, three expressed the will to mutate a certain

event in the past and thus reflected a focus on the past implications of a counterfactual while the other three expressed the speaker’s confidence in the horse or its possibility to win future races and thus reflected a focus on the future implications of a counterfactual. These thoughts were picked from the free-responses of a different group of participants in a pilot study conducted earlier which adopted the same scenario.

Participants’ counterfactual probability estimates were measured by asking them to rate on a 9-point scale as to “How likely you think the horse you bet on (*Captain Dunne*) would have won the race if it hadn’t stumbled 100 metres from the finishing line?” (1=Extremely unlikely, 9=Extremely likely).

Table 3.1 *Items for Measuring Temporal Perspective*

Category	Statements
Past-Implications	1: If only the accident hadn’t happened.
	2: If only I had bet on another horse.
	3: That horse which ran into Captain Dunne really annoyed me.
Future-Implications	1: Captain Dunne almost won the race and it will have a good chance to win next time.
	2: At least I didn’t bet on the horse that was injured.
	3: Captain Dunne performed well and had the potential to win the race.

To check if the manipulation on the perception of progression was successful, participants were presented with a climbing curve and a flat line (see A and B below) and asked to choose one that they thought best described the finished race.



The questionnaire also included some measures whose purposes digress from the main theme of the thesis. However, a complete sample of the questionnaire can be found in Appendix D.

3.2.2 Results

3.2.2.1 Manipulation Check

If the manipulation of the perception of progression was successful, a higher proportion of participants in the Progression: Present condition than in the Progression: Absent condition should choose the climbing curve A instead of the flat line B as a better representation of the horse race. The results show that while a significant minority of only 36.2% of the participants in Progression: Absent condition picked climbing curve A best representing the horse race (21 out of 58, $\chi^2(1, N=58) = 4.41, p = .036, w = .28$), this proportion was raised to a significant majority of 74.1% in the Progression: Present condition (40 out of 54, $\chi^2(1, N=54) = 12.52, p < .001, w = .48$). The change in the proportion was significant ($\chi^2(1, N=112) = 16.17, p < .001, w = .38$). Those results indicate that the manipulation of the perception of progression was successful.

3.2.2.2 Counterfactual Probability Estimates

Supporting the prediction that the sense of progression towards the target outcome would heighten one's counterfactual probability estimates, a two-way perceived progression \times future possibility ANOVA revealed a main effect of progression on participants' ratings of counterfactual probability ($F(1, 110) = 34.94$, $p < .001$, $r = .49$) (see Figure 3.3). More specifically, the participants in the Progression: Present condition thought the horse was more likely to win the race ($M = 7.44$, $SD = 1.26$) than those in the Progression: Absent condition ($M = 5.80$, $SD = 1.64$). As expected, the analysis did not reveal a significant main effect of future possibility or a significant interaction between the two independent variables ($F(1, 110) = 0.53$, $p = .467$, $r = .07$; $F(1, 110) = 0.07$, $p = .792$, $r = .03$, respectively).

3.2.2.3 Affective States

The 18-item affect measurements yielded a high internal reliability (Cronbach's $\alpha = .88$). However, the item "determined" had a weak correlation ($r = .19$) with the sum of the scales so it was excluded from the analysis. By doing this the inter-item reliability was lifted slightly (Cronbach's $\alpha = .89$). The remaining 17 items were averaged to establish an affective index for each participant. A two-way ANOVA revealed a significant main effect of future possibility on affect ratings ($F(1,110) = 16.47$, $p < .001$, $r = .36$) (see Figure 3.4). In general, the participants judged that the gambler would be feeling better when the outcome of the race was not decisive ($M = -0.71$, $SD = 1.02$) than when there was no second chance ($M = -1.52$, $SD = 1.09$). This was within expectation because generally speaking, the outcome in the FP: High condition was less severe than that in the FP: Low condition and therefore it should elicit less intense negative emotions. Also within expectation was a non-significant main effect of Progression ($F(1,110) = 0.14$, $p = .712$, $r = .03$).

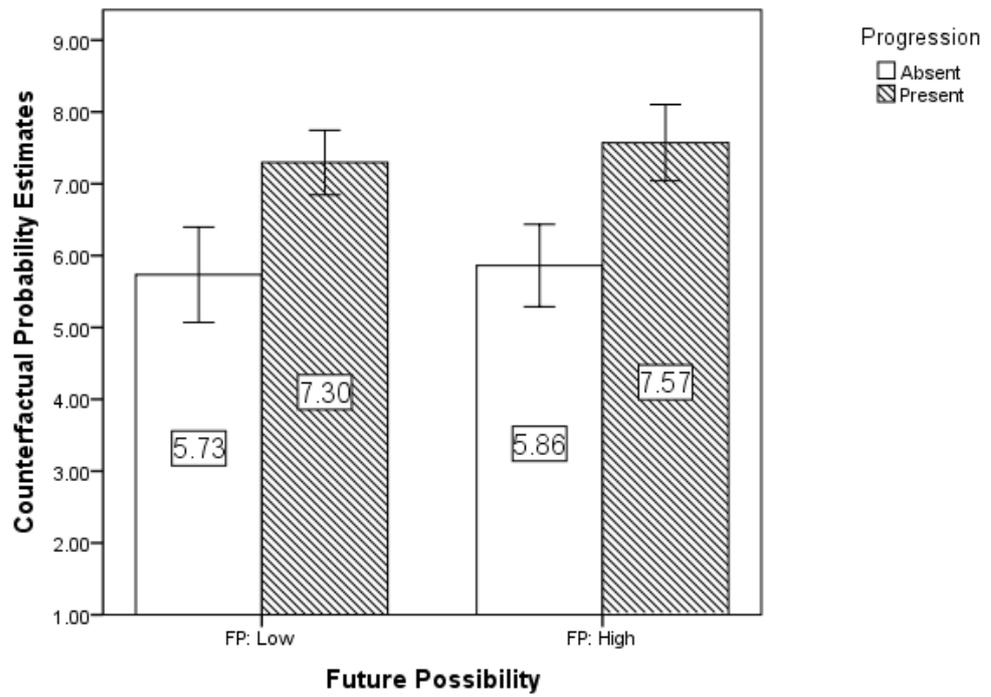


Figure 3.3 Mean (with error bars representing 95% CIs) Counterfactual Probability Estimates across all Conditions

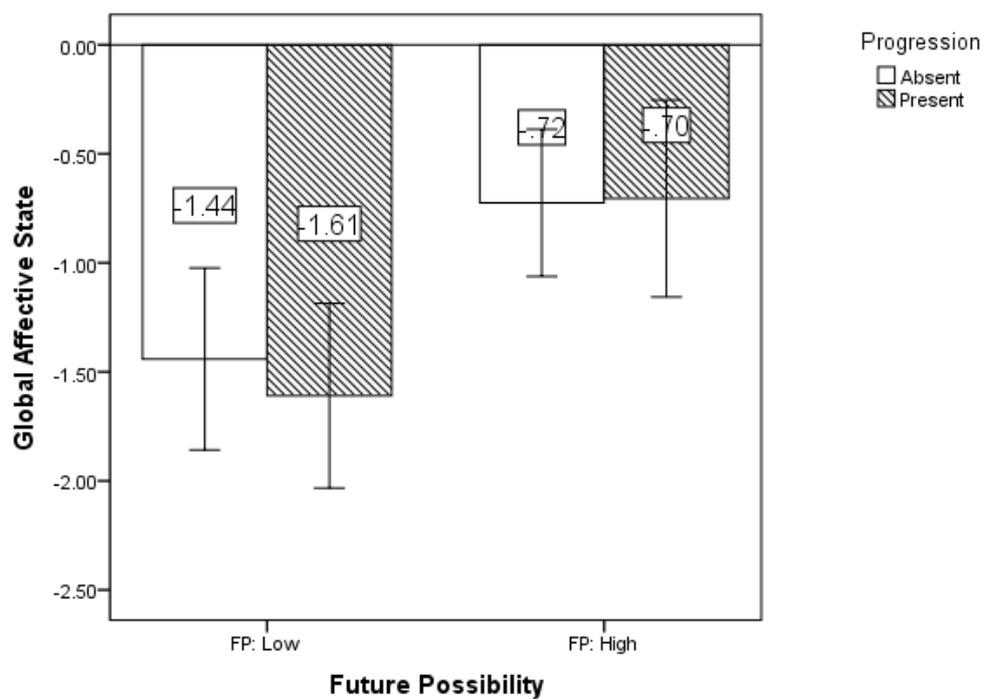


Figure 3.4 Mean (with error bars representing 95% CIs) Affect Ratings across all Conditions

However, the predicted progression \times future possibility interaction was also non-significant ($F(1,110) = 0.22, p = .639, r = .04$) (see Figure 3.4), which fails to support the hypothesis that the emotional consequences of perceived progression should be moderated by the perception of future possibility. In fact, no evidence was found that the perceived progression influenced emotions at all – the analyses reveal that the difference in the affect ratings between the Progression: Absent and the Progression: Present condition was not significant in either the FP: Low or the FP: High condition ($F(1, 55) = 0.33, p = .566, r = .08$; $F(1, 55) = 0.01, p = .941, r < .01$, respectively).

3.2.2.4 Mediating Effect of Counterfactual Probability Estimates

It was predicted that participants' counterfactual probability estimates should mediate the effect of the perceived progression on emotions and the nature of the mediation should depend on the perception of future possibility. However, because the total effect of progression on emotions was not found to be significant in either of the two future possibility conditions, the hypothesis regarding the moderated mediating effect of counterfactual probability estimates was not supported. Like in Experiment 2, analyses recommended by Preacher et al. (2007) were carried out to explore the possibility that the perceived progression has an indirect effect on emotions via counterfactual probability judgments, which is moderated by perceived future possibility (FP).

As Figures 3.1 and 3.2 show, the predicted total effect of progression on emotions was denoted by path c . The predicted indirect effect of progression on emotions via counterfactual probability estimates was denoted by path ab , with a representing the effect of proximity on counterfactual probability estimates and path

b representing the effect of counterfactual probability estimates on emotions when controlling for proximity. Further, importantly, it was proposed that the nature of path *b* was moderated by perceived future possibility (FP). Before this moderated indirect effect was tested, participants' progression conditions were coded as 0 (absent) or 1 (present) and their FP conditions were coded as 0 (FP: High) and 1 (FP: Low).

First of all, path *a* was examined by conducting a regression on counterfactual probability estimates with progression as the predictor. Consistent with the earlier results of the two-way ANOVA, it was found that progression significantly predicted counterfactual probability estimates in the expected direction ($\beta = 0.49, t = 5.96, p < .001$). Secondly, to investigate path *b*, a multiple regression was conducted on emotions with progression, counterfactual probability estimates, FP as well as the product of counterfactual probability estimates and FP as the predictors. As Table 3.2 shows, against the prediction, the product of counterfactual probability estimates and FP did not significantly predict emotions. This non-significant interaction implies that overall, the indirect effect of progression on emotions via counterfactual probability estimates is not moderated by FP.

Table 3.2 *Regression on Emotions*

Predictor	β	<i>t</i> value	<i>p</i> - value
Constant	-	-0.33	0.743
Progression	0.07	0.69	0.492
CTP	-0.13	-0.98	0.329
FP	-0.06	-0.17	0.868
CTP \times FP	-0.33	-0.91	0.367

Note: Key: CTP = Counterfactual Probability Judgments; FP = Future Possibility

However, the analysis on the indirect effect in each individual FP condition revealed that the indirect effect of progression on emotions via counterfactual probability estimates (path *ab*) was significant only in the FP: Low condition ($Z = -2.05, p = .040$; Bootstrap (5000 samples) 95% CI: $\{-0.6363, -0.0286\}$), reflecting the quality of the contrast effect. On the other hand, this indirect effect was weaker and did not reach a significant level in the FP: High condition ($Z = -0.95, p = .340$; Bootstrap (5000 samples) 95% CI: $\{-0.5287, 0.1993\}$). This is backed up by the results of multiple-regression analyses conducted in each individual FP condition, which revealed that counterfactual probability estimates significantly predicted emotions when controlling for perceived progression (path *b*) only in the FP: Low condition ($\beta = -0.30, t = -2.02, p = .048$) but not in the FP: High condition ($\beta = -0.15, t = -0.96, p = .342$). These results provide some support to the proposition that the perceived progression has an indirect effect on emotions via counterfactual probability estimates and the nature of the indirect effect is moderated by the perception of future possibility.

3.2.2.5 Attention Focus

Participants' free written responses were coded as to whether they reflected a focus on the past implications of a counterfactual or its future implications. The coding scheme followed similar protocols as in Experiment 1 and the inter-coder reliability was high (Agreement percentage = 98%; Cohen's Kappa = 88%). Examples for the statements that reflected a past perspective are: "I would have won if it wasn't for that horse"; "Annoyed feeling, as you could have won the £50 bonus if the race went to plan" and "If the other horse hadn't caused the accident it would have been fine". Examples for the statements that reflected a future perspective are:

“Good chance of winning the 2nd race”; “It could win next time” and “optimistic about next time”.

Table 3.3 summarises the number of past and future-perspective statements generated by participants in the two future possibility conditions. It is noticeable that only a small proportion of the total statements can be categorised as either future or past-perspective statements. Thus, like in Experiment 2, the non-parametric Chi-square test was conducted on the total number of statements in each category. In total, participants generated a slightly smaller proportion of past-perspective statements in the FP: High condition (25 out of 277, 9.0%) than in the FP: Low condition (32 out of 278, 11.5%), although this difference was not significant ($\chi^2(1, N=555) = 0.93, p = .335, w = .04$). On the other hand, participants generated a bigger proportion of future-perspective statements in the FP: High condition (40 out of 277, 14.4%) than in the FP: Low condition (9 out of 278, 3.2%). This difference was significant ($\chi^2(1, N=555) = 21.63, p < .001, w = .20$).

Table 3.3 *The Number of Past and Future-perspective Statements Generated by Participants across FP: Low and FP: High condition*

Category	FP: Low (N = 55)	FP: High (N = 59)
Future-perspective	9 (0.16)	40 (0.70)
Past-perspective	32 (0.56)	25 (0.44)
Total	278 (4.88)	277 (4.86)

Note: Figures in brackets in row 2, 3 and 4 indicate the average number of statements per participant in that particular category and condition.

Ratings were also obtained towards statements which reflected either a focus on the past implications of a counterfactual or its future implications. The ratings on the three past-perspective statements displayed a poor inter-item reliability (Cronbach's $\alpha = .42$). A principal component factor analysis on the three items (KMO = .51; Bartlett's test of sphericity $\chi^2(3) = 24.95, p < .001$) suggests a one-factor solution (Eigenvalue = 1.47, explained 48.8% of the total variance). Item 1 and 3, loaded heavily onto this factor (.82 and .84, respectively) while the loading of item 2 was weak (.30). Thus, item 2 was deleted from the scale and inter-item reliability was lifted (Cronbach's $\alpha = .59$). Against the prediction, a two-way ANOVA revealed no significant main effect of future possibility on the ratings of past-implication statements ($F(1,110) = 0.31, p = .577, r = .05$). That is, the ratings of past-implication statements generated in the FP: Low condition was not significantly higher ($M = 6.75, SD = 1.84$) than in the FP: High condition ($M = 6.57, SD = 1.83$).

The ratings on the three future-perspective statements also displayed a poor inter-item reliability (Cronbach's $\alpha = .54$). A principal component factor analysis on the three items (KMO = .56; Bartlett's test of sphericity $\chi^2(3) = 38.25, p < .001$) suggests a one-factor solution (Eigenvalue = 1.63, explained 54.4% of the total variance). Item 1 and 3, loaded heavily onto this factor (.80 and .83, respectively) while the loading of item 2 was relatively weak (.54). Thus, item 2 was deleted from the scale and inter-item reliability was lifted (Cronbach's $\alpha = .65$). A two-way ANOVA revealed a significant main effect of future possibility on the ratings of future-implications statements ($F(1,110) = 17.60, p < .001, r = .37$). On average, participants rated the two future-implication statements higher in the FP: High condition ($M = 7.14, SD = 1.53$) than the FP: Low condition ($M = 5.85, SD = 1.80$),

indicating that the participants in the FP: High condition were more future-oriented than those in the FP: Low condition.

Generally speaking, being consistent with the findings of Experiment 1 and 2, those results suggest that the presence of future possibility encouraged people to focus more on the future implications of a counterfactual.

3.2.3 Discussion

When exposed to multiple proximity cues, the perception of closeness of an alternative outcome might be shaped not only by a single, static proximity cue derived from the end result but also by the variations in proximity over time. The present experiment found evidence for this proposition – a race horse, which had a weak start but then kept gaining on the leader, was perceived to be more likely to have won the race than the other horse, which was following right behind the leader consistently, despite both horses stumbling metres before the finishing line when they were neck-and-neck and failing to show by the same amount of distance. It was argued that, in both cases, people would start a mental simulation in which the mutability of the factual outcome was examined on the condition that the horse did not stumble. The shrinking distance in the catching-up scenario makes the imagination of winning easier than in the other scenario and thus led to higher counterfactual probability estimates.

However, the effect of progression on counterfactual probability estimates did not seem to be passed on to emotions reactions. The experiment failed to demonstrate a significant total effect of progression on emotions in either the FP: Low or the FP: High condition. Nonetheless, the indirect effect analyses indicate that

the perceived progression did have an indirect effect on emotions via counterfactual probability estimates. This effect, being consistent with the general principle of the REM, appeared to be dependent on the perception of future possibility. That is, counterfactual probability judgments negatively predicted emotions only when future possibility was low (i.e., no future races) but not when future possibility was high, although this discrepancy in the correlational strengths was not quite strong enough to produce a significant interaction between counterfactual probability estimates and future possibility on emotions.

It was speculated that the null total effect of progression on emotions could be the result of the insufficient strength of the textual-based manipulation. Future experiments should employ more vivid stimuli such as graphic illustrations. As noted by Roese, Fessel, Summerville, Kruger, and Dilich (2006), the vividness of the stimuli increases the mental processing fluency, which could facilitate the establishment of the sense of progression. What's more, it was possible that losing £50 might be a negative outcome that is so severe that its huge impact on emotions overshadowed other factors like progression. Thus, scenarios featuring less dramatic outcomes should be considered in future experiments.

3.3 Experiment 5

The previous experiment has demonstrated that people's counterfactual probability estimates would increase when the causal script of an event displayed a progression towards the target outcome. However, it failed to demonstrate the effects of the sense of progression on emotions, possibly due to an inadequacy in the strength of the progression manipulation. The present experiment used a similar horse-racing scenario. To enhance the strength of the manipulation of progression,

the text-based description of the race was supplemented by graphic-based illustrations to facilitate the formation of the sense of trend. Also, a mixed-design was employed in the present experiment with progression being treated as a within-participant variable. As mentioned in Section 2.3.3, within-participant design has been showed by Teigen (1998) to be able to enhance the strength of the proximity manipulation. Thus, the manipulation of progression was expected to be more potent in a within-participant design as well. Finally, the severity of the negative outcome (i.e., losing the race) was reduced for the gamblers by decreasing their stakes put into the bet from £50 in the previous experiment to £30. This was to enhance the strength of the progression stimulation on emotions by drawing participants' attention more to the trend of the race instead of the valence of the outcome when making judgments of affect. The same predictions were made regarding the effects of progression on counterfactual probability estimates and emotions as in Experiment 4.

3.3.1 Method

3.3.1.1 Design

The experiment investigated the effects of two independent variables - perceived progression and future possibility (FP) - on people's counterfactual probability estimates and emotions. It was a 2 (Progression: Present/Absent) × 2 (FP: Low/High) mixed-design with progression treated as a within-participant variable and FP a between-participant variable.

3.3.1.2 Participants

A total of 107 students of Durham University participated in the experiment (40 Males, 65 Females, 2 failed to report gender). Among them, 15 were recruited

and responded to the questionnaires in one of their maths classes pertaining to a foundation program. The remaining 92 students were recruited in the university main library. The latter group of participants were each offered £2 monetary incentives.

3.3.1.3 Materials and Procedure

The horse racing story in the previous experiment was re-adopted with trivial adaptations to go along with the mixed-design. To be more specific, all participants read that there were two gamblers (Henry and John) betting on two different horses in the same race. The manipulations of progression and future possibility were carried out in the same fashion as in Experiment 4. The scenario for the FP: Low condition reads as this.

Henry and John are at Doncaster Racecourse and are in the middle of the horse racing event *Racing Post Trophy*. The upcoming race is a 5-furlong (1 kilometre) flat race consisting of 8 horses. [Henry has bet £30 on the horse *Captain Dunne* to win the race and John instead, has bet £30 on *Silver Line* to win the race] (see Betting Table below).

Henry	•Captain Dunne
John	•Silver Line

Betting Table

Both horses they bet on were considered to have a moderate chance of winning and [Henry and John will get their stake of £30 back plus a bonus of £30 if the horse they bet on does win. If their horse does not win, they will lose the total stake of £30.] Now, all the 8 horses are ready in the stalls and the race is about to begin.

The gates were opened and the horses set off (see Figure A)!



Figure A Start off

Henry's horse *Captain Dunne* started strongly. It obtained 2nd place and was 1 metre short of the leader *Cosmic Sun*. *Cosmic Sun* sustained this advantage throughout the first half of the race and at the half-way point (500 metres), *Captain Dunne* was still 1 metre short (see Figure B).

On the other hand, John's horse *Silver Line* had a fairly weak start and was in 5th place at the half way point (500 metres), 7 metres short of the leading horse *Cosmic Sun* (see Figure B).

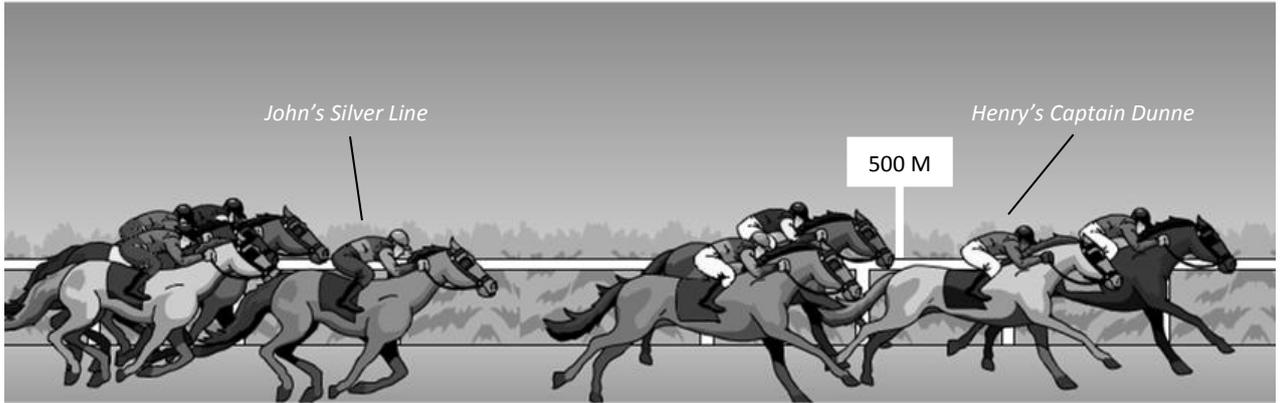


Figure B Half way

The finishing line was getting closer and the 1 metre deficit between Henry's horse *Captain Dunne* and *Cosmic Sun* remained constant. However, John's horse *Silver Line* started to increase its pace at the beginning of the second half of the race. It overtook its opponents one after another and advanced rapidly to the leading horse *Cosmic Sun* and 2nd place *Captain Dunne* (see Figure C).

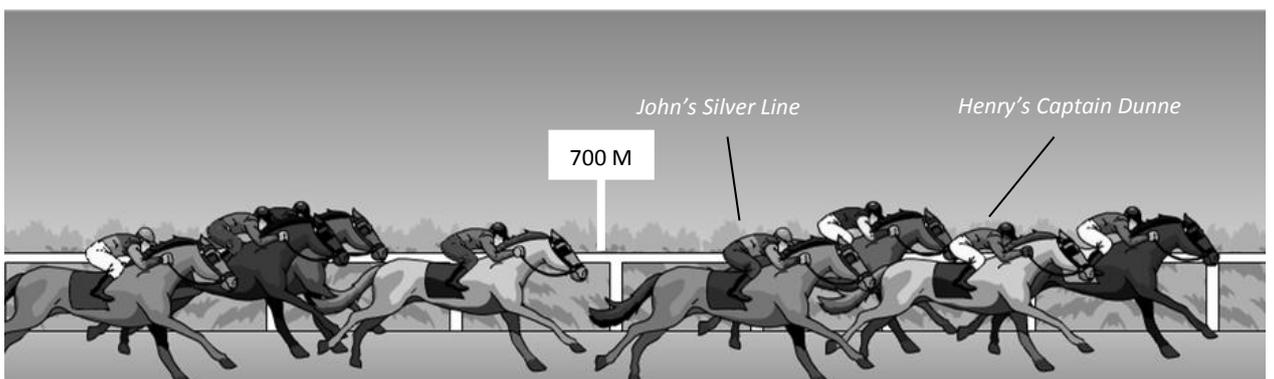


Figure C 300 metres from finishing

Silver Line was closing the gap between itself and the leading horse in a rapid and steady rate – 6 metres, 4 metres, 2 metres – and 100 metres from the finishing line, *Silver Line* was neck and neck with Henry’s horse *Captain Dunne* in 2nd place and they were both 1 metre short of the leader *Cosmic Sun* (see Figure D).

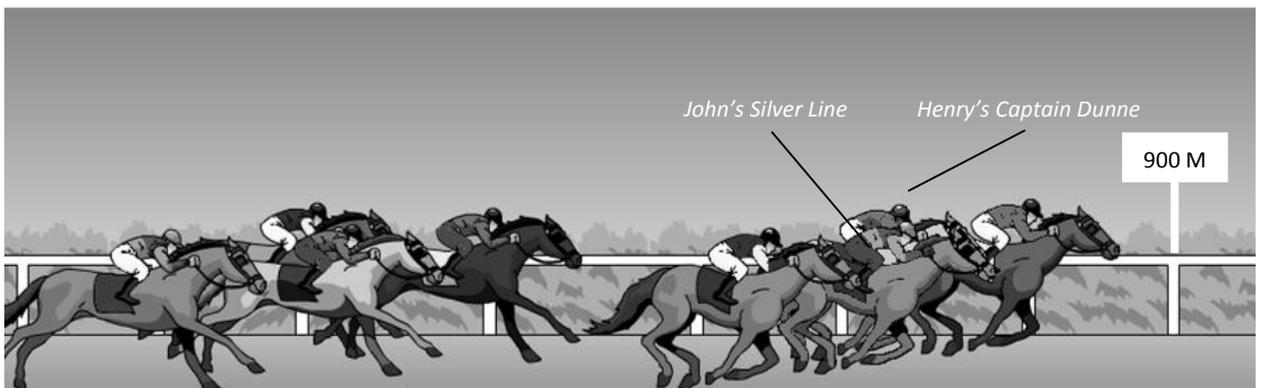


Figure D 100 metres from finishing

Suddenly the horse in 4th place went out of control and ran into the backs of Henry and John’s horses. This incident caused both *Captain Dunne* and *Silver Line* to lose their step and stumble slightly. Although both horses were not injured and the jockeys of both horses responded quickly and succeeded in avoiding a total fall over, they clearly lost pace and lost ground on the leading horse. As a result, Henry’s horse *Captain Dunne* and John’s horse *Silver Line* finished the race at almost the same time, 4 metres behind the winner

Cosmic Sun (see Figure E). [Henry and John both lost their £30 stake.]

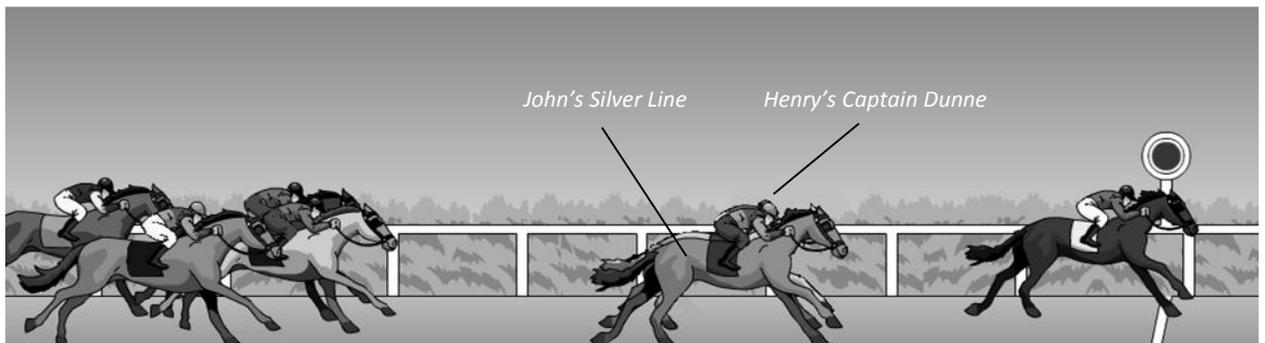


Figure E Finishing

In the FP: High condition, the text in the square brackets was replaced in order by the words “Those horses will be competing in the same race again one week later at the same venue. Henry has bet £30 on the horse *Captain Dunne* to win at least one of the two races. Instead, John has bet £30 on the horse *Silver Line* to win at least one of the two races”, “Henry and John will get their stake of £30 back plus a bonus of £30 if their horse wins one or both races. If their horse does not win at least one of the two races, they will lose the total stake of £30. They are not allowed to switch their bet to other horses once the first race begins” and “Now Henry and John’s horses need to win the second race to stop them from losing their £30 stake”.

Like in Experiment 3, both a single-item and a multi-item affect scale were employed to measure participants’ affect judgments. Participants were firstly asked to rate the global affective states of Henry and John respectively on a 9-point scale (1 = Extremely negative; 9 = Extremely positive) by responding to the question “In general, how negative or positive do you think Henry and John will be feeling respectively after the race?”.

Then the participants were presented with 12 emotion-related adjectives (“Happy”, “Annoyed”, “Satisfied”, “Frustrated”, “Pleased”, “Miserable”, “Content”, “Disappointed”, “Proud”, “Regretful”, “Elated” and “Discouraged”). Under each emotion-related adjective, the participants were asked to rate on a 9-point scale both for Henry and John separately as to the extent to which they thought Henry and John would experience that particular emotion (1 = Not at all, 9 = Extremely). As in previous experiments, those ratings were rescored from 0 (1=not at all) to -8 (9=extremely) for the negative emotions and 0 (1=not at all) to +8 (9=extremely) for the positive emotions. Hence, on both positive and negative scales, 0 represents a lack of emotion (neutrality) with higher scores representing better moods and lower scores worse moods.

To measure counterfactual probability estimates, the participants were asked: “How likely do you think Henry’s and John’s horses would have won the race if the accident had not happened 100 metres from the finishing line?” (1 = Extremely unlikely, 9 = Extremely likely).

The questionnaire also included some measures whose purposes digress from the main theme of the thesis. However, a complete sample of the questionnaire can be found in Appendix E.

3.3.2 Results

3.2.2.1 Counterfactual Probability Estimates

Confirming the finding of Experiment 4, a two-way perceived progression × future possibility ANOVA revealed a significant main effect of perceived progression on counterfactual probability estimates ($F(1, 103) = 32.64, p < .001, r = .49$)(See Figure 3.5). To be more specific, participants judged that John's horse (Progression: Present) had been more likely to win the race ($M = 6.73, SD = 1.51$) than Henry's horse (Progression: Absent) ($M = 5.61, SD = 1.66$). However, it should be noted that the effect size was no bigger than that found in Experiment 4 (where $r = .49$ as well), which used a between-participant design. Surprisingly, the main effect of future possibility was also found significant ($F(1,103) = 5.21, p = .024, r = .22$). The participants who were told there was going to be two races (FP: High) assigned higher counterfactual probability ratings to the horses ($M = 6.44, SD = 1.71$) than those who were told there was going to be only one race (FP: Low) ($M = 5.91, SD = 1.69$). The cause of this effect is unclear but it is possible that the unchangeable outcome in the FP: Low condition might have activated the participants' psychological defense system (Gilbert & Ebert, 2002), under the influence of which people understated the mutability of a past outcome in order to gain comforts. Finally, as expected, no significant progression × FP interaction was found ($F(1, 103) = 0.12, p = .731, r = .03$).

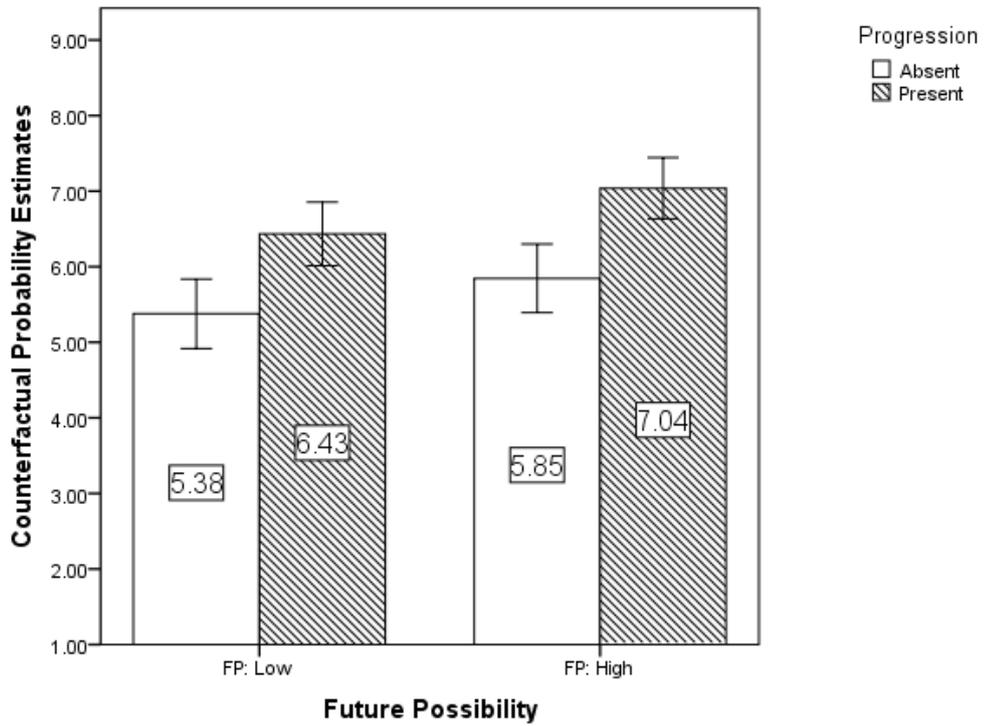


Figure 3.5 Mean (with error bars representing 95% CIs) Counterfactual Probability Estimates across all Conditions

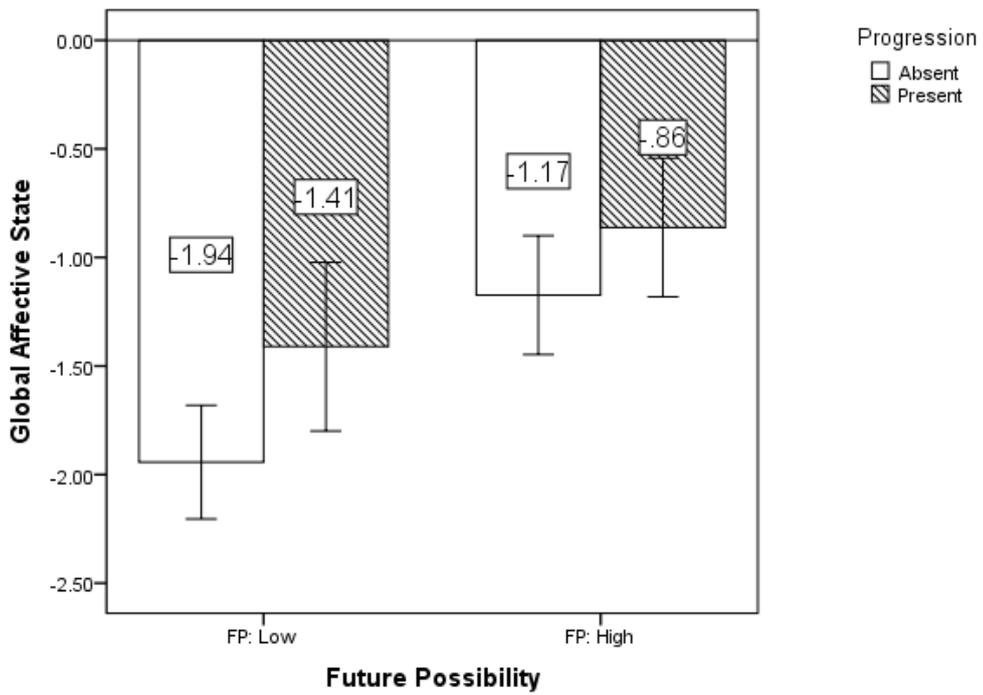


Figure 3.6 Mean (with error bars representing 95% CIs) Affect Ratings across all Conditions

3.2.2.2 Affect States

Like in Experiment 3, participants' ratings on the single-item and multi-item affect scales produced the same pattern of results. Thus, only the analyses on the multi-item affect ratings are reported here. The 12-item affect measures yielded a good internal reliability both in the ratings for Henry (Cronbach's $\alpha = .78$) and John (Cronbach's $\alpha = .86$). However, the item "regretful" was found to be poorly correlated to the total measures ($r = .13$ for Henry and $r = .24$ for John). After deleting this item from the scale, the internal reliabilities were improved (Cronbach's $\alpha = .80$ for Henry and Cronbach's $\alpha = .87$ for John). The remaining 11 items were averaged to form a measure of the global affective state for both Henry and John.

A two-way ANOVA revealed a significant main effect of future possibility on participants' affect ratings ($F(1, 104) = 11.05, p = .001, r = .31$) (See Figure 3.6). That is, the participants who were told there was going to be two races (FP: High) gave higher affect ratings to Henry and John ($M = -1.02, SD = 1.46$) than those who were told there was going to be only one race (FP: Low) ($M = -1.68, SD = 1.43$). This is unsurprising because the outcome of the race was less severe if it was not decisive and should elicit less intense negative emotional reactions. However, the predicted progression \times FP interaction was not significant ($F(1, 104) = 1.20, p = .276, r = .10$). Instead, the analysis found a significant main effect of progression ($F(1, 104) = 17.58, p = .001, r = .38$). Regardless of FP condition, participants Judged that John (Progression: Present) would feel better ($M = -1.14, SD = 1.32$) than Henry (Progression: Absent) ($M = -1.57, SD = 1.04$). These results fail to support the hypotheses that the perception of future possibility moderates the emotional consequences of perceived progression.

3.2.2.3 The Mediating Effect of Counterfactual Probability Estimates

The mediating role of counterfactual probability estimates in the relationship between progression and emotions was examined by the same method in Experiment 3, recommended by Judd et al. (2001). The data were examined against the following criteria for mediation: (1) Progression has effects on counterfactual probability estimates; (2) Progression has effects on emotions; (3) Counterfactual probability estimates were related with emotions in each progression condition; and (4) The difference in emotions between the two progression treatments (present/absent) could be predicted by the difference in counterfactual probability estimates. These four criteria were examined in order. The predictions derived from these four criteria for the FP: Low condition and the FP: High condition were summarised in Tables 3.4 and 3.5

The previous analysis has found a significant main effect of progression on counterfactual probability estimates. Therefore, criterion one is satisfied. Because the effects of progression and the counterfactual probability estimates on emotions were expected to differ across different level of future possibilities, the last three criteria were examined separately for the FP: Low and the FP: High conditions.

Table 3.4 *Predictions and Results regarding the Four Criteria to Identify Counterfactual Probability Estimates as Mediating Variable (FP: Low condition)*

Criterion	Prediction	Descriptives	<i>p</i> -value
1	$C_P > C_A$	$C_C > C_F$	< .001
2	$A_P < A_A$	$A_C > A_F$	= .002
3	C_P predicts A_P	$\beta = -0.002$	= .987
	C_A predicts A_A	$\beta = -0.28$	= .045
4	C_D predicts A_D	$\beta = -0.25$	= .070

Note: Key: A = Affect Ratings, C = Counterfactual Probability Estimates
 Key for subscript letters: P = Progression-Present, A = Progression-Absent, D = Difference between two progression Conditions

Table 3.5 *Predictions and Results regarding the Four Criteria to Identify Counterfactual Probability Estimates as Mediating Variable (FP: High condition)*

Criterion	Prediction	Descriptives	<i>p</i> -value
1	$C_P > C_A$	$C_C > C_F$	< .001
2	$A_P > A_A$	$A_C > A_F$	= .008
3	C_P predicts A_P	$\beta = -0.20$	= .161
	C_A predicts A_A	$\beta = -0.14$	= .327
4	C_D predicts A_D	$\beta = -0.06$	= .661

Note: Key: A = Affect Ratings, C = Counterfactual Probability Estimates
 Key for subscript letters: P = Progression-Present, A = Progression-Absent, D = Difference between two progression Conditions

FP: Low

When future possibility was low, progression was found to have an significant effect on emotions, ($F(1, 53) = 10.42, p = .002, r = .41$) (see Figure 3.6). However, this effect was not in the predicted direction. The perception of progression did not worsen one's mood in the FP: Low condition. Instead, participants judged that John (Progression: Present) would feel more positively than Henry (Progression: Absent), which indicates progression has actually improved the gambler's mood. It seemed that the assimilation effect was dominating one's affective experience even when future possibility was low. If this was true, counterfactual probability estimates would be found to have a positive relationship with affect. However, in each individual progression condition, counterfactual probability estimates were found to have either a significant negative correlation or non-significant correlation with affect (see Table 3.4), indicating that the relationship between counterfactual probability estimates and affect was still, if any, contrast-dominant. Further analysis also shows that the difference in the participants' counterfactual probability estimates for Henry's and John's horses marginally and negatively predicted the difference in the affect ratings (see Table 3.4). Thus, the proposed mediating effect of counterfactual probability estimates was rejected on the ground that the indirect effect and the total effect were in opposite directions.

The fact that counterfactual probability estimates were significantly correlated with emotions only when the progression was absent indicates that there was an interaction between progression and counterfactual probability estimates on people's emotional reactions. That is, counterfactual probability estimates seems to influence emotions more strongly when the perceived progression was absent than

when it was present. However, further analysis shows that the sum of participants' counterfactual probability estimates for Henry and John's horses did not significantly predict the difference in the affect ratings ($\beta = -0.17, t = 1.25, p = .217$), indicating there was no significant interaction between progression and counterfactual probability estimates.

Overall, these results suggest that in when future possibility was low, progression had an indirect effect on emotions via counterfactual probability estimates which reflected a quality of the contrast effect. However, this indirect effect seemed to be overridden by other mechanisms via which progression exerted impacts on emotions.

FP: High

When future possibility was high, progression was found to have a significant effect on emotions, ($F(1, 51) = 7.62, p = .008, r = .36$) (see Figure 3.6). Participants judged that John (Progression: Present) would feel more positively than Henry (Progression: Absent), indicating a domination of the assimilation effect. However, further analysis shows that in neither individual progression condition did counterfactual probability estimates have significant effects on affect (see Table 3.5). Also, the difference in the counterfactual probability estimates did not predict difference in the affect ratings (see Table 3.5). These results indicate that counterfactual probability estimates did not mediate or intervene the effect of progression on emotions in the FP: High condition and the observed total effect was caused by mechanisms other than the assimilation effect of counterfactuals.

The fact that negative correlations between counterfactual probability estimates and emotions were only found in the FP: Low condition but not in the FP: high condition indicates that the emotional consequences of counterfactual probability estimates, as well as the nature of the predicted indirect effect, is contingent on future possibility, although none of those correlation coefficients in the FP: Low condition was significantly different from their counterparts in the FP: High condition ($Z = 0.98, p = 0.327$ for Progression: Present condition; $Z = 0.72, p = 0.472$ for Progression: Absent condition; $Z = 0.97, p = 0.332$ for the difference).

3.3.3 Discussion

The present experiment successfully replicated the findings of Experiment 4 that the perceived progression towards a focal outcome would heighten one's counterfactual probability estimates regarding that outcome. It was found that regardless of the future possibility condition, participants thought the horse which had been catching up rapidly with the leader had a better chance to win the race than the horse which had been following the leader closely but consistently during the race. However, despite the fact that the present experiment used a more vivid stimulation of progression than its predecessor (i.e., graphic illustrations) and adopted a within-participant design to enhance the effect of the progression manipulation, the effect of progression on counterfactual probability judgments observed in this experiment was not stronger than the previous experiment. It was speculated that, while a within-participant setup made salient to participants the different trends displayed by the two race horse, it might have also prohibited or disrupted the formation of the sense of progression by forcing one's focus to jump back and forth between the stories of the two horses.

What's more, it was found in the present experiment that the absence of future possibility lowered one's subjective likelihood of the horse winning, which indicates the possibility that counterfactual probability judgments can be influenced by motivational factors. Tykocinski and Steinberg (2005) discovered that people sometimes adopted a strategy called the *retroactive pessimism* as a defence mechanism when they failed to achieve their goal. That is, in the face of failure or grave disappointment, people sometimes oppress the thought that the success or a better outcome was very likely in order to gain comfort. In one of their studies, participants were asked to imagine that they applied for a grant to cover their tuition fee in university but failed to obtain it. Participants gave lower counterfactual probability estimates when the loss was severe (i.e., the grant could have covered 50% of their tuition fee) than when the loss was moderate (i.e., the grant could only have covered 10% of their tuition fee), presumably because people are more motivated to adopt the defensive mechanism when the outcome is severe than when it is not. Under a similar logic, in the present experiment, the participants in the FP: Low condition might have been more motivated to deny that their horse could have won than those in the FP: High condition because the outcome in the former case was more severe.

Suggestive evidence was found that the perceived progression has an indirect effect on emotions via counterfactual probability estimates and the nature of this indirect effect depends on the perception of future possibility. The relationship between counterfactual probability estimates and emotions was indicative of a nature of contrast effect domination in the FP: Low condition and this relation seemed to be weaker (although not significantly) in the FP: High condition, suggesting that the presence of future possibility enhanced the assimilation effect.

However, the observed indirect effect seemed to be overshadowed by the influence of other factors. In the experiment, participants judged that John (Progression: Present) would be feeling better than Henry (Progression: Absent) in both the FP: Low and the FP: High condition. However, these positive total effects were unlikely to be related with counterfactual thinking. First of all, in the FP: Low condition, this positive total effect of progression on affect was in the opposite direction to the effect of counterfactual probability estimates. Secondly, in the FP: High condition, the positive total effect still exists even when the effect of counterfactual probability estimates on affect was not significant.

Thus, there seemed to be a mechanism between progression and emotions that operates independently from counterfactual probability estimates. It was speculated that in a horse race, the thrill and excitement that could be directly derived from the sense that “we are winning” could have contributed to the observed total effect. Indeed, in the present experiment, the perceived progression toward winning was found to increase counterfactual probability estimates and may evoke more intense disappointment regarding the *outcome* of the game (“The horse could have won but it didn’t!”). However, one might still be able to take joy out of the *process* of the race. That is, seeing one’s horse getting closer and closer to winning might be an enjoyable experience itself, which could cancel out some negative affect from the disappointment due to losing a race. This speculation receives some support from our results, which indicates that, when the future possibility was low, the negative relationship between counterfactual probability estimates and emotions was weaker in Progression: Present condition than in Progression: Absent condition. Presumably, the strength of the relationship in the former condition has been diluted by the positive effect of progression on emotions.

This view is consistent with the finding of Hsee and Abelson (1991, Study 2), in which participants were asked to monitor the vertical movement of a bar along a scale, which represents the probability that they would win a hypothetical gamble. The higher the bar went, the higher the probability it represented that they would win. This task resembles the one in the present experiment in that participants were given live feedback about the propensity of a certain future outcome (e.g., winning a gamble). They found that participants' satisfaction was a function of the rising rate of the probability (the faster the bar was rising, the higher level of satisfaction was reported). Unlike the present experiment, they did not disclose information about the final results of the gamble and therefore participants wouldn't be disappointed due to their prior expectation of winning. However, their results do show that regardless of the final outcome, people could take pleasure merely out of the rising of the expectations for a positive outcome.

In a scenario study like the present experiment, the effect of the race *process* on affect might have become very prominent because participants had weak affective attachments to the *outcome* of the race due to its limited implications to their life. They might have focused more and thus were more affected by the vivid textual and graphical depicts of the process of the race. Thus, it was argued that to make it possible to detect the effect of counterfactual probability estimates on one's overall affective experiences, real-life tasks should be introduced to future experiments.

3.4 General Discussion

3.4.1 Progression and Counterfactual Probability Estimates

The sense that something almost happened was believed to rely heavily on the events cues emerging from the causal episode that precedes an outcome

(Kahneman & Varey, 1990). The previous chapter has demonstrated the effect of one of those cues – proximity - on people’s counterfactual probability estimates and emotions on different levels of the perception of future possibility. The current chapter made an attempt to extend those findings by examining the situation where people are exposed to multiple proximity cues. It was argued that when multiple cues of proximity are made available, counterfactual probability judgments as well as the sense that something almost happened are not only determined by the proximity of the end result but also by the trend or progression developed by the variation in proximity over a period of time prior to the final outcome. This notion receives supports from both experiments presented in this chapter. The race horse displaying a trend of “catching-up” was thought to be more likely to win compared to the race horse bearing no such trend, despite the fact that they both stumbled and lost the race by the same margin. This effect was robust in both between-participant and within-participant designs.

The finding that people’s counterfactual probability judgments are dependent not only on a single, static value of proximity but also on its variations is an important extension to the existing evidence of the proximity heuristic (Teigen, 1998, 2005). It is also in line with the theoretical framework of the *availability heuristic*, which posits that people sometimes infer the probability of an event from the ease of retrieving it from memory or mentally constructing it. In the case of a counterfactual probability judgment, the fewer properties of the real world that people need to mentally mutate in order to undo the outcome, the closer or more convincing a counterfactual is. Besides static distance, trend could be one of the properties that can be retained or mutated in one’s counterfactual world. In our story, after the horse race, people made attempts to construct a counterfactual world in which the horse

had won. Clearly, in the imaginary world, for the horse to win the race, it had to overtake the leader. If the horse had been gaining on the leader in the real world, then such a trend of overtaking could be retained in the counterfactual world without any necessity of correction. However, if the horse had been following the leader consistently, then such a trend would need to be corrected in the counterfactual world, which means more mental mutations and less convincing counterfactuals.

A competing alternative explanation for the obtained effect of progression is that participants' memory of the proximity has been distorted by the motion of the two horses. That is, instead of having a direct effect on counterfactual probability estimates, progression might have heightened it by making the static distance between the target horse and the leader look somewhat shorter. A phenomenon called *representation momentum* has been widely documented in the research of visual perception (see for example, Freyd & Finke, 1984), in which people's perceived final position of a moving object which abruptly halted is further along the initial direction of its travelling than where it actually is. Thus, the strong forward motion of the "catching-up" horse might distort the audience's perception of its final position before stumbling and makes it look closer to the winner than the other horse. It is believed that this explanation is unlikely because in both experiments, the textual description of the race explicitly told the participants that the two horses were in the same distance behind the leader before they stumbled. Nevertheless, the distortion of perceived proximity can indeed play a part in the counterfactual probability estimates of the audience in a real life horse race where the perceptions of motion and position are derived from visual stimulations.

The observed effect of progression is also open to another alternative explanation. That is, the causal link between “catching-up” and “win” might not have been derived from the basic physical cues like “trend” or “proximity” but from more rational grounds. The thrilling experience of “catching-up” might be believed to have a positive impact on the confidence and motivation of both the jockey and the horse. Those psychological impacts may well be translated into good performance and raise their likelihood of winning. This view coincides with the literatures of psychological momentum in sport. In the Antecedents-Consequences Psychological Momentum Model (Vallerand, Colavecchio, & Pelletier, 1988), it was proposed that the perception that one is progressing towards winning can give rise to improved synchronism, heightened confidence, perception of control and energy, which in turn lead to good performance. This proposition is supported by the empirical study by Perreault and Vallerand (1998), in which participants took on the task of 12-minute solo bike riding and were led to believe they were in a one-on-one competition with another participant of a similar physical condition. During the ride, they were also given false feedbacks about their performance in relation to their opponent. It was found that participants gave higher power output (hence better performance) when they were led to believe that they were gaining on their opponent from behind than when they were tied with their opponent or trailing behind. The psychological momentum-performance effect could be especially prominent in a horse race featured in the scenario of the present experiment because such a sport requires high arousal.

Although even the improvement in the *objective performance* in the “catching-up” scenario has to be preceded by the *subjective belief* that one is truly winning, it is still worthwhile to test the direct or “pure” effect of the perception of

progression on people's counterfactual probability estimates. For this purpose, future experiments could introduce abstract stimuli to evoke the sense of progression (e.g., the motion of dots) without addressing any real-life context. Alternatively, experiments could be set in a context where neither the actor nor the spectator has control over the outcome of an event (e.g., chance-determined gambling game).

3.4.2 Progression and Emotions

The results of the two experiments indicate considerable complexities regarding the emotional consequences of the sense of progression. First of all, evidence has been obtained from both experiments suggesting that the perceived progression had an indirect effect on emotions via counterfactual probability estimates and the indirect effect is contingent on the perception of future possibility. While the results indicate a negative correlation between the counterfactual probability estimates and emotions when the outcome of the race was decisive, no such relationship was found when the outcome of the race was not decisive. Those findings are consistent with those in Chapter 2 and concur with the hypothesis that the presence of future possibility enhances the assimilation effect and diminishes the contrast effect. Also in line with the findings of Chapter 2, participants were found to focus more on the future implications of a counterfactual when future possibility was high. Indeed, The catching-up horse was not only regarded as a horse that had had a bigger chance of winning in the just-finished race but also a horse that had a bigger chance to win future races. However, the later implication can only be appreciated when there is a second race.

Nonetheless, the total effect of progression on emotions seemed to be quite insensitive to this indirect effect as well as the manipulation of future possibility.

Progression was found to have no significant effect on emotions in either of the future possibility conditions in Experiment 4 but had positive effect on emotions regardless of future possibility condition in Experiment 5. Counterfactual probability estimates did not seem to be the only intervening variable through which the perceived progression can influence emotions. Other mechanisms might have diluted or overridden the predicted indirect effect. One possible mechanism, as identified in the discussion section of Experiment 5, is that the sense of progression may improve one's mood by raising one's expectation of winning, although this could lead to higher level of disappointment later when the outcome of losing is revealed. Thus, the heightened sense of progression towards winning might have dual effects on emotions. On one hand, during the development of a horse race, the progression towards winning engenders positive emotions like thrill and hopefulness. On the other hand, after the revelation of the losing outcome at the end of the race, the progression towards winning lifts counterfactual probability estimates and engenders negative emotions like disappointment.

The overall emotional experiences might be determined by how much focus people give to the *process* of an event relative to its *outcome*, which might be in turn affected by several situational factors. For example, negative events that are severe and high in self-relevance may dispose people to focus more on its outcome than the ones that are mild and low in self-relevance. Thus, the emotional experiences in the former case should be more susceptible to counterfactual probability estimates. As discussed in Experiment 5, the reason why the effect of counterfactual probability estimates was overwhelmed in our experiments could be that participants had weak affective attachments to the outcome described in a scenario study. Another possible factor is the phrasing of the question regarding the judgment of affect. In the two

experiments presented in this chapter, participants were invariably asked to make judgments about the gamblers' emotional experiences "after the race". The ambiguous scope of the question might have led participants to take a comprehensive consideration regarding both the process and the outcome of the race. It is believed that if the scope of the questions had been restricted to the *outcome* of the race, participants' ratings on affect might have been more susceptible to their counterfactual probability estimates.

In the two experiments presented in this chapter, the perception of progression was elicited by text or pictures which depicted the physical movements of objects. However, when cues of physical motion or proximity are not directly available to aid probability estimations, people may still apply the analogue of proximity and progression to those situations. For example, it might be appropriate to say that a person "was close to becoming a doctor" or "almost became a doctor" if he/she graduates from medical school with prominent academic performance and spends years in a hospital as an intern but finally decides to leave the health sector and launch a new career somewhere else. In such a case, the counterfactual probability is estimated even when there is no clear cue of proximity or progression on a perceptual level. The next chapter will examine the role of progression in such cases where the perception of progression is not informed by physical but by conceptual distances.

Chapter 4 Diminishing of Causal Proximity - Temporal Order Effect on Counterfactual Probability Judgments

4.1 Introduction

The experiments reported in Chapter 3 demonstrated how the sense of progression or “shrinking distance” to a target outcome affects people’s subjective likelihood regarding that outcome. The perceived progression was operationalized in a different fashion in the present chapter. As discussed briefly in Chapter (Section 1.3.3.2), it is argued that the subjective sense of progression or “shrinking distance” is not only provoked by basic perceptual stimulations like motion or physical distance (e.g., the variation in the size of the gap between horses in a race). It can also be provoked by the decrease or increase in the *causal distance* to a target outcome. For example, for one person who tosses a coin five times and aims to see five heads in a row, every time a head is obtained, the person might perceive him/herself to be one step “closer” to seeing five heads. It is argued that the person in the coin-tossing game might base their perception of propensity and counterfactual probability estimates on the cues of causal proximity to a target state (i.e., tossing five heads) in a similar way that gamblers in a horse race base their probability estimates on cues of physical proximity between their horse and the leader. Only that in the former case, the perceived proximity to a target outcome was not cued by visible distance in the material world but by the numbers of premises that have to be satisfied for a target outcome to be true (e.g., How many “heads” are still needed to realize the outcome of “five heads”?).

In the case of causal proximity, the effect of perceived progression might manifest itself as a temporal order effect. According to Kahneman and Varey (1990),

the perception of propensity is crucial to the validation of close counterfactuals. For the statement “Outcome A almost happened instead of outcome B” to be plausible, the propensity of outcome A must have been very high at some point during the development of the event before the occurrence of a decisive event, which dictates outcome B and brings the propensity of outcome A to zero. Thus, a decisive event which occurs late in a causal sequence will allow the perception of propensity to be accumulated to a high level before dropping and provoke the sense “things were going well but we blew it the last minute”. On the other hand, a decisive event which occurs early in the causal sequence will disrupt the accumulation of the perception of propensity and terminate the event before the perceived propensity goes high.

To illustrate, consider a gambler who has been offered an opportunity to win £500 if they draw three cards of the same suit from a deck of cards. It is quite plausible to say “I could have drawn three hearts” if the gambler drew a spade, followed by two hearts. However, this counterfactual might be even more compelling if the gambler drew two hearts first, followed by a spade. Please note that in both cases, the gambler is one card from winning, meaning that the causal distances separating the real outcome and its alternative are equal. However, in the latter case, the events preceding the final outcome are organized in such an order that it provokes a perception that “the gambler is winning” while in the former case this perception is disrupted by the drawing of a spade as the first card.

There have been several investigations on the effect of antecedents’ temporal order on counterfactual thinking, which demonstrate that when a factual outcome is preceded by a sequence of independent events, the event which occurs later in the sequence is more likely to be mutated in one’s counterfactual construction and is

given more causal significance than the event which occurs earlier (Byrne, Segura, Culhane, Tasso, & Berrocal, 2000; Miller & Gunasegaram, 1990; Spellman, 1997; Walsh & Byrne 2004). For example, in a study by Miller and Gunasegaram (1990), participants were presented a scenario in which Jones and Cooper were said to have been offered an opportunity to win \$1000 if they both tossed a coin and matched each other's result. Jones tossed the coin first and got a head. Cooper tossed next and got a tail. Thus, neither of them won anything. The majority of the participants (86%) thought Cooper, who tossed the coin second, would experience a greater extent of guilt and be blamed more than Jones, despite the fact that, as argued by the two authors, the actions of the two persons contributed equally to the final outcome.

In attempt to explain this temporal order effect, Spellman (1997) proposed that causal reasoning involves a probability updating process. In her discussion of what is called *crediting causality*, people judge and compare the causal importance of two events to an outcome by calculating and comparing the changes in the probability of the outcome due to the occurrence of each event. In the aforementioned coin-tossing scenario, Jones' toss, regardless of its outcome, did not change the probability of winning - it remains 50% before and after his toss. However, if the result of Cooper's toss matched Jones', the probability of winning became 100%. If it did not, the probability of winning became 0%. In either case there would be a change in the chance of winning (i.e., from 50% to 100% or from 50% to 0%). Thus, Cooper, who tossed the coin after Jones, would be considered more decisive to the final outcome than Jones and his action would seem more mutable.

It should be noted that there is an important distinction in the order effect examined in the present thesis and the one tested in the previous research. To clarify, the earlier research investigated how the mutability of one *antecedent* was affected by its position in a causal sequence when *several* antecedents equally contribute to the final outcome. For example, in the aforementioned coin-tossing scenario where Jones and Cooper were aiming to obtain the same value out of their tosses, the actions of the two were equally decisive to the final outcome in that one can always mentally mutate the final outcome by altering the result of either action. In this case, the antecedent that occurs later in the causal sequence (i.e., Cooper's toss) will be more likely to be mutated in people's counterfactual world than the antecedent that occurs earlier (i.e., Jones' toss). This effect was identified by the thesis as the temporal order effect type 1. In contrast, the thesis investigated what is called the temporal order effect type 2 – that is, the mutability of an *outcome* is affected by the temporal position of its *only* decisive antecedent in the causal sequence. To illustrate this distinction, consider a similar scenario involving coin tossing. This time, instead of aiming to match each other's result, Jones and Cooper will win only if *both* of them toss a head (i.e., they will lose if they both toss a tail). The temporal order effect type 2 would predict that if one of the two persons tossed a tail, the losing outcome should be perceived to be more mutable if it was the second person, rather than the first person who tossed a tail.

Despite the distinction, the two types of temporal effects might share some common grounds in terms of mechanism. The theoretical underpinning of the temporal order effect type 2 is Kahneman and Varey (1990)'s theory of perceived propensity and close counterfactuals, which in essence, proposed a probability updating process. Take the adapted coin-tossing scenario for example (where Jones

and Cooper must both toss a head in order to win). Before anyone has tossed a coin, the chance of winning is 25% because tossing two heads is one of four possible outcomes (H-H, H-T, T-H, T-T). Now suppose Jones tosses first and gets a tail, which brings the chance of winning (or propensity to win) down to 0%. It would remain at 0% even if Cooper gets a head in the next toss. Thus, the chance of winning peaks at 25% and then drops to 0%. However, suppose the game is rerun and this time Jones tosses first and gets a head, which brings the chance of winning up to 50% because now there are two possible outcomes (H-H, H-T). If Cooper tosses second and gets a tail, then the chance of winning will drop to 0%. In this case, the chance of winning peaks at 50% and then drops to 0%. In both cases, the two players get one head and one tail. However, they might perceive themselves “closer” to winning in the second case where “tail” appears later in the causal sequence because the probability or the propensity of winning peaks higher and also drops by a bigger magnitude.

4.2 Experiment 6

The experiment presented in this chapter examined the temporal order effect type 2 on counterfactual probability estimates and emotions in a real-life gambling environment, where participants were given real money and gambled in multiple trials of a computer-simulated coin-flipping game. In each trial, participants flipped three coins simultaneously and stopped them in succession by repeatedly pressing the “space” key on the keyboard. They would win if the three coins stopped at the same value (i.e., three heads or three tails) but would lose if otherwise. Table 4.1 provides a list of all eight possible outcomes, which fall into four categories – Win (H-H-H, T-T-T), Lose on third coin (H-H-T, T-T-H), Lose on second coin (H-T-H,

T-H-T) and Lose on first coin (H-T-T, T-H-H). Because a fair coin has a 50% chance of landing either heads or tails, the probabilities of the eight outcomes are equal. Thus, participants had 25% chance of seeing each of the four categories listed above. It is also important to note that if participants lost, they were always one coin away from winning, meaning that the static causal proximities to winning were equal in all losing trials and the losing outcome can always be mentally undone by mutating the result of one decisive coin. However, it was predicted that as a result of the temporal order effect type 2, participants would report higher counterfactual probability estimates and would be more disappointed by the result if they lost on the third coin (i.e., decisive event comes last) rather than on any other coin.

What's more, to investigate whether the perception of progression is derived from the temporal order in which the antecedents *occur* in the real world or the temporal order in which the antecedents were *revealed* to participants, a "simultaneous" condition (as opposed to the "sequential" condition introduced earlier) was added to the experimental design. To recap, in the sequential condition participants flipped the three coins simultaneously by pressing the "space" key and stopped them in succession by pressing the "space" key three times on the keyboard. In contrast, in the simultaneous condition, participants started the three coins flipping in succession by pressing the "space" key three times and pressed it a fourth time to stop all three coins flipping simultaneously.

Table 4.1 *List of possible outcomes and their categorization*

Outcomes	Combinations
Win	H-H-H
	T-T-T
Lose on third	H-H-T
	T-T-H
Lose on second	H-T-H
	T-H-T
Lose on first	H-T-T
	T-H-H

Notes: H = Head; T = Tail

It should be noted that in both conditions, the outcomes of the three coins were determined in succession. That is, in the sequential condition, the outcomes of the three coins were determined one after another by the moment they were *stopped* flipping while in the simultaneous condition, they were determined one after another by the moment they were *started* flipping. It was only the disclosures of the results that were different between the two conditions. Spellman (1997) found that both the occurrence order and the revelation order have effects on causal attribution. Thus, it was expected that both orders would have effect on counterfactual probability estimates, too. If that's true, then (1) the temporal order effect should be observed in both the sequential condition and the simultaneous condition; and (2) the effect should be stronger in the sequential condition because both the occurrence order and the revelation order were having an effect on counterfactual probability judgments in

this condition while only the occurrence order was having an effect in simultaneous condition.

As a continuation of the tradition in the previous experiments, the effect of the perception of progression (derived from the temporal order of events) on emotions was also examined. Because participants undertook as many as 80 game trials in the experiment, measuring a wide range of emotions between those trials would be practically difficult. Thus, unlike its predecessors, the present experiment exclusively focused on one typical contrast-effect-derived emotion – disappointment. To minimize the impact of the *process* of progression on one’s emotional reactions, participants were explicitly asked to report the level of disappointment regarding the *outcome* of the game. It should be noted that although participants took gambles in repeated trials and hence their perception of future possibility should be high, a domination of the contrast effect was still expected to be observed because the participants were asked in the question to focus on the outcome of the just-finished trial alone. It was predicted that participants’ ratings on disappointment should follow the same pattern as their counterfactual probability estimates. That is, in both the sequential and the simultaneous conditions, participants would be more disappointed if they lost on the third coin than if they lost on any other coin. However, the effect should be stronger in the sequential condition than the simultaneous condition. Of course, the effect of temporal order on the feeling of disappointment should be mediated by counterfactual probability estimates.

The reason why the game was configured to involve flipping three, instead of two coins is that it allowed for a testing of the confounding effect of memory availability on counterfactual probability estimates. As noted by Miller and

Gunasegaram (1990), temporal order effects could arise simply because the last event in the sequence is more available in memory and thus more mutable. In a coin-flipping game, it is possible that when evaluating the credibility of the statement “I could have won”, participants back-track the causal sequence in search of the decisive antecedent. It might be less effortful for participants to find the decisive event if it occurs last in the causal sequence (thus readily available in memory) than if it occurs earlier. For example, if the participant loses on the first coin, she/he will have to track all the way back to the beginning of the trial to find the decisive antecedent in order to construct a counterfactual world in which she/he wins. If memory availability does play a part in the effect of temporal order on counterfactual probability judgments in the coin-flipping game, then the probability judgment and the level of disappointment should be reported higher after losing on the *second* coin than after losing on the *first* coin, because in the latter case the decisive event occurs even further back in the causal sequence.

Another possible confounding variable is attention. It could be that in the case where people lose on the second or the first coin, their attention to the outcome of the last coin simply lapses because it no longer dictates the outcome of the game. This could cause poor memory on the value of the third coin and hence difficulty in mental simulation, which in turn leads to lowered counterfactual probability judgments and disappointment compared to losing on the third coin. To rule out the confounding effect of attention, participants were asked to undertake a memory recall task after different types of outcomes. If the temporal order effect is partially caused by a shift in attention, then participants should recall better when losing on the third than on any other coin. What’s more, their memory recall performance should be positively correlated with counterfactual probability estimates.

4.2.1 Method

4.2.1.1 Design

The experiment investigated the effect of two independent variables - Temporal Order of antecedents and Revelation - on counterfactual probability estimates and emotions. It employed a 3 (Temporal Order: Lose on First/Lose on Second/Lose on Third) x 2 (Revelation: Sequential/Simultaneous) mixed design with Temporal Order as a within-participant variable and Revelation a between-participant variable.

4.2.1.2 Participants

Eighty two first year psychology undergraduates of Durham University were recruited as participants (14 males and 68 females) and were given real money to gamble in a computer-simulated coin-flipping game. The computer programme was written by IT technician David Knight in author's department. Participants also received either participant credits or £2 monetary compensation for taking part. On top of that, they were entitled to keep whatever was left of the gambling fund at the end of the experiment.

4.2.1.3 Materials and Procedure

The experiment was run on one participant or in small groups of three or four at a time. At the beginning of the experiment, all the participants were given an oral introduction to the purpose and the basic procedure of the study. They were told that the purpose of the experiment was to investigate people's gambling behaviours and they were going to be given real money to bet in a computer-simulated coin-flipping game. Having given written consent to taking part in the experiment, they were led into a two-square-metre isolated cubical and seated before a computer.

After the computer programme was launched, text messages appeared on the screen giving instructions on how to play the game. Participants then pressed the “space” key to enter a block of four practice trials before proceeding to the 80 experimental trials. Figure 4.1 shows the interface of the programme. In each trial, participants were asked to complete four actions in succession: *Bet – Flip – Lock – Answer*.

Bet

All participants started with 2000 credits (equivalent to £2). At the beginning of each trial, participants used the “up” or “down” key on the keyboard to adjust the amount of credits they wished to bet, which were displayed in the box at the bottom-right corner of the screen. The frame of the box changed its colour between black and red alternately to remind the participants to adjust their bet at the beginning of each trial. The minimum allowed bet was set to 1 and the maximum was 25. The upper limit made sure that participants would not be in deficit after 80 trials even if they used the most aggressive betting strategy and lost every trial. At the end of the game, they could trade whatever was left of their credits for real money at a rate of 10 credits = 1p. Their total remaining credits were always displayed in the box at the bottom-left corner of the screen.

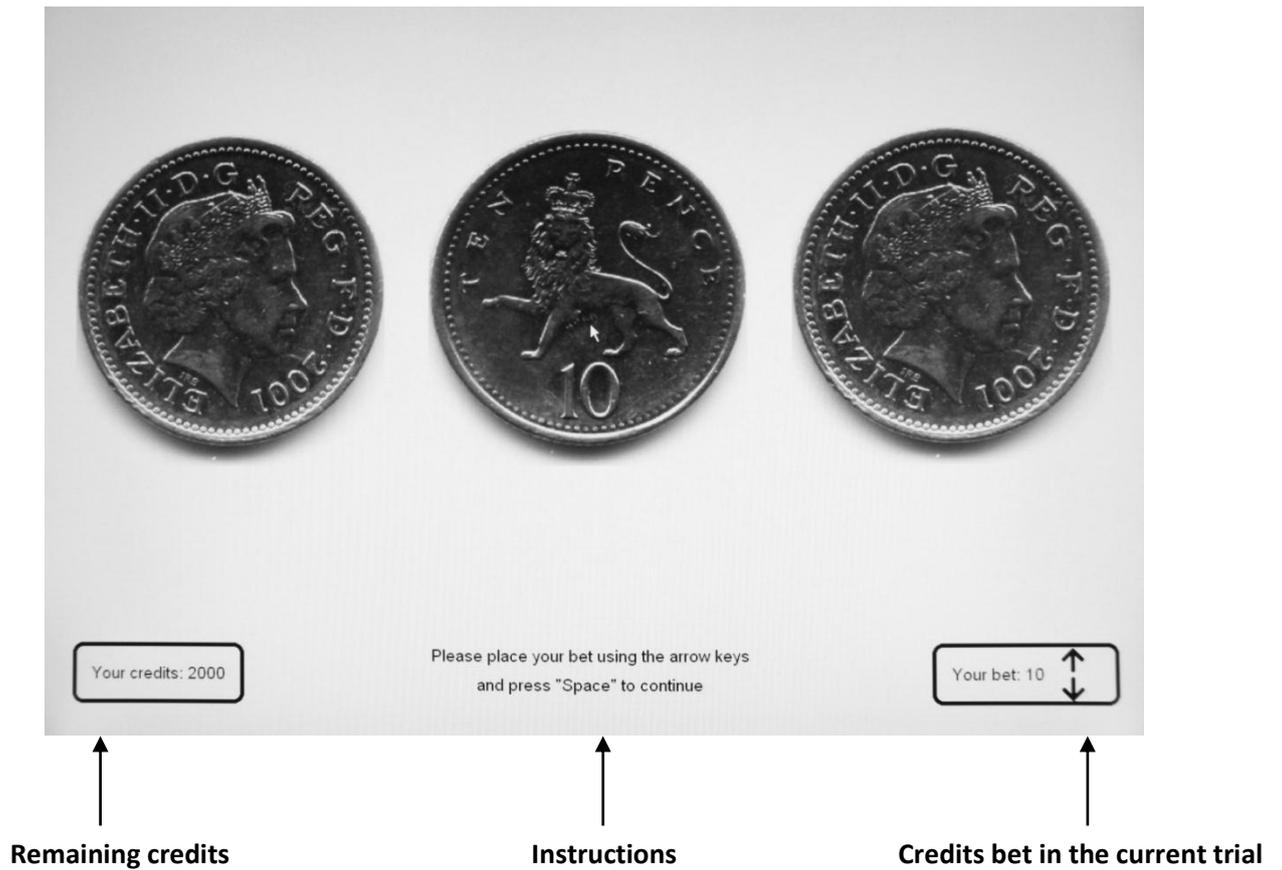


Figure 4.1 Coin-flipping simulation Program Interface

Flip and Lock

After placing their bets, the computer prompted the participants to press the “space” key to flip three identical coins laid across the computer screen. The initial pre-flipping value assigned to each coin was randomized at the beginning of each trial to prevent the participants from developing a winning strategy. In the Revelation: Sequential condition, the participants pressed the “space” key once to make the three coins start flipping rapidly at the same time (at a speed of 45 milliseconds per flip). Then they pressed the “space” key three times in sequence to stop the coins flipping one by one from left to right. In comparison, in the Revelation: Simultaneous condition, the participants pressed the “space” key three times to make

the three coins start flipping one by one from left to right. Then they pressed the “space” key for a fourth time to stop all three coins flipping at the same time. In both conditions, the minimum interval between the presses of the “space” key was set to be one second. This feature was to prevent the participants from pressing the key too quickly, in which case the sense of progression would be obscured. The outcome of the flipping of each coin was NOT pre-programmed and was completely determined by the moment of participants pressing the “space” key.

In both conditions, if all three coins showed the same value (i.e., H-H-H or T-T-T in Table 4.1), the words “Congratulations, you won” would appear on screen and participants won three times the amount they had bet for that trial. Otherwise, the words “Sorry, you didn’t win this time” would appear on screen and they lost the full amount of whatever they had bet.

Answer

At the end of each trial, regardless of outcome, participants were instructed to press the “space” key to bring up the first of two questions. The first question was the target question and was determined by the outcome of the just-finished trial. For example, following the outcome of a Losing on third trial, the target question would be one of the four following questions⁴:

- (1) (To measure their counterfactual probability estimate) To what extent do you agree with the following statement: “I could have won this trial.” (1 = Strongly disagree; 9 = Strongly agree)

⁴ The purpose of Question 2 digresses from the main theme of the thesis and thus its results were not reported in the main body of the thesis.

- (2) (To measure the perception of luck) How lucky or unlucky do you think you were in this trial? (1 = Extremely unlucky; 9 = Extremely lucky)
- (3) (To measure disappointment) How disappointed are you regarding the result of this trial? (1 = Not at all; 9 = Extremely)
- (4) (To measure participant's recall accuracy) How many heads/tails have you got in this trial? Please indicate by pressing a number from 0-3 (0 = none, 3 = 3 heads/tails).

As the reader has probably noticed, unlike Experiment 2, 3, 4 and 5, participants' were not asked to rate counterfactual probability directly in this experiment. Instead, the participants were asked to report the level of agreement on a statement of counterfactual probability. The purpose of this adjustment was to avoid prompting participants to engage in deliberate calculation of the odds or probability of winning in a mathematical way instead of reporting their intuitive estimations.

The four questions were brought up by the computer in rotation after each Losing on third trial. The same set of questions was configured for Losing on second and Losing on first trials and they followed the same rotation setup. It should be noted that each of the three sets of questions rotated independently from the other two. Although the interest of the experiment lay in the participants' responses after losing trials, two questions were still asked after winning trials to balance the time spent by participants in each trial and to minimize suspicions. The four aforementioned target questions were used for winning trials with superficial adaptations to fit them in context (e.g., the statement in the question (1) was changed

to “I could have lost this trial” and the word “disappointed” in question (2) was changed to “pleased”).

After all outcomes, the second question asked was always a filler question which was randomly selected by the computer from a pre-composed filler questions pool (see Appendix F). What’s more, the amount that participants bet on each trial was recorded by the computer. The purpose of this measure deviates from the main theme of the thesis and hence its results are not fully reported. However, references to those results will be made in the results section when they help interpret the data of interest.

Participants were given a chance to take a rest after 40 trials for as long as they wished. After the total of 80 trials, participants traded their final balance for real money with the experimenter. Then they were given a written debrief and thanked for their contribution to the study.

4.2.2 Results

4.2.2.1 Preliminary Analysis

As Table 4.2 indicates, on average, the four outcomes occurred with similar frequencies (means close to 20) and this was true for both the sequential and the simultaneous conditions. This pattern is consistent with the theory of probability and confirms that the computerised coin tossing programme produced a fair result. Table 4.3 indicates that each of the three questions concerning counterfactual probability, the level of disappointment and memory recall appeared around five times on average after each type of outcome for each person. Means of the ratings regarding those three questions were therefore taken by averaging all the available scores for

each participant. It was shown that other extracting methods (e.g., averaging the first three scores, first four, first five and so forth) yielded the same results for all analyses.

Table 4.2 *Means of Frequencies of Four Outcomes across Two Revelation Conditions*

Outcome Categories	Revelation Conditions		Overall
	Sequential	Simultaneous	
Win	18.93 (times) Range: (12 - 28)	19.24 (times) Range: (11 - 28)	19.09 (times) Range: (11 - 28)
Lose on third	20.37 Range: (14 - 31)	20.20 Range: (11 - 30)	20.28 Range: (11 - 31)
Lose on second	21.17 Range: (10 - 28)	19.66 Range: (10 - 30)	21.04 Range: (10 - 32)
Lose on first	19.54 Range: (10 - 32)	20.90 Range: (12 - 29)	19.60 Range: (10 - 29)

Table 4.3 *Means of Frequencies of Three Questions Following Three Losing Outcomes*

Outcome Categories	Measures		
	Counterfactual Probability Estimates	Level of Disappointment	Memory Recall
Lose on third	5.41 (times) (range: 3 - 8)	4.93 (times) (range: 3 - 8)	4.65 (times) (range: 2 - 7)
Lose on second	5.61 (range: 3 - 8)	5.02 (range: 2 - 8)	5.03 (range: 2 - 8)
Lose on first	5.31 (range: 3 - 8)	4.85 (range: 2 - 8)	5.05 (range: 3 - 8)

4.2.2.2 Counterfactual Probability Estimates

For each participant, means were taken of their counterfactual probability statement ratings following “Lose on third” trials, “Lose on second” trials and “Lose on first” trials separately. The means of “Lost on second” trials and “Lose on first” trials were pooled together because in both cases, participants knew that they had lost the trial after seeing the outcome of the second coin and thus there was no meaningful psychological difference between the two types of outcomes in terms of perceived propensity. A mixed temporal order \times revelation ANOVA revealed a significant main effect of temporal order ($F(1, 80) = 12.85, p = .001, r = .37$) (see Figure 4.2). More specifically, counterfactual probability estimates were higher after “Lose on third” trials ($M = 6.17, SD = 1.45$) than other trials ($M = 5.83, SD = 1.57$).

However, under the main effect of temporal order, there was a significant temporal order \times revelation interaction ($F(1, 80) = 11.32, p = .001, r = .35$). As Figure 4.2 suggests, the effect of the temporal order was only significant when the outcomes of the three coins were presented sequentially ($F(1, 40) = 14.32, p = .001, r = .51$), where the counterfactual probability ratings were significantly higher after “Lose on third” trials ($M = 6.43, SD = 1.63$) than other trials ($M = 5.76, SD = 1.89$). On the other hand, when the outcomes of the three coins were presented simultaneously, temporal order did not have a significant effect on counterfactual probability estimates ($F(1, 40) = 0.08, p = .782, r = .04; M = 5.92, 5.90; SD = 1.21, 1.19$, respectively). Going against the hypothesis, the null effect in the simultaneous condition suggests that the temporal order effect found in the sequential condition was caused by the revelation order of the events alone but not the occurrence order. As expected, the main effect of revelation was not significant ($F(1, 80) = 0.35, p = .556, r = .06$).

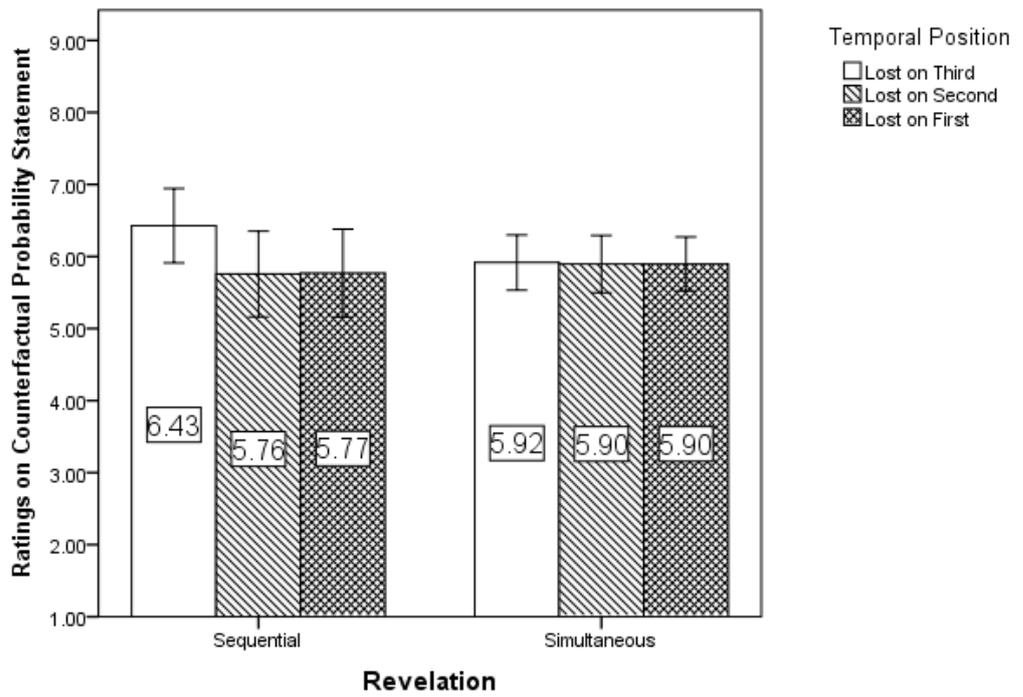


Figure 4.2 Mean (with error bars representing 95% CIs) Ratings on Counterfactual Probability Statement across all Conditions

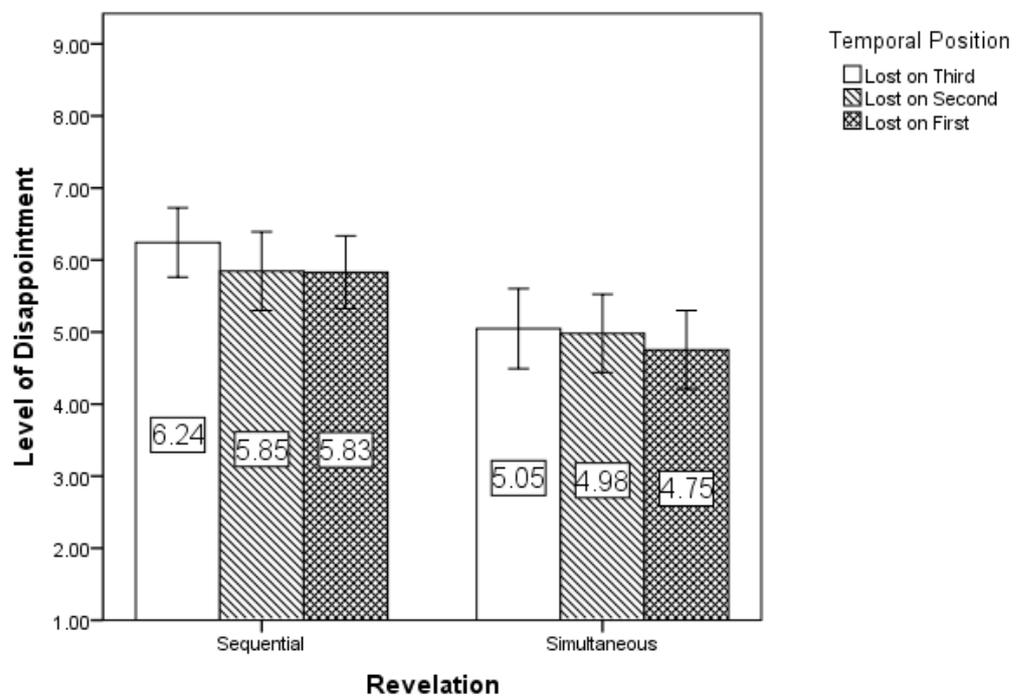


Figure 4.3 Mean (with error bars representing 95% CIs) Ratings on Disappointment across all Conditions

Finally, to make sure that the temporal order effect found in the sequential condition was not caused by the fact that the “losing coin” appearing later in a sequences is more available in memory than if appearing earlier, comparison was drawn between the means of “Lose on second” and “Lose on first” trials. It was found that the mean ratings of counterfactual probability did not significant differ after these two types of trials ($t(40) = 0.15, p = .882, r = .03$) (see Figure 4.3), indicating that memory availability could not explain the effect of temporal order on counterfactual probability estimates.

4.2.2.3 Disappointment

Mean scores were also taken of the disappointment ratings following the three losing outcomes separately. As was done before, the means of “Lost on second” trials and “Lose on first” trials were pooled together. It was predicted that participants’ ratings on disappointment should be in the same fashion as the ratings on counterfactual probability. A mixed temporal order \times revelation ANOVA on participants on the ratings of disappointment revealed a significant main effect of temporal order ($F(1, 80) = 9.93, p = .002, r = .33$)(see Figure 4.3). That is, participants were more disappointed after “Lose on third” trials ($M = 5.64, SD = 1.74$) than other trials ($M = 5.35, SD = 1.70$).

Contrary to expectations, the temporal order \times revelation interaction was not significant ($F(1, 80) = 1.47, p = .229, r = .13$). Nevertheless, there is an indication from Figure 4.3 that the effect of the temporal order on participants’ feelings of disappointment was weaker in the simultaneous condition than in the sequential condition. Simple main effects tests showed that, when outcomes were revealed in succession, temporal order had a significant effect on the level of disappointment ($F(1, 40) = 8.10, p = .007, r = .41$) - the ratings on disappointment were significantly

higher after “Lose on third” trials ($M = 6.24$, $SD = 1.53$) than other trials ($M = 5.84$, $SD = 1.61$). On the other hand, when the outcomes of the three coins were presented simultaneously, temporal order had no significant effect on the level of disappointment ($F(1, 40) = 2.28$, $p = .139$, $r = .23$; $M = 5.05$, 4.87 ; $SD = 1.76$, 1.67 , respectively). What’s more, in sequential condition, the level of disappointment did not significantly differ after “Lose on second” and “Lose on first” trials ($t(40) = 0.12$, $p = .906$, $r = .03$), indicating that memory availability could not explain the effect of temporal order on disappointment.

Also, surprisingly, the analysis found a significant main effect of revelation ($F(1, 80) = 8.82$, $p = .004$, $r = .31$). Overall, participants were more disappointed if the outcomes were presented to them sequentially ($M = 5.97$, $SD = 2.25$) than simultaneously ($M = 4.93$, $SD = 2.25$). This difference however can’t be explained by participants’ counterfactual probability estimates because those estimates were not significantly different across the two revelation conditions. Instead, it could be due to the fact that the participants in the sequential condition had a higher sense of control over the outcome of the game and thus had a higher expectation of winning in general. The discrepancy in the sense of control could arise from two sources. First of all, participants in the sequential condition received feedback more frequently during the course of every trial than those in the simultaneous condition. When the outcomes of the three coins were presented in succession, participants got immediate feedback every time after pressing the “space key” while participants in the simultaneous condition did not receive any feedback until the end of the game. Higher feedback frequency in the former condition might have raised participants’ sense of control. Secondly, in the sequential condition, participants had control on when a coin would *stop* flipping while in the simultaneous condition, participants

had control on when a coin would *start* flipping. Participants might view that how the flipping stopped contributed more to the outcome of the flipping than how a flipping started because the former occurred later in the causal chain. Thus, a higher sense of control over the outcome of the game might arise if participants were asked to control the stopping of the coin rather than the starting of it.

The analyses on participants' adjustments to the amounts bet after each trial support these speculations. Participants in the two revelation conditions seemed to adopt different betting strategies. On average, after a losing trial, participants in the sequential condition *reduced* their bet ($M = -0.10$, $SD = 0.81$) while those in the simultaneous condition *increased* their bet ($M = 0.22$, $SD = .81$). This difference was significant ($F(1, 80) = 6.41$, $p = .013$, $r = .27$). On the other hand, after a winning trial, an opposite pattern arose – participants in the sequential condition *increased* their bet ($M = 0.47$, $SD = 1.18$) while those in the simultaneous condition *reduced* their bet ($M = -0.48$, $SD = 2.27$). This difference was also significant ($F(1, 80) = 5.59$, $p = .020$, $r = .26$).

It is speculated that the participants in the sequential condition had a higher sense of control and therefore might interpret winning (or losing) as an indication of their successful (or an unsuccessful) strategy or their good (or bad) skills, which would in turn lead to future winning (or losing). On the other hand, participants in the simultaneous condition might have perceived that the game was chance-determined and thus were susceptible to the gambler's fallacy (see Sundali & Croson, 2006), believing losing outcomes were more likely to be followed by winning outcomes and winning outcomes were more likely to be followed by losing outcomes.

4.2.2.4 Mediating effect of Counterfactual Probability Estimates

It was predicted that counterfactual probability estimates would mediate the effect of temporal order on emotions. Again, this mediation was examined against the four criteria recommended by Judd et al. (2001): (1) Temporal order has an effect on counterfactual probability estimates; (2) Temporal order has effects on the level of disappointment; (3) Counterfactual probability estimates were related to disappointment in each temporal order condition and (4) The difference in the level of disappointment between the three Temporal order treatments (Lose on third, Lose on second and Lose on first) could be predicted by the difference in counterfactual probability estimates. These four criteria were examined in order.

Previous analyses have shown that in the simultaneous condition, the temporal order had no significant effect on counterfactual probability estimates or feelings of disappointment, which violated criterion one and two and thus did not support the proposition that the counterfactual probability estimates mediate the effect of temporal order on disappointment in this condition.

On the other hand, in the sequential condition, previous analyses showed that the temporal order of the decisive event has effects on both counterfactual probability estimates and disappointment in a similar fashion, which meets criterion one and two. However, counterfactual probability estimates were not found to significantly predict disappointment in any temporal order condition ($B = -0.10$, $t = -0.65$, $p = .552$ for Lose on third; $B = -0.12$, $t = -0.74$, $p = .466$ for other trials), which violates criterion three and therefore does not support hypothesis regarding the mediating effect of counterfactual probability estimates.

4.2.2.5 Performance of Memory Recall

Once participants pressed a number key to answer the question in the memory recall task, the computer automatically appraised the answer and produced a score of either 1 (if correct) or 0 (if false). These scores were later averaged for each outcome. Thus, higher score indicate better memory recall. As was done before, the means of “Lost on second” trials and “Lose on first” trials were pooled together. A mixed temporal order \times revelation ANOVA revealed a non-significant main effect of temporal order on memory recall ($F(1, 80) = 1.98, p = .163, r = .15$) and a non-significant temporal order \times revelation interaction ($F(1, 80) = 3.74, p = .057, r = .21$), indicating that in neither the sequential condition nor the simultaneous condition, participants’ performance of memory recall was significantly affected by the temporal order of the decisive coin. However, Figure 4.4 does indicate that participants in the sequential condition performed better in memory recall after losing on the third than any other outcomes. Analysis in this particular condition shows that the main effect of temporal order on memory recall was significant ($F(1, 40) = 5.27, p = .027, r = .34$). That is, participants had better memory recall of “Lose on third” trials ($M = 0.81, SD = 0.20$) than other trials ($M = 0.73, SD = 0.17$). However, the performance of memory recall did not positively predict counterfactual probability estimate ($B = -.28, t = -1.79, p = .081$ when losing on the third coin; $B = -0.14, t = -0.90, p = .373$ when losing on other coins). These results rule out the possibility that the observed temporal order effect on counterfactual probability was due to a lapse of attention after seeing the mismatch of the first two coins.

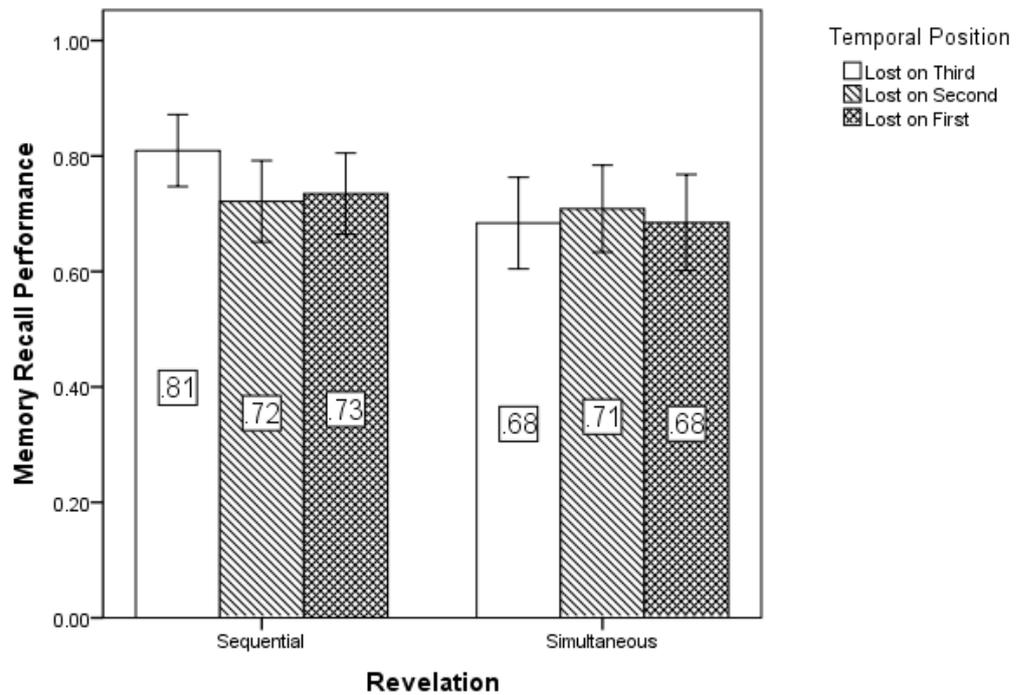


Figure 4.4 Mean (with error bars representing 95% CIs) Memory Recall Performance across all Conditions

4.3 General Discussion

The previous research has found that after the occurrence of an outcome, the mutability of one particular antecedent is affected by its temporal position in the event chain that precedes the outcome (Byrne et al., 2000, Miller & Gunasegaram, 1990; Spellman, 1997; Walsh & Byrne 2004). The present experiment has successfully demonstrated a different type of temporal order effect. That is, after the occurrence of an outcome, the mutability of this outcome (i.e., counterfactual probability) and its emotional consequences are affected by the temporal position of the decisive event in the event chain, which is referred to as temporal order effect type 2. In the computer-simulated coin-flipping game, when the outcome of the coins were presented in succession, both the sense that “I could have won” and the feeling of disappointment were stronger if the decisive event came last (i.e., losing on the

third coin) than if it came earlier (i.e., losing on the second or first coin), presumably because a decisive event that occurs later in the casual sequence allowed a sense of progression towards the target outcome (e.g., “I am winning!”) to be established, which lifts one’s perceived propensity of winning.

As a development from the last chapter, the present experiment demonstrated that the sense of progression can be derived from the diminishing in a causal distance to a target outcome. It also showed that the sense of progression toward a goal or desirable outcome can indeed exert a negative impact on one’s emotional experiences if that goal or desirable outcome fails to realize. More specifically, the results show that when the outcomes of the coins were presented sequentially, losing on the last coin was more disappointing than losing on the second or the first coin. However, the experiment failed to obtain evidence that people’s counterfactual probability estimates play a mediating role in the observed effect because no significant correlational connection was found between the counterfactual probability estimate and the level of disappointment. One possible explanation could be that the experiment failed to control other factors that could potentially contribute to the feeling of disappointment. For example, in the present experiment, participants were allowed to change the amount of bet freely, which could have introduced a source of variance in disappointment – participants should be more disappointed by a losing outcome when they had put more money at the stake. The influence of this factor to the feeling of disappointment could have diluted the effect of counterfactual probability estimates.

The results also suggest that the temporal order effect has got more to do with the revelation order (i.e., the order in which the information of the events in a causal

sequence is disclosed to people) rather than the occurrence order (i.e., the order in which the events in a causal sequence actually happen). In the simultaneous condition, where the outcomes of the three coins were determined in succession (i.e., participants pressed the “space” key three times to activate the flips of the three coins one after another) but presented at the same time, the effect of temporal order was not found. This finding is at odds with that of Spellman (1997), which found both the effects of occurrence order and revelation order on the perceived causal importance of an antecedent. The reason for this inconsistency could be that in the scenario study of Spellman (1997), participants were explicitly told about the order of the occurrence of the antecedents (i.e., order of coin tosses). By comparison, in the simultaneous condition in the present experiment, the information that the outcomes of the three coins were determined in succession was very subtle because participants only had control over when the coins started flipping but not over when the coins stopped flipping. It therefore may have been easily overlooked by participants. Thus, it is argued that our results are inconclusive regarding whether temporal order effect can be triggered by revelation order, occurrence order or both. This issue needs further examinations in experiments where the manipulation of occurrence order is made more salient to participants.

A possible alternative explanation for the observed temporal order effect would be on the grounds of memory availability. It was possible that people gave higher counterfactual probability estimates and felt more disappointed after losing on the third coin than any other coin simply because the decisive event in this case was more available in memory and hence made the mental simulation of what might have been less effortful. However, it was argued that this explanation is unlikely. If memory availability did play a part in the judgments of counterfactual probability,

participants should have given higher ratings on the counterfactual statement when they lost on the second coin than when they lost on the first because in the latter case, the decisive event was earlier in the causal sequence and should be less available in memory. However, the difference between the two conditions was non-significant.

This non-significant result, however, is in favour of the “propensity” explanation. Before seeing the outcome of the first coin, all participants’ prospect of winning was 25%. After the revelation of the first coin, this prospect remained 25%. However, if the second coin differed from the first coin in its value, the prospect of winning would drop to 0%. The prospect would remain at 0% regardless of the outcome of the third coin. Therefore, whether participants lost on the first coin or the second coin, the prospect of winning, which directly informed one’s perceived propensity, peaked at the 25%. Therefore the counterfactual probability estimates should be equal across the two conditions, which was exactly what the experiment has found.

The observed temporal order effect is also possible to have been simply caused by lapses of attention in the Lose on second and Lose on first trials. In these two conditions, when the value of the second coin failed to match that of the first coin, participants might simply have lost interest in the outcome of the third coin, which made them give lower ratings on counterfactual probability and disappointment. However, this possibility is also dismissed by the results, which show that although participants’ memory recall accuracy regarding the detail of the just-finished trial significantly differs after different outcomes, it did not positively predict their counterfactual probability estimates. This indicates that attention has not played a role in participants’ probability judgments.

To conclude, the evidence presented in this chapter confirms that people's counterfactual probability judgments are susceptible to the temporal order of the antecedents in the causal sequences. When a decisive antecedent occurs late in a causal sequence, a perception of progression towards the focal outcome is triggered, which will heighten one's counterfactual probability judgment and the level of disappointment, although the mediating role of counterfactual probability judgments between progression and disappointment still needs empirical support.

Chapter 5 General Discussion

5.1 Summary of Findings

The thesis set out to investigate the determinants of people's judgments of counterfactual probability and their role in people's emotional reactions to past events. The six experiments presented in the thesis provide insights into two central questions: (1) How do people make counterfactual probability judgments?; and (2) How do these judgments subsequently influence their emotional experiences? The findings regarding these questions are summarized separately in the following sections.

5.1.1 The Determinants of Counterfactual Probability Judgments

The results of Experiments 1, 2 and 3 presented in Chapter 2 support the hypothesis that people's counterfactual probability judgments can be informed by the event cue of outcome proximity. More specifically, the three experiments demonstrated that people's subjective likelihood of the occurrence of a counterfactual outcome will be heightened when the real outcome is spatially or numerically proximate to that alternative possibility (i.e., getting close to scoring a goal in a football game; failing a job entry test by one point; beating or beaten by the opponent by one point in score in a TV game show). These results confirm and advance the previous demonstration of the proximity-probability relationship (Teigen, 1998; Tykocinski & Steinberg, 2005) by: (1) ruling out the potential confounding of the absolute value of numbers in the relationship between numerical proximity and probability judgments (Experiment 3); and (2) showing that

conditional counterfactual probability judgments are affected by proximity cues in a similar way as *unconditional* ones (Experiment 2).

However, the fact that the effect of numerical proximity on counterfactual probability judgments was noticeably weaker in Experiment 2 (where participants were asked “How likely you think you would have passed the test if you hadn’t spent so much time in the bar the night before?”) than in Experiment 3 (where participants were asked “How likely do you think that Kelly (or another contestant in the story) could have won (or lost) the round that just finished?”) highlights the possibility that people may take slightly different strategies when dealing with conditional and unconditional counterfactual probability judgements. It was suspected that, while both kinds of probability judgments are closely related to the perception of propensity and thus can be informed by the event cue of proximity, judgments of conditional counterfactual probability might be also affected by the perceived correlation between the antecedent (e.g., “drinking”) and the outcome (e.g., the result of the examination”).

Experiments 4, 5 and 6 presented in Chapters 3 and 4 investigated the determination of counterfactual probability judgments in the situation where people do not only receive feedback about the proximity of the final outcome but also about how the proximity to a target outcome varies over a prolonged causal episode preceding the final outcome. It was found that, when controlling for outcome proximity, the trend with which the proximity to a focal outcome varies before the revelation of the final outcome also matters to the estimation of counterfactual probability. Experiments 4 and 5 demonstrated that a trend of “shrinking distance” between a target horse and the leader heightened people’s subjective likelihood of

the horse winning when it actually lost. As argued in Section 3.4.1, this effect was unlikely to be the result of a distorted visual perception caused by the motion of the “catching-up” horse because the textual descriptions of the race in Experiment 4 made it very explicit that the two horses were behind the leader by the same distance before they stumbled. This information was made even more transparent in Experiment 5 where the positions of the two race horses during the race were illustrated by pictures. In contrast, these results suggest that participants have used a simulation heuristic where the propensity of winning was estimated by assessing the ease with which a counterfactual scenario, where the horse actually won, can be imagined.

Experiment 6 demonstrated that people also apply the physical metaphor of distance and motion into situations where the “closeness” between a real outcome and its alternatives is only conceptual (e.g., “How close was I to tossing three heads in a row?”). A temporal order effect was found on people’s perception of counterfactual probability. That is, in a coin-flipping game where the objective was to obtain three coins in the same value (either three heads or three tails), if the coins were presented sequentially, the subjective probability of winning after a losing trial was heightened when a decisive event (i.e., obtaining a tail when the other two coins turned out to be heads, or vice versa) occurred later in the event sequence (e.g., obtaining one tail after obtaining two heads) rather than earlier (e.g., obtaining one tail, followed by two heads).

As argued in Section 4.3, this temporal order effect was unlikely to be caused by the fact that later events in a sequence are more available in memory than earlier events. Counterfactual probability judgments did not differ significantly after losing

on the first coin and after losing on the second coin. However, memory availability could play a role in occasions when the causal episode of an outcome covers a longer period of time than a coin-flipping game. The results also indicate that attention was not a confounding variable in the observed effect because no significant positive correlation was found between participants' memory recall accuracy and counterfactual probability estimates.

The temporal order effect was found only when the outcomes of three coins were determined and revealed sequentially (sequential condition) but not when they were determined sequentially but revealed simultaneously (simultaneous condition), indicating that the temporal order effect can only be derived from the "revelation order" but not the "occurrence order". However, as argued in Section 4.3, this result could be caused by the fact that the occurrence order was not particularly salient to the participants in the simultaneous condition. Thus, it is inconclusive whether the observed temporal order effect emerged from the revelation order, the occurrence order or both.

Together, the results presented in Experiments 4, 5 and 6 support a general principle that the perception of progression towards a focal outcome will lift one's perception of propensity towards that outcome and hence heighten one's counterfactual probability estimates if the focal outcome fails to be realized. The fact that the effect of progression was found both in a skill-oriented sports event (i.e., horse racing) and a chance-determined gamble (i.e., coin-flipping game) indicates that perceptions of progression are not necessarily derived from a rational understanding of the causal relationship between the trend and the outcome (e.g., a horse that catches up indicates it's in top form and will give a strong performance).

Instead, they can be derived purely from the superficial features of an event, which may create an illusion of trend (e.g., a stronger sense that “I could have won” when losing on the third coin than when losing on the first or the second coin). Thus, it seems that event cues like proximity and progression could either be a frugal and useful heuristic that helps people deal with complex judgment tasks or a source of judgmental bias. This point will be elaborated in Section 5.2.4

Overall, the findings of the six experiments support and develop the notion of the proximity heuristic (Teigen, 1998) by showing that not only the static proximity is used as a cue for counterfactual probability judgments but also the dynamic variations in proximity. More broadly, the results are also in support with the notion of the simulation heuristic (Kahneman & Tversky, 1982), which posit that people estimate probability or propensity of an outcome by assessing how easily the outcome can be imagined in mind. It was assumed that a short distance to an alternative outcome and a sense of rapid progression towards it both facilitate mental simulation and thus are able to heighten one’s probability judgments about what could have been.

5.1.2 Counterfactual Probability Judgments and Emotions

Being consistent with the finding by Petrocelli et al. (2011), the results of Experiments 2, 3, 4 and 5 suggest that a counterfactual probability judgment plays an important role in people’s emotional reactions to past events. While Petrocelli et al. (2011) only demonstrated a contrast-dominant emotional consequences of counterfactual probability judgments, the correlational analyses in the experiments presented in this thesis suggest that (1) counterfactual probability judgments could exert influence on emotions in the direction of either contrast-domination

(Experiments 2, 4 and 5) or assimilation-domination (Experiment 3), although the thesis failed to document both types of dominance in any single experiment; (2) the effects of counterfactual probability judgments on emotions are contingent on the perception of future possibility (i.e., the data from Experiments 2, 3, 4 and 5 is indicative of a general rule that the absence of future possibility enhances the contrast effect and the presence of future possibility enhances the assimilation effect, which is consistent with the prediction of the REM (Markman & McMullen, 2003)); and (3) the observed moderating effect of future possibility was likely to be caused by the fact that the presence of future possibility encourages people to focus more on the future implications of a counterfactual, compared to when the future possibility is absent (Experiments 1, 2 and 4).

However, it should be noted that none of the experiments demonstrated that the moderation of the perception of future possibility can be strong enough to reverse the emotional consequences of counterfactual probability judgments. While the results of Experiments 2, 4 and 5 suggest that the assimilation effect brought up by the presence of future possibility has cancelled out the contrast effect, the results of Experiment 3 suggests that the contrast effect brought up by the absence of future possibility has cancelled out the assimilation effect. These results are at odds with those of McMullen and Markman (2002), who demonstrated in the context of a basketball game that a dominance of the contrast effect (e.g., the team being one point down felt more negative than the team being 15 points down at the end of game) was reversed to a dominance of the assimilation effect when the future possibility was present (e.g., the team being one point down felt more positive than the team being 15 points down at half time). However, they did not measure counterfactual thinking in any way, which made their results open to alternative

interpretation. As argued in Section 2.1, in their experiment, the observed dominance of the assimilation effect when future possibility was high could be simply caused by the fact that the team which was one point down at half time had an objectively better chance to win than the team which was trailing far behind. Thus, it is argued that the experiments in this thesis, which ruled out this confounding factor and directly examined the relationship between counterfactual thinking and emotions, render more valid results. The conclusion is that, although the perception of future possibility is capable of moderating the effects of counterfactual thinking on emotions, it can-not reverse them.

What's more, while counterfactual probability judgments were found to have an effect on emotions, their contributions to the total emotional consequences of proximity and progression are still ambiguous. Firstly, there still lacks definitive evidence for the mediating role of counterfactual probability judgments in the emotional consequences of outcome proximity. In Experiment 2, although proximity was found to have an indirect effect on emotions via counterfactual probability judgments, the mediation was rejected on the ground that the total effect of proximity on emotions was not significant. This was believed to be caused by the weak effect of proximity on counterfactual probability judgments. When this effect was enhanced in Experiment 3, the total effect did display the predicted pattern. However, this time only indicative evidence was found that the total effect was mediated by counterfactual probability judgments. As argued in Section 2.4.3, this could be caused by the restricted range of the dependent variable (i.e., affect) due to a within-participants design. Thus, it is suggested that the mediation of counterfactual probability judgments should be examined in future experiments using a between-participant setup.

Secondly, although evidence suggests that the counterfactual probability judgment is an intervening variable between progression and emotions, this indirect effect didn't seem to contribute much to the total effect – it appeared to be diluted or overwhelmed by other effects that progression has on emotions. That is, the process of a rapid progression towards a desirable outcome can itself be very enjoyable, despite the fact that it heightens one's expectation of success and hence introduces the feeling of disappointment when this expectation fails to be confirmed. When measures were taken to divert participants' attention to the outcome of an event instead of its process (Experiment 6), progression did affect emotions in a way that reflects a dominance of the contrast effect. However, the results fail to obtain any evidence that this effect was mediated by counterfactual probability judgments. That is, participant's counterfactual probability judgments did not correlate with emotions. This is suspected to have been caused by the fact that participants were allowed to change their bet freely in the experiment, which may have introduced variations to people's feeling of disappointment. To rectify this limitation, participants in future experiments should be asked to bet with fixed stake.

Overall, the evidence support the proposition that counterfactual probability judgments have an effect on emotions and the nature of this effect is moderated by the perception of the future possibility. The nature of the moderation is consistent with the prediction of the REM that the absence of future possibility enhances the contrast effect and the presence of future possibility enhances the assimilation effect. However, the moderation of future possibility is not strong enough to reverse the dominance of one effect to the dominance of the other. What's more, only indicative evidence was obtained that counterfactual probability judgments mediate the relationship between proximity/progression and emotions. This relationship should

receive further examinations in a between-participant setup. Measures should also be taken to control factors other than counterfactual probability judgments which potentially have powerful impacts on people's emotional experiences.

5.2 Limitations and Future Research

5.2.1 Propensities versus Dispositions

The results of the experiments presented in this thesis support the notion that counterfactual probability judgments are informed by the perception of propensity and thus are established via the strategy of the simulation heuristic (Kahneman & Tversky, 1982) or the proximity heuristic (Teigen, 1998, 2005). However, it should be noted that the potency of this support was limited by the fact that the participants in our experiments did not have the liberty of choosing different strategies to reach probabilistic judgments.

Kahneman and Varey (1990) distinguished two types of subjective probabilities – *propensity* and *disposition*. Propensity, as introduced by the present thesis, was defined as the subjective probability of an outcome informed by the event cues *after* the relevant causal episode begins (e.g., the probability judgment regarding the outcome of a football game based on what occurs during the match). In contrast, disposition refers to the subjective probability of an outcome based on the information *prior to* the commencing of the relevant causal episode, like base rates (e.g., “Team A has beaten Team B most of the time in the past) or other causal information (e.g., “Team A has stronger defence line than Team B”). More importantly, the two authors made an important observation that the usage of the word “almost” in a close counterfactual (e.g., “Team A almost won the football game.”) is considered appropriate only when the *propensity* of a counterfactual

outcome is perceived to be high. On the other hand, a high *disposition* does not suffice a close counterfactual. The two authors refer to this phenomenon as *disposition neglect* in retrospective judgments. To illustrate, they presented a scenario study where participants read about Mark, who is known as a very strong player in chess but narrowly missed the registration for a chess tournament. Although it can be argued that Mark's disposition of winning the tournament was high (because he is a stronger player), 97% of the participants thought it was "very peculiar" to comment "Mark almost won the tournament" (p. 1104).

Given its close tie to the usage of "almost", the judgment of counterfactual probability is also expected to be subject to disposition neglect. This is not to say, however, that the information about prior probabilities does not affect counterfactual probability judgments. In the above scenario, it might be more plausible to say "Mark could have won the tournament" if he is known as a strong player than if he is not. However, it will be interesting to see how people make counterfactual probability judgments when the disposition and the propensity are at odds. For example, which horse would be considered to have been more likely to win – the horse which had a weak performance in the past but lost the race by an inch or the horse which had a strong performance in the past but lost the race by a long way?

The experiments presented in the thesis fail to give insights into this question. In some of our studies (Experiments 2 and 3), participants were provided with no information regarding the prior probability of an outcome. In other studies where they did receive this information (Experiments 1, 4, 5 and 6), it was kept symmetrical across conditions (e.g., in Experiment 5, participants were told that the two horses in question both had moderate chance of winning). Thus, these

experiments were incapable of examining whether the use of the event cues will still be a preferred strategy for counterfactual probability judgments even when competing information about the disposition is available. Future research should address this limitation by granting participants the freedom to adopt different judgmental strategies. For example, information about winning odds should be provided to the participants who make judgments about how likely a horse could have won a race or how likely they could have won a gamble. Similarly, relevant historical records of academic performance should be made available to participants who make judgments about how likely a student could have passed an examination. It is expected that the judgments of counterfactual probability should be affected more by cues of proximity or progression than the information of prior probabilities.

5.2.2 Proximity Heuristic versus Simulation Heuristic

Both the proximity heuristic and the simulation heuristic make the prediction that counterfactual probability judgments are affected by the perception of closeness. However, as a distinction, their accounts regarding the psychological process underpinning this proximity-probability relationship are slightly different. The simulation heuristic (Kahneman & Tversky, 1982) suggests that the reason why counterfactual probability estimates are higher when a focal outcome is close is because the short distance between the reality and its counterfactual alternative makes it easy for a counterfactual scenario to be mentally constructed. On the other hand, the proximity heuristic (Teigen, 1998, 2005) suggests that the observed relationship between closeness and probability judgments is caused by the fact that people use proximities as direct cues for probabilities. These two proposed heuristics are so alike that in many occasions, including in the six experiments presented in this

thesis, they render the same predictions. Thus, our studies are incapable of testing which theory provides a more accurate account of the psychological process under the observed effect. Future research, however, could address this matter by observing the situations where the two heuristics would yield *different* predictions.

Consider the following scenario featured in a study by Teigen (2005): “One winter day, three girls walk in a row on a narrow sidewalk. Annie walks in front, followed by Bente, with Christine hindmost. An icicle falls from a roof and hits Annie. Fortunately, she is not injured” (p. 427). In this case, both heuristics would predict that Bente, who walks in the middle would have a higher counterfactual probability estimate of being hit (e.g., “It could have been me”) than Christine because Bente is physically closer to the victim. Now, consider an alternative scenario in which Annie is still hit by the icicle but this time she walks in the middle with Bente behind her and Christine in the front. The interesting question is, would Bente change his counterfactual probability judgments of being hit? The proximity heuristic would predict *no* because Bente’s distance to the victim does not differ in the two scenarios. However, the simulation heuristic would disagree. Although Bente can easily imagine how he was hit by the icicle instead of Annie due to his proximity to the victim, there is a salient fact that Christine is also very close to the victim. Bente, therefore, can also easily imagine how Christine was hit instead of Annie and himself (e.g., “I could have been Christine as well”). The salient counterfactual world in which Christine was hit will make it more difficult for Bente to imagine how he could have been the victim. Thus, according to the simulation heuristic, Bente should have a lower counterfactual probability estimate in the latter scenario than in the former. Future research should test the two heuristics to see

which one provides a more accurate account of the psychological process underlying the intuitive judgments of counterfactual probability.

5.2.3 The Perception of Closeness

It should be noted that the distances that were chosen to provoke the sense of “closeness” and “farness” in the experiments presented here were all quite arbitrary. For example, in Experiment 3, the difference in final scores was fixed at either one point for the close condition or 15 points for the far condition. Although the 14-point difference has been shown by McMullen and Markman (2002) to be sufficient to provoke different degrees of the sense of closeness, their usages lack theoretical underpinnings. This problem is prevalent in the literature on “near-misses”, in which spatial, temporal and numerical proximity have often been manipulated to a certain extent without any explanation being provided as to why they were manipulated in such ways. Thus, while the effects of outcome proximity on a range of social and cognitive judgments have been frequently documented by the previous research, a question remains unanswered: how close is close enough?

It may be convenient to assume that the closeness in the physical world has a linear relationship with the subjective feeling of closeness. Thus, a basketball team who is beaten by the opponent by 12 points should be considered to be closer to winning and hence be assigned to a higher counterfactual probability of winning than another team being beaten by 13 points. What’s more, the difference found in the counterfactual probability estimates between these two teams should be exactly the same as that found between two teams who are beaten by 24 and 25 points, respectively. However, this linear account might oversimplify the real-life situation. In one aforementioned study by Teigen (1998, Study 2), participants were presented

with a scenario in which Per, who is on a fishing trip, comes back to his car and finds that another car in the parking lot has fallen victim of a rockslide. Participants were told that the damaged car is either right next to Per's car (close condition) or 50m away (far condition). Difference in the counterfactual probability estimates between the two conditions was only found to be significant in a within-participant set-up but not in a between-participant set-up. That is, if the variation of distance was not made salient to them, participants' subjective feeling of closeness is the same for "right next" and "50m".

Miller et al. (1990) introduced the concept of mental models to explain the effect of outcome closeness on the mutability of a past outcome. Mental models refer to "content-based rules of thumb about the ways that systems operate" (p. 313). The authors argued that if the distance between an event and its counterfactual alternative falls in a "critical range of values around which parameters in the model can be manipulated or set" (p. 313), the reality will be thought to be easy to transform from one state to another. This account implies a non-linear relationship between the closeness in the physical world and one's subjective feeling of closeness. That is, the distance between the reality and its alternative has to be diminished below a "tipping point" to make a meaningful difference in people's perception of "closeness" and counterfactual probability estimates.

The mental model account also implies that the determination of this "tipping point" could be contextual and subject to individual differences because an individual may apply different mental models to different situations and different individuals may apply different mental models to the same situation. As an illustration, an interval of two metres may be considered adequate and safe when

cars are slugging in a traffic jam. However, the same distance might be considered dangerously close when cars are travelling at 70 miles an hour on the motor way. Also, a young driver who just obtained his/her license may have different perceptions of closeness compared to an experienced driver. One challenge for future research is to identify the situational and individual factors that influence people's perception of closeness, which will help develop more accurate predictions regarding people's judgments of counterfactual probability.

5.2.4 Conditional versus Unconditional Counterfactual Probability

The notion of counterfactual probability employed by the thesis covers both the conditional probabilities (e.g., "How likely could my horse have won the race if it hadn't stumbled?") and unconditional probabilities (e.g., "How likely could my horse have won the race?"). The two types of counterfactual probability were not treated very differently in the present thesis because it is believed that their judgmental processes share some common grounds. That is, the judgments of both types of probability might involve mental simulation (Kahneman & Tversky, 1982) and should be both subject to the alterations of event cues like proximity and progression, as was found by the experiments presented in this thesis. However, the psychological processes used to produce these two probability judgments might not be exactly the same.

As pointed out by Teigen (1998), a retrospective probability judgment requires the judge to engage in mental time travel. Over et al. (2007) also suggested that "...the subjective probability of the counterfactual at the present time is the

same as the conditional probability $P(q|p)$ ⁵ at an earlier time (as given by the context)". Thus, to evaluate a "if-then" counterfactual conditional, the judge would naturally rewind the story back to the temporal position right before the occurrence of the event that is specified in the condition and make a prospective judgments about the propensity of a target outcome, pretending that the outcome was unknown. For example, answering the question "How likely could I have passed the test if I hadn't got drunk the night before" would require the judge to travel back to the night before the test and evaluate the prospective conditional probability "How likely am I to pass the test tomorrow if I don't get drunk tonight?".

As being postulated by the theorization of the simulation heuristic, such a judgment might be reached by simulating oneself actually preparing for the test instead of drinking and assessing the ease with which the counterfactual outcome (i.e. passing the test) can be imagined. The experiments presented in this thesis have demonstrated that the ease of imagination may be determined by event cues like proximity and progression. It might also, as mentioned in Section 5.1.1, be affected by the judge's belief in the correlation between the "if" conditional and the "then" outcome. That is, when holding outcome proximity constant, counterfactual probability estimates should be higher if the correlation between the conditional and the outcome is perceived to be strong than if it is perceived to be weak. For example, the extent to which people think "drinking" is correlated to the "mark" in an examination would affect their judgments about the likelihood of passing if they had not got drunk. The results of Experiment 2 suggest that when the causal relation is

⁵ $P(q|p)$ denotes the probability of an event q given that an event p occurs.

very strong, the effect of outcome proximity on counterfactual probability estimates can be attenuated.

On the other hand, the temporal position of the judgment is not specified in an unconditional counterfactual probability assessment. So how do people decide how far they should travel back in time in order to make the judgment? The answer to this question is important because spontaneous counterfactual thinking is mostly activated by the motivation to mutate a past factual outcome rather than the antecedent of a past outcome (Roese, 1997; Roese & Olson, 1997) and thus a counterfactual simulation usually starts with a question in mind concerning unconditional probability (e.g., “How likely could the accident have been avoided?”).

One possible strategy to resolve the problem of the temporal positions of judgments is to treat an unconditional counterfactual probability as a global evaluation of the probabilities of all the possible conditionals. For example, after taking a taxi to the airport but missing his/her flight, one might start asking a question regarding the unconditional probability of catching the flight (i.e., “How likely could I have caught the plane?”). This person might construct several counterfactual scenarios in which different aspects of the incident are mutated. Those different scenarios are translated into several different conditional probability assessments (e.g., “How likely could I have caught the flight, if I had not overslept this morning/If I had used public transportations/If the taxi driver had taken a different route,”). Each of those conditional probabilities will be evaluated separated by mental simulation. Afterwards, those conditional probabilities will each be weighed by the probability of its “if” condition (i.e., How likely could I have not overslept?; How likely could I have used the public transportations?; How likely

could the taxi driver have taken a different route?) and integrated into a global estimation of the mutability of a past outcome.

However, while this method might be relatively easy to implement for the participants who read a scenario which only contains limited elements in the causal episode of an outcome, it might not be practically possible in real life situations where there could be numerous elements of a story that can be mutated. As argued by E.P. Seelau et al. (1995), people only consider limited possible alternatives when constructing a counterfactual world. Thus, a second possible strategy is for the judge to base a global unconditional counterfactual probability judgment not on all but only a subset of possible conditionals that come to mind most easily. As mentioned earlier, the antecedents of an outcome differ in mutability (Roese & Olson, 1995). It could be that, when evaluating the mutability of an outcome, only the conditionals that concern the most mutable aspects of the reality will be considered while other counterfactual possibilities will be omitted. This strategy is more frugal than the one mentioned above and may yield similar results: Since people use mental simulations to evaluate probabilities, the conditionals that are difficult to come to mind (e.g., “How likely could I have caught the flight if I had suddenly acquired the ability of flying?”) are usually led by “if” conditions that are deemed improbable (e.g. suddenly acquiring the ability of flying). Thus, even if those conditionals had been considered, they would have been given little weight anyway when composing the global counterfactual probability.

In an extreme case, when making an unconditional counterfactual probability judgment regarding an actual outcome that is preceded by only one prominently mutable antecedent (e.g. a car accident on the way to the airport), people may

consider only one conditional probability (e.g., How likely could I have caught the plane if I had not been involved in that car accident) and other possible paths to mutate the actual outcome are simply neglected. Also, the probability of the “if” condition in this case (i.e., the probability of avoiding an accident) might be judged very high (because it slips into mind easily). Thus, in these extreme circumstances, evaluating an unconditional counterfactual probability (e.g., “How likely could I have caught the plane?”) and a conditional one (e.g., “How likely could I have caught the plane if I had not been involved in the accident?”) should yield the same result.

Nevertheless, in order to make a judgment about an unconditional counterfactual probability, people may not always need to convert it into one or several conditional ones. There are situations where no information about the antecedents of a factual outcome is provided. For example, in the TV game show scenario in Experiment 3, only information about final scores was provided to the participants. This is also true in several studies by Teigen (1998). But people still seemed to be able to handle the task of judging a counterfactual probability without any difficulty in those cases. The information about outcome proximity seems to be sufficient to justify a counterfactual “Things could have been different”, even if no material in the story was there to help one contemplate how exactly things could have been different. As Tversky and Kahneman (1982) noted, “to assess availability it is not necessary to perform the actual operations of retrieval or construction. It suffices to assess the ease with which these operations could be performed, much as the difficulty of a puzzle or mathematical problem can be assessed without considering specific solutions” (p. 164).

There are also situations where people are provided with the information about the antecedents of an outcome but they still base their probability judgments purely on cues of proximity or progression. The coin-flipping gambling game in Experiment 6 is a good example of this. In this game, a losing outcome (e.g., Head-Tail-Head) could always be mutated by altering the outcome of only one coin. Therefore, a conditional counterfactual should be obvious after each losing trial. That is, “I could have won if I had one more head/tail.” Please note that the probability of this conditional was always the same despite the temporal position of the losing coin because: (1) the likelihood of winning if one had one more head/tail was always the same; and (2) the likelihood of getting one more head/tail was always equal because the outcomes of the three coins were independent from each other. Thus, if participants’ unconditional counterfactual probability judgments (i.e., “How likely could I have won?”) had been based on the aforementioned conditional probability judgments, they would have been the same regardless of the temporal position of the losing coin. However, what was found in the experiment was that participants’ unconditional probability judgments were higher when losing on the last coin than when losing on other coins, which indicates that participants did not convert the unconditional counterfactual probability judgments into conditional ones.

It was possible that the salience of the critical antecedent (i.e., getting a head when a tail was needed or vice versa) was dampened by the fact that participants were always one coin from winning. This lack of salient mutable antecedent, might have disposed the participants to base their probability judgments on other more salient cues like proximity and progression.

It is speculated that, when making an unconditional counterfactual probability judgment, people may switch between the two different strategies depending on the salience of mutable antecedents and the availability of proximity/progression cues. To test this idea, future experiments could employ a similar coin-flipping gambling task but include a condition where participants have to flip and get the same values from four coins, instead of three coins, in order to win. In this case, instead of always losing on one coin, people might lose on two coins (e.g., Head-Tail-Tail-Head). Thus, if people lose on one coin (e.g., Head-Tail-Head-Head), the losing coin will look salient and mutable, which might dispose people to convert the unconditional probability judgment (i.e., “How likely could I have won?”) to a conditional one (i.e., “How likely could I have won if I had got one more head/tail?”). If this happens, the temporal order effect on unconditional counterfactual probability judgments should be diminished.

5.2.5 The Validity of Counterfactual Probability Judgments

One issue that has not been addressed in depth by the present thesis is whether the use of event cues like proximity and progression in the judgment of counterfactual probability is a source of cognitive bias or an optimal strategy and a reasonable compromise when the observer has limited information and mental recourse to calculate probabilities accurately. Or put in another way, to what extent could proximity and progression accurately reflect “true” counterfactual probabilities? Unfortunately, there might not be a definite answer to this question. It is still under fierce debate in the philosophical literature how people *should* conduct probability judgments regarding counterfactuals (see for example, Bennett, 2003; Shaffer, 2009).

Indeed, it is practically difficult to examine the reliability of one's counterfactual probability judgments simply because one can't, at least for now, travel back in time.

However, there is evidence indicating that the reliance on event cues like proximity and progression may at least result in violations of the formal rule of probability theory. In the aforementioned study by Teigen (1998, study 2), participants read a story about a ski racer Bjarne who beats his opponent in a race. It was found that participants' judgments about the probability of the factual (i.e., the likelihood of him winning) and their judgments about the probability of the counterfactual (i.e., the likelihood of him losing) were both above the midpoint of the scale, which violates the complementary rule of probability theory. Similar evidence can also be found in the counterfactual probability estimates made by the participants in Experiment 5, where the mean ratings of the likelihood of John's horse winning and the likelihood of Henry's horse winning (when they actually both lost) are both above the mid-point of the scale, despite the fact that the participants were told explicitly that the two horses were in the same race and there was going to be only one winner.

Evidence also suggests that the reliance on the cue of proximity could lead to an overestimation of retrospective probability. One example is Teigen (1998)'s finding that the same event (e.g., winning a lottery) can be considered more likely if it was close to happening (but did not happen) than if it did actually happen. More specifically, participants imagined that they were a customer in a record store who either received gifts as the number 10,000 customer visiting the store or queued behind a woman who became the lucky customer (and hence did not become the lucky customer but was very close). An event should not be rated more likely if it

did not occur than if it did occur. However, it was found that participants rated their chance of being the lucky one higher if they narrowly missed this opportunity than if they actually got it. Also participants' ratings in the former case were close to mid-point of the scale, despite that "being the number 10,000 customer" was a very rare event.

Although the reliance on the events cues like proximity and progression could lead to counterfactual probability judgments that violate the formal rule of probability, they still can be argued to be functional or useful if "closer" or "stronger progression" does indeed reflect a higher probability in the real world. Miller et al. (1990) argued that sometimes it is rational to base probability judgments on distance. In the TV game show scenario used in Experiment 3, it could be argued that the people who were beaten by their opponent by one point did have better chance of winning than those who were beaten by 15 points because getting 15 points is indeed harder than getting one point. However, in some situations, proximity might lead to an illusion of high probability. Turnbull (1981) found that in a lottery, people who held the ticket with a number that was numerically close to the winning ticket reported a higher level of disappointment than those whose ticket was numerically far, despite the fact that their chances of winning were the same because the winning number was drawn randomly. The researchers in gambling have noticed that near-miss outcomes (e.g., losing on one symbol at a slot machine; betting on the number that is right next to the winning number on the wheel of the Russian roulette) encourage persistent gambling behaviours (Dixon et al., 2009; Gilovich & Douglas 1986; Griffiths, 1999; Reid, 1986), presumably because the short distance to winning enhances the perception that "I could have won" and "I will win next time" even if the games are chance-determined.

In a similar way, the perception of progression could also lead to either rational or irrational increases in probability judgments depending on contexts. As discussed in Section 3.4.1, a “catching-up” horse could indeed be more likely to win than the horse consistently falling behind because the subjective perception of moving towards one’s goal has been shown to improve objective performance (Vallerand et al., 1988). Also, in the case of causal proximity, it can be argued that the outcome was indeed more likely to have turned out differently if a decisive event occurs later, rather than earlier, in its causal sequence.

Consider a football team which took a lead in the early stage of a game but was tied later. People’s perception that “the team could have won” might be stronger when the scores were tied within minutes of the final whistle than when they were tied in the early stage of the game. There could be a rational basis for this judgment. Because the events in the causal sequence are not independent in this case (i.e., the occurrence of one event depends on the occurrence of an earlier event), if the scores were tied in the early stage of the game, the consequences of undoing this decisive event would appear quite uncertain because it changes every event that follows. Thus, the counterfactual “If they had not been tied, they would have won” might be quite weak because people could easily construct a counterfactual scenario where the team was not tied but still did not win (e.g., “Even if they had not got tied at that moment, they might have still got tied later and not won”). In contrast, mutating a decisive event (i.e., being tied) that occurs at the end of the game introduces little change to the whole causal episode because all the events that occur prior to the decisive event can still be retained in the counterfactual world. This might make people more certain or confident in the counterfactual they construct compared to if the decisive event occurs early in the game. Therefore, when an outcome is preceded by a

sequence of events which are causally dependent on each other, it can be argued that it is justifiable to consider an outcome to be more mutable if a decisive event occurs later in its causal sequence than earlier.

However, when the antecedents in a causal episode are causally independent of each other, like in the coin-flipping game in Experiment 6, the temporal order effect seems to be less justifiable. In this case, undoing the outcome of an earlier coin will not affect the outcomes of coins that follow. Thus, if a person sees two heads and a tail, the conditional counterfactual “I could have won if I got one more head” as well as the unconditional counterfactual “I could have won” should be equally plausible regardless of the temporal order of the outcomes of the three coins. However, as was found in Experiment 6, people’s sense that “I could have won” was higher if they lost on the last coin than any other coin.

Future research should particularly focus on the situations where the perception of progression is likely to lead to judgmental biases because of their important real-life implications. For example, the temporal order effect observed in the present thesis seems to have been already extensively exploited by the designers and the manufacturers of slot-machines in casinos. As discovered by Strickland and Grote (1967), a slot machine, which reveals the outcomes of the three wheels sequentially from left to right, usually has the highest proportion of winning symbols on the first wheel, a lower proportion on the second wheel, and the lowest proportion on the third wheel. This particular design will undoubtedly raise the probability of the gambler losing on the third wheel instead of on the first or the second. The two researchers also discovered that the slot machine with this design led to more persistent gambling behaviour than the slot machine whose winning symbol

arrangement was the other way around, presumably because losing on the last wheel, like losing on the last coin in our experiment, created intense frustration that “I could have won” and also made future winning seem more likely.

5.2.6 Beyond Temporal Perspective

When examining the emotional consequences of counterfactual probability judgments, the present thesis exclusively focused on the moderation of the situational factor of temporal perspective. However, it should be noted that it is not the only factor that can potentially influence the strengths of the contrast and assimilation effects. As reviewed in Section 1.2.3.2, the relative strengths of the two effects can be manipulated by directing one’s attention between the counterfactual imagination and its difference to the reality using explicit verbal instructions (McMullen, 1997). The strengths of the two effects can also be influenced by whether the task is outcome oriented or process oriented (Markman & Tetlock, 2000). In addition, Markman and McMullen (2003) proposed that the assimilation effect should be promoted after counterfactual thinking to the extent that the self or the current situation is perceived to be mutable in the future, presumably because the mutability of the self or the current situation makes an upward counterfactual state appear attainable and also makes one feel vulnerable to a downward counterfactual state.

It is important to recognize that these factors may not operate independently but rather interact with each other to determinate the strengths of the contrast and assimilation effects. For example, the effect of perceived future possibility on the strength of the assimilation may depend on whether one perceived the self or the current situation as being mutable. Hence, the counterfactual thought “If I had put

more effort into the revision, I would have passed the test” indicates future possibility only if one holds the belief that he or she *will* put more effort into the revision next time. Thus, instead of examining individual factors in an isolated manner, future research should aim to clarify how these different factors interact with each other and determine the strengths of the contrast and assimilation effects jointly.

How people make probability judgments about counterfactuals and how these judgments influence people’s affective experiences are important topics to explore because such judgments are prevalent in everyday life and bear profound psychological implications. What’s more, by exploring this topic, we will also get a better understanding of the cognitive process of counterfactual thinking as a whole. The next section is devoted to this matter.

5.3 Theoretical Implications

5.3.1 The Basic Process of Counterfactual Thinking

In general, our findings regarding the determinants and the emotional consequences of counterfactual probability judgments help advance the conceptual framework of the basic process of counterfactual thinking. More specifically, an AES model is proposed which posits that counterfactual thinking consists of three basic stages: Activation – Estimation – Simulation.

Activation

The concept of “activation” employed here is the same in meaning to the one used in Roese and Olson’s (1995, 1997) two-stage model of counterfactual thinking, which refers to “whether the process of counterfactual thinking is turned on or off”

(Roese & Olson, 1997, p. 5). Upon the activation of counterfactual thinking, people start to consider the alternative to a factual outcome. Counterfactual thinking can be activated spontaneously, mostly when a factual outcome is negative (Gleicher, et al., 1990; Roese, 1994; 1997; Roese & Olson, 1995; 1997) or proximate to an alternative state (Meyers-Levy & Maheswaran, 1992; Roese & Olson, 1995; 1996). For example, a student might start to consider “Could the result of my examination have been different?” when he/she fails or gets numerically close to the boundary of a higher or lower grade. The evidence for those proposed factors has already been reviewed in Section 1.2.2 and hence won’t be repeated here. It is emphasized that, whichever factor activates the process of counterfactual thinking, it starts with a question – a question regarding the *unconditional* probability of an alternative outcome. (e.g., “How likely could the results of my examination have been different?”).

Estimation

In this stage, the answer to the question regarding the unconditional counterfactual probability of a past outcome posed in the earlier stage will be estimated. Section 5.2.4 has discussed different strategies that people might adopt to assess unconditional counterfactual probabilities. People may search for mutable antecedents in the causal script of the factual outcome and then construct one or several counterfactual scenarios by altering different aspects of the reality. By doing this, an unconditional counterfactual probability judgment is converted into one or several conditional ones. To illustrate this with an earlier example, a person who missed his/her flight and wondered “How likely could I have caught the plane?” might convert this question into several conditional probability judgments like “How

likely could I have caught the flight if I had not overslept in the morning/if I had taken the public transportations/if I the taxi driver had taken a different route?”.

Norm theory (Kahneman & Miller, 1986) predicted that unusual or atypical events in the causal sequence are more likely to be mutated in one’s constructions of the counterfactual scenario than usual or typical events. Also, controllable or dynamics aspects of an event have been found to be more mutable than uncontrollable and stable ones (Markman, Gavanski, Sherman, & McMullen, 1995; Roese & Olson 1995).

The probability of each conditional counterfactual will be estimated, possibly by the strategy of the simulation heuristic or the proximity heuristic, informed by event cues like proximity and progression as well as the perceived correlation between the condition and the outcome. Those conditional probability estimates will be weighed by the probabilities of their “if” conditions before being integrated to form a global evaluation of the unconditional counterfactual probability. When the antecedents of the factual outcome are unknown or when none of the antecedents is mutable, people may adopt a more frugal strategy of assessment, by which the estimation of the probability of the counterfactual outcome is purely based on event cues of proximity or progression, without any aspect of the reality being mentally mutated.

Simulation

Finally, the emotional experiences after a negative outcome depend on the interaction between the counterfactual probability estimate and the simulation mode. More specifically, a counterfactual probability estimate determines the “magnitude” of the emotional responses. The higher a counterfactual probability estimate is, the

more intense the emotional reaction will be. On the other hand, the simulation mode determines the “quality” of the emotional responses. A reflective simulation enhances the assimilation effect and an evaluative simulation enhances the contrast effect (Markman & McMullen, 2003).

Compared to previous models, the AES model proposed here emphasizes that counterfactual thinking is not only a mental process of constructing a world that’s different to the reality but also, more importantly, a process of evaluating the probability of that world. Thus it is the result, rather than the activation, of this evaluation, that critically determines the psychological impacts of a counterfactual. This claim coincides with the latest finding by Petrocelli et al. (2011) that counterfactual probability judgments are better predictors for judgments of blame and affect than counterfactual frequencies (which denote the degrees of counterfactual activation). The inclusion of counterfactual probability judgments in the conceptual framework of counterfactual thinking renders researchers a new perspective on how the psychological impacts of counterfactual thinking documented by previous research can be explained. It also helps us develop novel predictions as to how counterfactual thinking can affect people’s social judgments, motivations and behaviours. Some of those implications are discussed below.

5.3.2 Counterfactual Probability, Functions and Motivations

5.3.2.1 Counterfactual Probability Judgments and Behavioural Intention

The functional theory of counterfactual thinking (Epstude & Roese, 2008; Roese, 1994; 1997) posits that self-concerned counterfactual thinking can serve a preparative function by facilitating improvements in future behaviours. It is assumed in the REM that the effects of counterfactuals on people’s behavioural intentions

partly depend on the emotions they evoke (Markman & McMullen, 2003; Markman et al., 2008). More specifically, in an achievement-pursuing task, the negative emotions induced by counterfactual thinking worsen one's affective experience but increase motivation and persistence. The positive emotions induced by counterfactual thinking, on the other hand, should have the opposite effects. Following this argument, the REM predicts that the contrast effect following upward counterfactuals and the assimilation effect following downward counterfactuals should both increase motivation and persistence because they both engender negative emotions (non-complacency and fear, respectively). Therefore, they serve preparative functions for the future. By comparison, the assimilation effect following upward counterfactuals and the contrast effect following downward counterfactuals should both decrease motivation and persistence because they both engender positive emotions (complacency). Therefore, they serve the function of affective enhancement. In a word, the effects of counterfactual thinking on behavioural intentions should depend on both its direction (i.e., upward or downward) and the simulation mode (i.e., reflective or evaluative).

However, the AES model proposed here indicates that the direction and the simulation mode of a counterfactual should interact with counterfactual probability on behavioural intentions. For example, contrasting a highly probable upward counterfactual like "I would have passed the test if I had not got drunk" could induce dissatisfaction towards the results and anger in oneself, which drives the desire to improve one's performance in the future. However, an improbable upward counterfactual like "I would probably still have failed even if I had not got drunk" makes a negative outcome appear inevitable and can actually ease one's initial adverse emotional experiences derived from the negative outcome (Gleicher et al.,

1990) and prevent corrective behaviours. In a similar way, although assimilating a highly probable downward counterfactual like “I would have failed the test if I had got drunk” could promote preventive behaviours against drinking by inducing negative emotions like fear, this function will be weakened if one concludes that the counterfactual probability is actually quite low (i.e., “I would still have passed even if I had got drunk the night before”).

Counterfactual thinking could also affect behavioural intentions through other mechanisms. In a recent paper by Epstude and Roesse (2008), two pathways were proposed via which an upward counterfactual can affect future behavioural changes. First of all, the causal inference derived from a counterfactual can heighten behavioural intentions via the “content-specific pathway”. That is, the thought “I could have passed the test if I had not got drunk” pinpoints the causal relationship between “not drinking” and “passing the test” and should lead to behavioural intention “I will not get drink next time”. Secondly, upward counterfactual thinking can affect behavioural intentions via a “content-neutral pathway” by inducing negative emotions and lifting one’s self-efficacy, confidence and the perception of control. Thus, the thought “I could have passed the test if I had not got drunk” highlights the fact that “I can pass the test” and motivates behavioural change.

Again, the AES model would predict that the effectiveness of these two pathways may largely depend on one’s counterfactual probability judgments. First of all, a counterfactual probability judgment could affect the credibility of the causal inference derived from a counterfactual representation. When the counterfactual probability is low, upward counterfactual thinking might have a weak causal inference for future behavioural change. In extreme cases, low counterfactual

probability estimates might lead to “even if” thoughts, which deny the causal relationship between one’s behaviour and his/her goal and thus inhibit corrective behaviours (e.g., “Even if I had got drunk, I would still have failed the test. So my failure was not caused by drinking and there is no point avoiding getting drunk before the test next time”). Secondly, counterfactual probability estimates may affect behavioural intentions by influencing self-efficacy, confidence and the perception of control. In the case of upward counterfactual thinking, a low counterfactual probability estimate could deflate confidence and hope and thus reduce the motivation to change (e.g., “I would have still failed the examination even if I had put more effort in it. So what’s the point of trying?”).

In summary, counterfactual probability judgments may have critical effects on behavioural intentions after counterfactual thinking by influencing affective reactions, the credibility of the causal inferences and the expectancies for future success. These propositions open new avenues for future research.

5.3.2.2 Counterfactual Probability Judgments and Affect Enhancement

Although positive emotions induced by counterfactual thinking hinder the motivation for future behavioural change, they can help people improve their affective well-being and cope with traumatic events (Markman et al., 1993). This function could come especially useful where the future implications of a counterfactual are irrelevant (e.g., when the outcome is unchangeable or out of one’s control). As predicted by the REM, the assimilation effect following upward counterfactual thinking and the contrast effect following downward counterfactual thinking both reduce the motives for future behavioural changes but can serve an affect-enhancement purpose because they induce positive emotions like

complacency. However, it is argued here that the affective-enhancement function of counterfactual thinking can also be achieved by manipulating the perception of counterfactual probability. For example, after having a car accident, the severely injured victim may mentally construct several counterfactual scenarios about what might have been. The traditional view of counterfactual thinking would recommend constructing downward counterfactuals to improve the victim's psychological well-being (e.g., "I should feel lucky and be grateful because I could have been killed"). However, the AES model indicates that generating implausible upward counterfactuals might have a similar effect (e.g., "Even if I had done something differently, I would have still been caught in the accident").

This proposition receives some support from one study by Tykocinski and Steinberg (2005, study 2) and Experiment 5 in this thesis, both of which revealed that people's counterfactual probability judgments after a negative outcome regarding an upward counterfactual decreased when the outcome became more severe. This is presumably because people's desire for affect-enhancement was stronger when the outcome was severe than it was not. The role of counterfactual probability judgments in affect-enhancements should be examined more directly in future research. It is expected that eliciting an upward counterfactual thinking with low counterfactual probability will not deteriorate one's psychological well-being after a traumatic event. On the contrary, it should be able to improve one's emotional experiences.

5.4 Concluding Remarks

People are not only affected by what did happen but also by what did not but could have happened. The present thesis embraces the idea that the psychological

impacts of these counterfactual worlds are largely determined by the certainties or uncertainties that are assigned to them. Six experiments examined both the antecedents and the emotional consequences of these probability judgments. First of all, being consistent with the simulation heuristic and proximity heuristic, it was found that both static information about outcome proximity and dynamic information about the trend of its variation affected one's counterfactual probability estimates. This is true for both conditional and unconditional probabilities, which were found to be heightened in the face of short or shrinking spatial, numerical or conceptual distances. Secondly, the emotional consequences of those probability judgments were investigated within the theoretical framework of the Reflective and Evaluative Model of Comparative Thinking (REM). Evidence suggests that counterfactual probability estimates are able to influence one's emotional experiences in either the direction of contrast-domination or assimilation-domination and the likelihood of these two directions are a function of the perception of future possibility – low perception of future possibility increases likelihood of the contrast-domination and high perception of future possibility increases likelihood of the assimilation-domination.

These findings have implications to both the research on subjective probability and counterfactual thinking. First of all, the current research is an important instalment to the existing literature on proximity-probability relationship which previously only focused on the effects of static proximity cues. Secondly, our results suggest that the psychological impact of a counterfactual world should be a result of a three-way interaction of its direction (i.e., upward or downward), probability (i.e., low or high), and simulation mode (i.e., reflection or evaluation). Combining our findings with the previous research, the thesis proposed the

Activation – Estimation – Simulation (AES) model to account for the general process of counterfactual thinking from a probabilistic point of view, where counterfactual thinking was described as a process of identifying, constructing and answering question regarding the probabilities of alternative worlds.

The thesis also illuminates the way for future research by posing new questions regarding both the psychological mechanisms and the consequences of counterfactual probability judgments. These questions include: Which is the more accurate account of the psychological mechanism underlying proximity-probability relationship, the simulation heuristic or the proximity heuristic? If such judgments are determined by perceived distance, how is objective closeness in the physical world is related to psychological closeness? How much weight do people assign to information about propensities and dispositions respectively when making counterfactual probability judgments? Do people use different strategies to reach conditional and unconditional probability judgments? How reliable are these judgments? What roles do those judgments play in people's motivation, behavioural intention, self-perception and coping mechanisms? Answering these questions will help us understand how people interpret their past in general and what impacts these interpretations have on their lives.

References

- Bennett, J. (2003). *A philosophical guide to conditionals*. New York: Oxford University Press.
- Boninger, D. S., Gleicher, F., & Strathman, A. (1994). Counterfactual thinking: From what might have been to what may be. *Journal of Personality and Social Psychology, 67*(2), 297-307.
- Brickman, P., & Campbell, D. T. (1971). Hedonic relativism and planning the good society. In M. H. Appley (Ed.), *Adaptation level theory: A symposium* (pp. 287–302). New York: Academic Press.
- Brickman, P., Coates, D., & Janoffbulman, R. (1978). Lottery winners and accident victims: Is happiness relative. *Journal of Personality and Social Psychology, 36*(8), 917-927.
- Byrne, R. M. J. (2007). Precis of the rational imagination: How people create alternatives to reality. *Behavioral and Brain Sciences, 30*(5-6), 439-+.
- Byrne, R. M. J., Segura, S., Culhane, R., Tasso, A., & Berrocal, P. (2000). The temporality effect in counterfactual thinking about what might have been. *Memory & Cognition, 28*(2), 264-281.
- Carroll, J. S. (1978). Effect of imagining and event on expectations for event: Interpretation in terms of availability heuristic. *Journal of Experimental Social Psychology, 14*(1), 88-96.
- Collins, R. L. (1996). For better or worse: The impact of upward social comparison on self-evaluations. *Psychological Bulletin, 119*(1), 51-69.
- Dixon, M. R., Nastally, B. L., Jackson, J. E., & Habib, R. (2009). Altering the near-miss effect in slot machine gamblers. *Journal of Applied Behavior Analysis, 42*(4), 913-918.

- Epstude, K., & Roese, N. J. (2008). The functional theory of counterfactual thinking. *Personality and Social Psychology Review, 12*(2), 168-192.
- Feeney, A., & Heit, E. (Eds.). (2007). *Inductive reasoning: Experimental, developmental, and computational Approaches*. New York: Cambridge.
- Festinger, L. (1942). A theoretical interpretation of shifts in level of aspiration. *Psychological Review, 49*, 235-250.
- Festinger, L. (1954). A theory of social comparison processes. *Human Relations, 7*(2), 117-140.
- Freyd, J. J., & Finke, R. A. (1984). Representational momentum. *Journal of Experimental Psychology-Learning Memory and Cognition, 10*(1), 126-132.
- Gilbert, D. T., & Ebert, J. E. J. (2002). Decisions and revisions: The affective forecasting of changeable outcomes. *Journal of Personality and Social Psychology, 82*(4), 503-514.
- Gilovich, T., & Douglas, C. (1986). Biased evaluations of randomly determined gambling outcomes. *Journal of Experimental Social Psychology, 22*(3), 228-241.
- Gilovich, T., Griffin, D., & Kahneman, D. (Eds.). (2002). *Heuristics and biases: The psychology of intuitive judgment*. New York: Cambridge.
- Gleicher, F., Boninger, D. S., Strathman, A., Armor, D., Hetts, J., & Ahn, M. (1995). With an eye toward the future: The impact of counterfactual thinking on affect, attitudes, and behavior. In N. Roese & J. M. Olson (Eds.), *What might have been: The social psychology of counterfactual thinking* (pp. 283-304). Hillsdale, NJ: Erlbaum.
- Gleicher, F., Kost, K. A., Baker, S. M., Strathman, A. J., Richman, S. A., & Sherman, S. J. (1990). The role of counterfactual thinking in judgments of affect.

Personality and Social Psychology Bulletin, 16(2), 284-295.

- Gregory, W. L., Cialdini, R. B., & Carpenter, K. M. (1982). Self-relevant scenarios as mediators of likelihood estimates and compliance: Does imagining make it so. *Journal of Personality and Social Psychology*, 43(1), 89-99.
- Griffiths, M. D. (1999). The psychology of the near-miss (revisited): A comment on Delfabbro & Winefield (1999). *British Journal of Psychology*, 90, 441-445.
- Hansen, C. H., & Hansen, R. D. (1988). Finding the face in the crowd: An anger superiority effect. *Journal of Personality and Social Psychology*, 54, 917-924.
- Helson, H. (1947). Adaptation-level as frame of reference for prediction of psychophysical data. *American Journal of Psychology*, 60(1), 1-29.
- Helson, H. (1964). *Adaptation-level theory: An experimental and systematic approach to behavior*. New York: Harper & Row.
- Hsee, C. K., & Abelson, R. P. (1991). Velocity relation: Satisfaction as the function of the first derivative of outcome over time. *Journal of Personality and Social Psychology*, 60(3), 341-347.
- Irwin, F. W. (1944). The realism of expectations. *Psychological Review*, 51, 120-126.
- Irwin, F. W., & Mintzer, M. G. (1942). Effect of differences in instructions and motivation upon measures of the level of aspiration. *American Journal of Psychology*, 55, 400-406.
- Johnson, J. T. (1986). The knowledge of what might have been: Affective and attributional consequences of near outcomes. *Personality and Social Psychology Bulletin*, 12(1), 51-62.
- Judd, C. M., Kenny, D. A., & McClelland, G. H. (2001). Estimating and testing mediation and moderation in within-subject designs. *Psychological Methods*, 6(2), 115-134.

- Kahneman, D. (1995). Varieties of Counterfactual Thinking. In N. Roese & J. M. Olson (Eds.), *What might have been: The social psychology of counterfactual thinking* (pp. 375-396). New Jersey: Lawrence Erlbaum Associates.
- Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. In T. Gilovich, D. Griffin & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment*. New York: Cambridge.
- Kahneman, D., & Miller, D. T. (1986). Norm theory: Comparing reality to its alternatives. *Psychological Review*, 93(2), 136-153.
- Kahneman, D., Slovic, P., & Tversky, A. (1982). *Judgment under uncertainty: Heuristics and biases*. New York: Cambridge University Press.
- Kahneman, D., & Tversky, A. (1982). The simulation heuristic. In D. Kahneman, P. Slovic & A. Tversky (Eds.), *Judgement under uncertainty: Heuristics and biases* (pp. 201-208). New York: Cambridge University Press.
- Kahneman, D., & Varey, C. A. (1990). Propensities and counterfactuals: The loser that almost won. *Journal of Personality and Social Psychology*, 59(6), 1101-1110.
- Lazarus, R. S. (1991). *Emotion and adaptation*. New York: Oxford University Press.
- Lewis, D. (1973). *Counterfactuals*. London: Blackwell.
- Lichtenstein, S., Slovic, P., Fischhoff, B., Layman, M., & Combs, B. (1978). Judged frequency of lethal events. *Journal of Experimental Psychology-Human Learning and Memory*, 4(6), 551-578.
- Lockwood, P. (2002). Could it happen to you? Predicting the impact of downward comparisons on the self. *Journal of Personality and Social Psychology*, 82(3), 343-358.

- Macrae, C. N. (1992). A Tale of two curries: Counterfactual thinking and accident-related judgments. *Personality and Social Psychology Bulletin*, 18(1), 84-87.
- Macrae, C. N., & Milne, A. B. (1992). A curry for your thoughts: Empathic effects on counterfactual thinking. *Personality and Social Psychology Bulletin*, 18(5), 625-630.
- Macrae, C. N., Milne, A. B., & Griffiths, R. J. (1993). Counterfactual thinking and the perception of criminal behavior. *British Journal of Psychology*, 84, 221-226.
- Mandel, D. R., & Lehman, D. R. (1996). Counterfactual thinking and ascriptions of cause and preventability. *Journal of Personality and Social Psychology*, 71(3), 450-463.
- Mandler, G. (1975). *Mind and emotion*. New York: John Wiley & Sons Inc.
- Markman, K. D., Gavanski, I., Sherman, S. J., & McMullen, M. N. (1993). The mental simulation of better and worse possible worlds. *Journal of Experimental Social Psychology*, 29(1), 87-109.
- Markman, K. D., Gavanski, I., Sherman, S. J., & McMullen, M. N. (1995). The impact of perceived control on the imagination of better and worse possible worlds. *Personality and Social Psychology Bulletin*, 21(6), 588-595.
- Markman, K. D., & McMullen, M. N. (2003). A Reflection and Evaluation Model of comparative thinking. *Personality and Social Psychology Review*, 7(3), 244-267.
- Markman, K. D., & McMullen, M. N. (2005). Reflective and evaluative modes of mental simulation. In D. R. Mandel, D. J. Hilton & P. Catellani (Eds.), *The psychology of counterfactual thinking* (pp. 77-93). New York: Routledge.
- Markman, K. D., McMullen, M. N., & Elizaga, R. A. (2008). Counterfactual

thinking, persistence, and performance: A test of the Reflection and Evaluation Model. *Journal of Experimental Social Psychology*, 44(2), 421-428.

Markman, K. D., McMullen, M. N., Elizaga, R. A., & Mizoguchi, N. (2006).

Counterfactual thinking and regulatory fit. *Judgment and Decision Making Journal*, 1(2), 98-107.

Markmann, K. D., & Tetlock, P. E. (2000). Accountability and close-call

counterfactuals: The loser who nearly won and the winner who nearly lost. *Personality and Social Psychology Bulletin*, 26(10), 1213-1224.

McCloy, R., & Byrne, R. M. J. (2002). Semifactual “even if” thinking. *Thinking & Reasoning*, 8(1), 41-67.

McMullen, M. N. (1997). Affective contrast and assimilation in counterfactual thinking. *Journal of Experimental Social Psychology*, 33(1), 77-100.

McMullen, M. N., & Markman, K. D. (2000). Downward counterfactuals and motivation: The wake-up call and the pangloss effect. *Personality and Social Psychology Bulletin*, 26(5), 575-584.

McMullen, M. N., & Markmann, K. D. (2002). Affective impact of close counterfactuals: Implications of possible futures for possible pasts. *Journal of Experimental Social Psychology*, 38(1), 64-70.

Medvec, V. H., Gilovich, T., & Madey, S. F. (1995). When less is more:

Counterfactual thinking and satisfaction among Olympic medalists. *Journal of Personality and Social Psychology*, 69(4), 603-610.

Medvec, V. H., & Savitsky, K. (1997). When doing better means feeling worse: The effects of categorical cutoff points on counterfactual thinking and satisfaction. *Journal of Personality and Social Psychology*, 72(6), 1284-1296.

- Meyerslevy, J., & Maheswaran, D. (1992). When timing matters: The influence of temporal distance on consumers' affective and persuasive responses. *Journal of Consumer Research*, 19(3), 424-433.
- Miller, D. T., & Gunasegaram, S. (1990). Temporal order and the perceived mutability of events: Implications for blame assignment. *Journal of Personality and Social Psychology*, 59(6), 1111-1118.
- Miller, D. T., & McFarland, C. (1986). Counterfactual thinking and victim compensation: A test of norm theory. *Personality and Social Psychology Bulletin*, 12(4), 513-519.
- Miller, D. T., & Ross, M. (1975). Self-serving biases in the attribution of causality: Fact or fiction? *Psychological Bulletin*, 82(2), 213-225.
- Miller, D. T., Turnbull, W., & McFarland, C. (1990). Counterfactual thinking and social perception: Thinking about what might have been *Advances in Experimental Social Psychology*.
- Morse, S., & Gergen, K. J. (1970). Social comparison, self-consistency, and the concept of self. *Journal of Personality and Social Psychology*, 16(1), 148-&.
- Mussweiler, T. (2003). Comparison processes in social judgment: Mechanisms and consequences. *Psychological Review*, 110.
- Nasco, S. A., & Marsh, K. L. (1999). Gaining control through counterfactual thinking. *Personality and Social Psychology Bulletin*, 25(5), 556-568.
- Oliver, R. L. (1977). Effect of expectation and disconfirmation on postexposure product evaluations: An alternative interpretation. *Journal of Applied Psychology*, 62(4), 480-486.
- Oliver, R. L. (1980). A cognitive model of the antecedents and consequences of satisfaction decisions. *Journal of Marketing Research*, 17(4), 460-469.

- Olson, J. M., Roese, N. J., & Zanna, M. P. (1996). Expectancies. In E. T. Higgins & A. W. Kruglanski (Eds.), *Social psychology: Handbook of basic principles* (1st ed.): Guilford Press.
- Over, D. E., Hadjichristidis, C., Evans, J. S. T., Handley, S. J., & Sloman, S. A. (2007). The probability of causal conditionals. *Cognitive Psychology*, *54*(1), 62-97.
- Perreault, S., & Vallerand, R. J. (1998). Coming from behind: On the effect of psychological momentum on sport performance. *Journal of Sport & Exercise Psychology*, *20*(4), 421-436.
- Petrocelli, J. V., Percy, E. J., Sherman, S. J., & Tormala, Z. L. (2011). Counterfactual Potency. *Journal of Personality and Social Psychology*, *100*(1), 30-46.
- Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods Instruments & Computers*, *36*(4), 717-731.
- Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research*, *42*(1), 185-227.
- Reid, R. L. (1986). The psychology of the near miss. *Journal of Gambling Behaviour*.
- Roese, N. (1999). Counterfactual thinking and decision making. *Psychonomic Bulletin & Review*, *6*(4), 570-578.
- Roese, N. J. (1994). The functional basis of counterfactual thinking. *Journal of Personality and Social Psychology*, *66*(5), 805-818.
- Roese, N. J. (1997). Counterfactual thinking. *Psychological Bulletin*, *121*(1), 133-148.

- Roese, N. J., Fessel, F., Summerville, A., Kruger, J., & Dilich, M. A. (2006). The propensity effect. *Psychological Science, 17*(4), 305-310.
- Roese, N. J., & Morrison, M. (2009). The psychology of counterfactual thinking. *Historical Social Research-Historische Sozialforschung, 34*(2), 16-26.
- Roese, N. J., & Olson, J. M. (1995). Counterfactual thinking: A critical overview. In N. J. Roese & J. M. Olson (Eds.), *What might have been: The social psychology of counterfactual thinking* (pp. 1-56). New Jersey: Lawrence Erlbaum Associates.
- Roese, N. J., & Olson, J. M. (1996). Counterfactuals, causal attributions, and the hindsight bias: A conceptual integration. *Journal of Experimental Social Psychology, 32*(3), 197-227.
- Roese, N. J., & Olson, J. M. (1997). Counterfactual thinking: The intersection of affect and function. *Advances in Experimental Social Psychology, Vol 29* (Vol. 29, pp. 1-59). San Diego: Academic Press Inc.
- Sanna, L. J. (1997). Self-efficacy and counterfactual thinking: Up a creek with and without a paddle. *Personality and Social Psychology Bulletin, 23*(6), 654-666.
- Sanna, L. J., & Turley-Ames, K. J. (2000). Counterfactual intensity. *European Journal of Social Psychology, 30*(2), 273-296.
- Seelau, E. P., Seelau, S. M., Wells, G. L., & Windschitl, P. D. (1995). Counterfactual constrains. In N. Roese & J. M. Olson (Eds.), *What might have been: The social psychology of counterfactual thinking* (pp. 57-79). New Jersey: Lawrence Erlbaum Associates.
- Shaffer, M. J. (2009). Decision theory, intelligent planning and counterfactuals. *Minds and Machines, 19*(1), 61-92.
- Sherif, M., & Hovland, C. I. (1961). *Social judgment: Assimilation and contrast*

effects in communications and attitude change. New Haven, CT: Yale University Press.

Sherif, M., Taub, D., & Hovland, C. I. (1958). Assimilation and contrast effects of anchoring stimuli on judgments. *Journal of Experimental Psychology*, 55(2), 150-155.

Sherman, S. J., Cialdini, R. B., Schwartzman, D. F., & Reynolds, K. D. (2002). Imagining can heighten or lower the perceived likelihood of contracting a disease: The mediating effect of ease of imagery. In T. Gilovich, D. Griffin & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment* (pp. 4). New York: Cambridge.

Smith, C. A., & Kirby, L. D. (2009). Putting appraisal in context: Toward a relational model of appraisal and emotion. *Cognition & Emotion*, 23(7), 1352-1372.

Spellman, B. A. (1997). Crediting causality. *Journal of Experimental Psychology-General*, 126(4), 323-348.

Stangor, C., & McMillan, D. (1992). Memory for expectancy-congruent and expectancy-incongruent information: A review of the social and social developmental literatures. *Psychological Bulletin*, 111(1), 42-61.

Strickland, L. H., & Grote, F. W. (1967). Temporal presentation of winning symbols and slot-machine playing. *Journal of Experimental Psychology*, 74(1), 10-&.

Sundali, J., & Croson, R. (2006). Biases in casino betting: The hot hand and the gambler's fallacy. *Judgment and Decision Making Journal*, 1(1), 1-12.

Taylor, S. E. (1991). Asymmetrical effects of positive and negative events: The mobilization–minimization hypothesis. *Psychological Bulletin*, 110, 67–85.

Teigen, K. H. (1998). When the unreal is more likely than the real: Post hoc

- probability judgments and counterfactual closeness. *Thinking & Reasoning*, 4(2), 147-177.
- Teigen, K. H. (2005). The proximity heuristic in judgments of accident probabilities. *British Journal of Psychology*, 96, 423-440.
- Turnbull, W. (1981). Naive conceptions of free will and the deterministic paradox. *Canadian Journal of Behavioural Science-Revue Canadienne Des Sciences Du Comportement*, 13(1), 1-13.
- Tversky, A., & Kahneman, D. (1982). Availability: A heuristic for judging frequency and probability. In D. Kahneman, P. Slovic & A. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases*. New York: Cambridge University Press.
- Tykocinski, O. E., & Steinberg, N. (2005). Coping with disappointing outcomes: Retroactive pessimism and motivated inhibition of counterfactuals. *Journal of Experimental Social Psychology*, 41(5), 551-558.
- Vallerand, R. J., Colavecchio, P. G., & Pelletier, L. G. (1988). Psychological momentum and performance inferences: A preliminary test of the Antecedents-Consequences Psychological Momentum Model. *Journal of Sport & Exercise Psychology*, 10(1), 92-108.
- Walsh, C. R., & Byrne, R. M. J. (2004). Counterfactual thinking: The temporal order effect. *Memory & Cognition*, 32(3), 369-378.
- Wells, G. L., & Gavanski, I. (1989). Mental simulation of causality. *Journal of Personality and Social Psychology*, 56(2), 161-169.
- White, K., & Lehman, D. R. (2005). Looking on the bright side: Downward counterfactual thinking in response to negative life events. *Personality and Social Psychology Bulletin*, 31(10), 1413-1424.

- Wills, T. A. (1981). Downward comparison principles in social psychology. *Psychological Bulletin, 90*(2), 245-271.
- Wilson, A. E., & Ross, M. (2001). From chump to champ: People's appraisals of their earlier and present selves. *Journal of Personality and Social Psychology, 80*(4), 572-584.
- Wilson, T. D., Lisle, D. J., Kraft, D., & Wetzel, C. G. (1989). Preferences as expectation-driven inferences: Effects of affective expectations on affective experience. *Journal of Personality and Social Psychology, 56*(4), 519-530.
- Wood, J. V., Taylor, S. E., & Lichtman, R. R. (1985). Social comparison in adjustment to breast cancer. *Journal of Personality and Social Psychology, 49*(5), 1169-1183.

Appendices – Experimental Materials

Appendix A Experimental Materials for Experiment 1

Information Sheet for Participants

TITLE OF PROJECT: Understanding how people respond to success and failure

This experiment is conducted by a research postgraduate in the Department of Psychology as part of the requirements for the doctoral degree.

Experimenter: Qiyuan Zhang
Supervisor: Dr Judith Covey

The participants are asked to read all of the following information

- This experiment is designed to examine how people respond to success and failure in daily life.
- You will be asked to read one short story featuring successes or failures that people may confront in real life.
- You will then answer some questions following the story about your thoughts and opinions.
- Please be advised that your participation in the experiment is absolutely voluntary and you are free to withdraw at anytime without having to give a reason for withdrawing or affecting your position in the University.
- All the data collected during the process of the experiment will be treated with full confidentiality and used for academic purpose only.
- If you consent to take part in this study please leave your name and signature on the **CONSENT FORM** overleaf.

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Consent Form

TITLE OF PROJECT: Understanding how people respond to success and failure

This experiment is conducted by a research postgraduate in Department of Psychology as part of the requirements for the doctoral degree.

Experimenter: Qiyuan Zhang
Supervisor: Dr Judith Covey

The participants are asked to answer all of the questions below independently and sign where appropriate.

- Have you fully read the information sheet for participants? (Yes / No)
- Have you had an opportunity to ask questions and to discuss about the study? (Yes / No)
- Have you received enough information about the study? (Yes / No)
- Do you consent to participate in the study? (Yes / No)
- Do you understand that you are free to withdraw from the study at any time without having to give a reason for withdrawing or affecting your position in the University? (Yes / No)

SignedDate.....

NAME IN BLOCK LETTERS.....

Signature of witness.....Date.....

NAME IN BLOCK LETTERS.....

Questionnaire for Future Possibility: Low Condition

Please read the story below carefully and answer the questions that follow.

The *Brazilian National Championships Série A* is the highest division of Brazilian football, which is composed of the 20 most competitive football clubs in the country. Football teams *Flamengo* and *Sao Paulo* are both the top clubs in the championships. They are now confronting each other in the national stadium and the game is about to begin. It is hard to predict which team will win because both teams showed top form in previous matches against other opponents. According to the rules set by the *Brazilian Football Confederation*, the team who wins the match obtains 3 points and the team who loses obtains none. If the scores are tied at the end of the full time (90 minutes plus injury time), the game ends in a draw, in which case both teams obtain 1 point. Since *Flamengo* and *Sao Paulo* currently hold equal points in the championship ranking table and it is near the end of the season, the result of this match will be critical to both teams.

After kicking-off, both teams have managed to exert some pressure on the opponent's defense line but no real threat was caused by either team. Now the game has entered injury time of the second half and it will be roughly 2 minutes before the referee ends the whole game. The scores are still 0-0.

Flamengo starts to build up their attack on the edge of the opponent's penalty area. They are showing excellent skills and teamwork. The defense line of *Sao Paulo* is torn apart while the *Flamengo* midfielder Lenon breaks into the penalty area with the ball. Lenon then passes the ball to his teammate Adriano (striker of *Flamengo*), who is currently in a good shooting position. Adriano gives it a powerful shot. But the ball hits the goal post and is deflected back into the pitch. A *Sao Paulo* defender clears the ball. The scores remain 0-0.

Questions:

Please answer the following questions. You can refer back to the story if necessary.

1. Which players do you think are in a better mood right now? _____

- A) The players of *Flamengo* B) The players of *Sao Paulo*

Could you tell us why you think they are in a better mood?

2. At this moment, one of the players is feeling disappointed. Who do you think it is? _____

- A) A player of *Flamengo* B) A player of *Sao Paulo*

3. At this moment, one of the players is feeling relieved. Who do you think it is? _____

- A) A player of *Flamengo* B) A player of *Sao Paulo*

4. At this moment, one of the players is feeling proud. Who do you think it is? _____

- A) A player of *Flamengo* B) A player of *Sao Paulo*

5. At this moment, one of the players is feeling discouraged. Who do you think it is? _____

- A) A player of *Flamengo* B) A player of *Sao Paulo*

6. At this moment, one of the players is feeling pleased. Who do you think it is? _____

A) A player of *Flamengo* B) A player of *Sao Paulo*

7. At this moment, one of the players is feeling frustrated. Who do you think it is?

A) A player of *Flamengo* B) A player of *Sao Paulo*

8. At this moment, one of the players is thinking: "we have a better chance to win this game than our opponent." Who do you think it is? _____

A) A player of *Flamengo* B) A player of *Sao Paulo*

9. At this moment, one of the players is thinking: "things could have been better." Who do you think it is? _____

A) A player of *Flamengo* B) A player of *Sao Paulo*

10. At this moment, one of the players is thinking: "things could have been worse." Who do you think it is? _____

A) A player of *Flamengo* B) A player of *Sao Paulo*

11. At this moment, one of the players is thinking: "we almost scored a goal." Who do you think it is? _____

A) A player of *Flamengo* B) A player of *Sao Paulo*

12. At this moment, one of the players is thinking: "we almost conceded a goal." Who do you think it is? _____

A) A player of *Flamengo* B) A player of *Sao Paulo*

Please tell us more about yourself:

1. Are you male or female? ____
A) Male
B) Female
2. What is your age? ____
3. What is your first language? _____

Please tell us how you think of the study:

Was the content of the story easy to understand?

(Yes/No)

Were the instructions given by the experimenter(s) clear and easy to follow?

(Yes/No)

Were the questions clear and easy to understand?

(Yes/No)

Any other comments (optional)?

Debriefing Sheet for Participants

TITLE OF PROJECT: Understanding how people respond to success and failure

This experiment is conducted by a research postgraduate in the Department of Psychology as part of the requirements for the doctoral degree.

Experimenter: Qiyuan Zhang

Supervisor: Dr Judith Covey

Thanks for your contribution to the study!

As stated in the information sheet, the current research explores how people react to successes and failures in daily life. To be more specific, the experiment was designed to investigate how people react to close outcomes (e.g. almost won a race, nearly failed a test). Many of you may have had the experience when you nearly succeeded in doing something but finally failed to achieve it (e.g. failing an examination by merely one point) or when you narrowly miss something bad (e.g. almost being hit by a car when crossing a street). It was demonstrated in some previous studies that people's emotional reactions would be intensified as such close outcomes occur. For example, Kahneman and Tversky (1982) found that people would judge missing a flight by 5 minutes to be more upsetting than missing the flight by half an hour. It was also suggested that such effects were mediated by a mental process called counterfactual thinking, which means the imaginations about the alternative worlds to the reality. For example, a student who failed an examination by merely one point would possibly ruminate about how he or she could have passed. Similarly a person who was almost hit by car may dwell on how he or she could have been hit or even been killed.

The current study investigates the situational factors which will potentially influence the emotional impacts of close outcome and counterfactual thinking. It was suggested that people could infer both positive and negative meanings from a close outcome. In the case of a football game, almost scoring a goal could be frustrating but it can also be seen as a sign of good potential and lift the football players' expectations for future success. Similarly, almost conceding a goal could be relieving but it can be seen as an indicator of threat and future failure, which will cause fear and anxiety and demoralize the football players. Thus, a close outcome could produce mixed emotions. Whether positive or negative emotions dominate one's affective experiences depends on which piece of information people focus on.

In our study, some of you were told that the football team *Flamengo* had almost scored the goal at the beginning of the match. In this circumstance, the future

opportunity was still open and the team who had almost scored a goal should focus more on the positive implications of a close outcome (e.g. “We are playing quite well and we will win this match”) while the team who had almost conceded the goal should focus more on the negative implications of the close outcome (e.g. “We almost lost that goal and we are losing this game”). So in this condition, we predict that people should judge the players of *Flamengo* to be feeling better than the players of *Sao Paulo*. On the other hand, some of you were told that *Flamengo* had almost scored a goal at the end of the game. In this case, the future opportunity was closed. We predict a reversed pattern in this condition as opposed to the previous one. That is, the team which had almost scored a goal would focus on the negative implications of a close outcome (e.g. “We missed a good opportunity”) and the team who had almost conceded would focus on the positive (e.g. “We were so lucky. We didn’t lose.”). So in this condition, people should judge the players of *Flamengo* to be feeling worse than the players of *Sao Paulo*.

If you have future queries, please contact the researcher:

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Appendix B Experimental Materials for Experiment 2

The Information sheet and the consent form are the same as used in Experiment 1

Questionnaire for Future Possibility: Low/Proximity: Close Condition

Please **vividly imagine** that you were applying for a job that you have been longing for. After the job interview, you were told that you had won the eligibility for the final entrance test. You would have to score at least 80 out of 100 points or your job application would be rejected.

You only have one chance to pass the test.

You had been preparing for the test for the whole month and you were planning to revise the whole material one last time the night before the test to “recharge” yourself. However, in the afternoon before the day of the test, you came across an old friend you hadn’t seen for quite a while on your way home from the library. You decided to buy him or her a drink in the local bar. Being aware that you would have a test the very next morning, you promised yourself to get back home no later than 7pm so you could do some study before going to bed. However, you two were having such a good time that neither of you were ready to call it an end until very late. It was already midnight when you eventually got home. Being too tired to study, you slammed yourself into bed.

You got up a little bit late the next morning. You grabbed your stuff and rushed out. You managed to arrive at the test venue on time and dashed onto your seat only seconds before the test began. You regained your breath and started working on the questions. Two hours later, you finished the test.

You got the results one week later by mail. You opened the mail only to find you’ve got 79 on your result sheet – you failed the test by 1 point. Therefore your job application would be rejected.

Questions

Please imagine that you were the job applicant who took the test in the story and answer the following questions

1. Please list 5 thoughts about what has happened in the story that most easily come to your mind.

1) _____

2) _____

3) _____

4) _____

5) _____

2. Please indicate the extent to which the following words would describe your feelings after receiving the result, by circling the number 1-9 on the scales provided below.

	1	2	3	4	5	6	7	8	9
Happy	Not at all		A little		Moderately		Quite a bit		Extremely

	1	2	3	4	5	6	7	8	9
Annoyed	Not at all		A little		Moderately		Quite a bit		Extremely

	1	2	3	4	5	6	7	8	9
Satisfied	Not at all		A little		Moderately		Quite a bit		Extremely

	1	2	3	4	5	6	7	8	9
Frustrated	Not at all		A little		Moderately		Quite a bit		Extremely

Pleased	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Miserable	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Delighted	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Sad	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Content	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Depressed	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Relieved	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Gloomy	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Glad	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Dis- appointed	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely

Proud	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Guilty	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Determined	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Regretful	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely

3. Please indicate how likely you think the following thoughts would come to your mind regarding what had happened in the story, using the scale provided below.

1) If only I had studied the night before the test instead of having so many drinks. _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

2) I nearly passed the test this time and I believe I will have a very good chance if a resit opportunity is given. _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

3) At least I've learnt something from the failure. _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

4) It probably wouldn't have made much difference if I hadn't gone out with my friend. _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

5) Even if I had studied the night before, I would still have failed. _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

6) It's good to know I've got the potential to pass the test and I'm competent for the job. _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

7) I feel bad because I don't seem to be competent for the job. _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

8) Why did my friend have to show up the night before the test? _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

9) I shouldn't have gone out with my friend. _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

10) It doesn't matter. The job doesn't suit me anyway. _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

4. Please indicate how likely you think you would have passed the test **if you hadn't spent so much time in the bar** the night before, using the number 1 to 9 on the scale provided below _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

5. To what extent do you agree the following statement?

"If I had been given a chance to resit, I would make more efforts in preparing for the test than the last time."

1	2	3	4	5	6	7	8	9
Strongly disagree		Disagree		Neither agree nor disagree		Agree		Strongly agree

6. If you are given a chance to resit, how likely do you think you will pass the test next time? _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

7. How close or far away do you think you **were** to (from) passing the test?

1	2	3	4	5	6	7	8	9
Extremely far away		Quite		Neither far or close		Quite		Extremely close

Appendix C Experimental Materials for Experiment 3

The Information sheet and the consent form are the same as used in Experiment 1

Questionnaire for Future Possibility: Low Condition

Please read the story below carefully and answer the questions that follow.

“Split Second” is an arena-based evening TV game show in the USA, which features a rich variety of mental and physical challenges in which the contestants try to outperform and eliminate their opponents to win big monetary prizes. Each episode of “Split Second” features two arenas located in different cities across the country. The competitions in the two arenas go on separately yet at the same time. At the end of each episode, one winner from each arena advances to the next stage of the competition.

In this episode of “Split Second”, 12 contestants are competing in two arenas located in Los Angeles and Philadelphia (six contestants compete in each arena). The winner from each arena wins \$50,000 and advances to the next week’s show, with the potential to win an additional \$100,000. The losers leave empty-handed.

Here is what happened in the Los Angeles arena:

After the first three rounds of competition, two contestants, Kelly and Susan, who have the highest scores among the six, play the final challenge. They have to beat their opponent in this challenge to be the Los Angeles winner of this episode of “Split Second”.

In the final challenge, a basketball shooting machine is introduced to the contestants (as pictured below), which has two bottomless baskets bolted side-by-side on a metal panel at one end of the machine. When the whistle goes off, the two contestants race 15 metres to the machine, pick up balls from the pool and start shooting the balls at the basket which has been pre-assigned to them. They score one point for each ball they throw in their basket. If they accidentally throw a ball into the wrong basket, their opponent will score one point instead of them. The objective is to outscore their opponent within the time limit of two minutes.

Picture: The basketball shooting machine featured in this episode of "Split Second"



The two contestants play just one round of this game. The contestant who outscores their opponent in this single round is the winner of Los Angeles arena in this episode of “Split Second”.

The result of the game is shown overleaf.

[Future Opportunity: Absent condition]

Result of the game		
Contestant	Kelly	Susan
Score	13 (Lost)	28 (Won)
Status	Retires from the competition empty-handed	Wins \$50,000 and advances to the next stage

Please read the results above carefully and then proceed to the next page to answer the questions. You can refer back to the content of the story while you are answering the questions if you feel like doing so.

Questions

1. In general, how negative or positive do you think Kelly (Susan) will be feeling now? Please indicate by circling a number from 1-9 on the scale provided below:

1	2	3	4	5	6	7	8	9
Extremely negative		Quite negative		Neutral		Quite positive		Extremely positive

2. To what extent do you think that Kelly (Susan) will be experiencing each of the following 12 emotions now? Please indicate by circling a number from 1-9 on each of the scales provided below:

	1	2	3	4	5	6	7	8	9
Happy	Not at all		A little		Moderately		Quite a bit		Extremely
	1	2	3	4	5	6	7	8	9
Annoyed	Not at all		A little		Moderately		Quite a bit		Extremely
	1	2	3	4	5	6	7	8	9
Satisfied	Not at all		A little		Moderately		Quite a bit		Extremely
	1	2	3	4	5	6	7	8	9
Frustrated	Not at all		A little		Moderately		Quite a bit		Extremely
	1	2	3	4	5	6	7	8	9
Pleased	Not at all		A little		Moderately		Quite a bit		Extremely
	1	2	3	4	5	6	7	8	9
Miserable	Not at all		A little		Moderately		Quite a bit		Extremely

Content	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Relieved	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Disappointed	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Proud	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Elated	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Discouraged	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely

3. How likely do you think that Kelly (Susan) could have won (or lost) the round that just finished? Please indicate by circling a number from 1-9 on the scale provided below:

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

4. How close or far away do you think that Kelly (Susan) was from winning (or losing) the round that just finished? Please indicate by circling a number from 1-9 on the scale provided below:

1	2	3	4	5	6	7	8	9
Extremely far away		Quite far away		Neither far or close		Quite close		Extremely close

From this point onward, the questions are only applicable to FP: High conditions:

5. How likely do you think that Kelly (Susan) will win (or lose) the next round? Please indicate by circling a number from 1-9 on the scale provided below:

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

6. How likely do you think that Kelly (Susan) will win (or lose) this Los Angeles episode of "Split Second"? Please indicate by circling a number from 1-9 on the scale provided below:

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

Please proceed to the next section of the story

Meanwhile, in the Philadelphia arena, Fiona and Christina are the two contestants who have the highest scores among the six in their group and make it to the final challenge. They take on the same challenge as Kelly and Susan do in the other arena.

[Future Opportunity: Absent] The two contestants play just one round of the basketball game. The contestant who outscores their opponent in this single round is the winner of Philadelphia arena in this episode of “Split Second”. The result of the game is shown overleaf. Please note that the contestants in one arena have no way of knowing what is happening in the other arena.

[Future Opportunity: present] The two contestants play up to 5 rounds of the basketball game. The contestant who outscores their opponent in 3 of these rounds is the winner of Philadelphia arena in this episode of “Split Second”. The result of the first round (out of 5 possible rounds) is shown overleaf. Please note that the contestants in one arena have no way of knowing what is happening in the other arena.

[Future Opportunity: Absent condition]

Result of the game		
Contestant	Fiona	Christina
Score	23 (Lost)	24 (Won)
Status	Retires from the competition empty-handed	Wins \$50,000 and advances to the next stage

Please read the results presented above carefully and then proceed to the next page to answer the questions. You can refer back to the content of the story while you are answering the questions if you feel like doing so.

Questions

1. In general, how negative or positive do you think Fiona (Christina) will be feeling now? Please indicate by circling a number from 1-9 on the scale provided below:

1	2	3	4	5	6	7	8	9
Extremely negative		Quite negative		Neutral		Quite positive		Extremely positive

2. To what extent do you think that Fiona (Christina) will be experiencing each of the following 12 emotions now? Please indicate by circling a number from 1-9 on each of the scales provided below:

	1	2	3	4	5	6	7	8	9
Happy	Not at all		A little		Moderately		Quite a bit		Extremely
	1	2	3	4	5	6	7	8	9
Annoyed	Not at all		A little		Moderately		Quite a bit		Extremely
	1	2	3	4	5	6	7	8	9
Satisfied	Not at all		A little		Moderately		Quite a bit		Extremely
	1	2	3	4	5	6	7	8	9
Frustrated	Not at all		A little		Moderately		Quite a bit		Extremely
	1	2	3	4	5	6	7	8	9
Pleased	Not at all		A little		Moderately		Quite a bit		Extremely
	1	2	3	4	5	6	7	8	9
Miserable	Not at all		A little		Moderately		Quite a bit		Extremely

Content	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Relieved	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Disappointed	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Proud	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Elated	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Discouraged	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely

3. How likely do you think that Fiona (Christina) could have won (or lost) the round that just finished? Please indicate by circling a number from 1-9 on the scale provided below:

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

4. How close or far away do you think that Fiona (Christina) was from winning (or losing) the round that just finished? Please indicate by circling a number from 1-9 on the scale provided below:

1	2	3	4	5	6	7	8	9
Extremely far away		Quite far away		Neither far or close		Quite close		Extremely close

From this point onward, the questions are only applicable to FP: High conditions:

5. How likely do you think that Fiona (Christina) will win (or lose) the next round? Please indicate by circling a number from 1-9 on the scale provided below:

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

6. How likely do you think that Fiona (Christina) will win (or lose) this Philadelphia episode of "Split Second"? Please indicate by circling a number from 1-9 on the scale provided below:

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

End of the experiment

Thanks for your participation

Debriefing Sheet for Participants

TITLE OF PROJECT: Understanding how people respond to success and failure

This experiment is conducted by a research postgraduate in the Department of Psychology as part of the requirements for the doctoral degree.

Experimenter: Qiyuan Zhang

Supervisor: Dr Judith Covey

Thanks for your contribution to the study!

As stated in the information sheet, the current research explores how people react to successes and failures in daily life. To be more specific, the experiment was designed to investigate how people react to near misses (e.g. almost won a race, nearly failed a test).

In the experiment, half of you were asked to focus on the two losers of the game show while the other half the two winners. The winners (or losers) beat (or were beaten by) their opponent either by 1 point (near miss) or by 15 points (blowout). We are interested in how people respond to near-misses as opposed to blowouts, either as winners or losers.

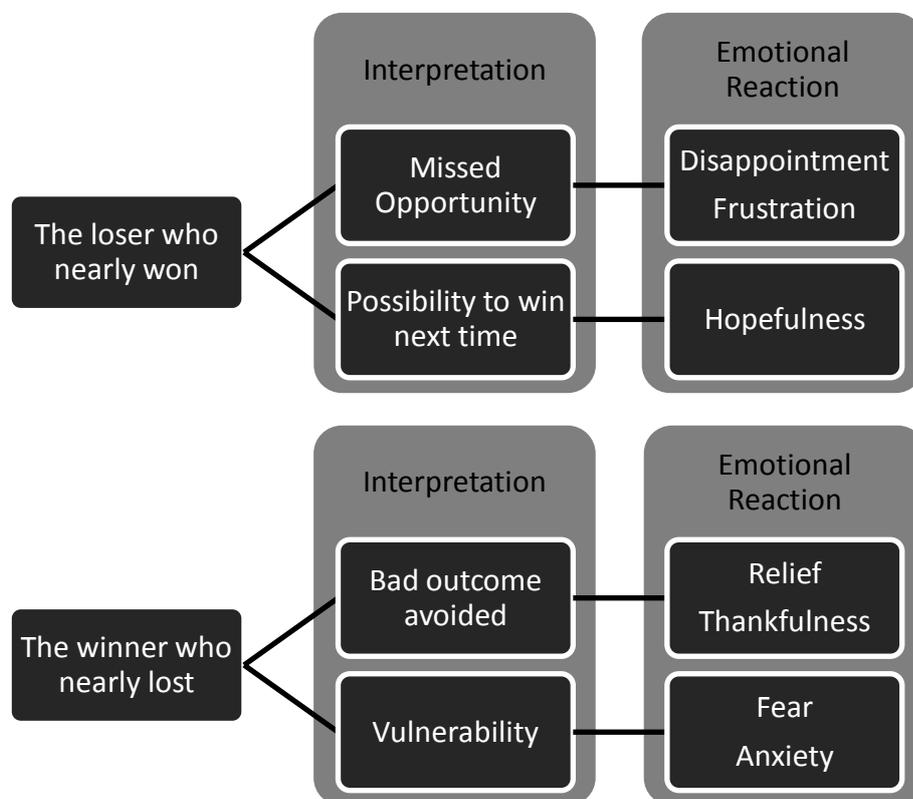


Figure: Possible interpretations to near-misses and their emotional implications

We proposed that people's reactions to near-misses depend on how they interpret them (see Figure), which should further be affected by people's perception of future opportunity. In the story, half of you were told that only one round was to be played and the result of this single round would determine the winner, in which case the perception of future opportunity was low. The other half were told that several rounds were to be played and the result was just for the first round, in which case the perception of future opportunity was high.

As Figure suggests, for the loser who nearly won, a low perception of future opportunity should dispose people to interpret a "nearly won" situation as an indicator of missed opportunity ("I could have won but I didn't") and thus one's mood should be WORSENER, while a high perception of future opportunity should dispose people to interpret a "nearly won" situation as a sign of future winnings (I could have won and I probably will) and thus one's mood should be IMPROVED. Correspondingly, for the winner who nearly lost, a low perception of future opportunity should dispose people to interpret a "nearly lost" situation as an indicator that a misfortune has been avoided ("I could have lost but I didn't") and thus one's mood should be IMPROVED, while a high perception of future opportunity should dispose people to interpret a "nearly lost" situation as a sign of vulnerability to losing the game (I could have lost and I probably will) and thus one's mood should be WORSENER.

Should you have further inquiries regarding this study, please email to:

qiyan.zhang@durham.ac.uk

Appendix D Experimental Materials for Experiment 4

The Information sheet and the consent form are the same as used in Experiment 1

Questionnaire for Future Possibility: Low/Progression: Absent Condition

Please **vividly imagine** that you are now at Doncaster Racecourse and are in the middle of the horse racing event Racing Post Trophy. The upcoming race is a 5-furlong (1 kilometre) flat race consisting of 8 horses. You've bet £50 on the horse *Captain Dunne* to win the race. The horse you bet on was considered to have a moderate chance of winning and if it does win, you will get your stake of £50 back plus a bonus of £50. If the horse does not win, you will lose the total stake of £50. Now, all the 8 horses are ready in the stalls and the race is about to begin.

The gates were opened and the horses set off! Your horse *Captain Dunne* had a fairly weak start and was in 5th place at the half way point (500 metres), 7 metres short of the leading horse *Cosmic Sun* (in racing terminology about '3 lengths'). However, your horse *Captain Dunne* started to increase its pace at the beginning of the second half of the race. It overtook its opponents one after another and advanced rapidly to the leading horse *Cosmic Sun*. The leading horse was losing its advantage at a fast and steady rate – 6 metres, 4 metres, 2 metres – and 100 metres from the finishing line, your horse *Captain Dunne* was in 2nd place and just 1 metre short of the leader *Cosmic Sun* (in racing terminology about 'half a length'). But suddenly the horse in 3rd place went out of control and ran into the back of your horse *Captain Dunne*. This incident caused your horse *Captain Dunne* to lose its step and stumble slightly. Although your horse was not injured and the jockey responded quickly and succeeded in avoiding a total fall over, your horse *Captain Dunne* clearly lost pace and lost ground on the leading horse. As a result, your horse finished 2nd about 3 metres (one and a half lengths) behind the winner *Cosmic Sun*. You lost your £50 stake. It was also reported that the horse which had caused the incident was severely injured and would not be able to run any race for at least a month.

Questions

Please imagine that you were the gambler who bet £50 on the horse *Captain Dunne* in the story and answer the following questions:

1. Please list 5 thoughts about what has happened in the story that most easily come to your mind.

1) _____

2) _____

3) _____

4) _____

5) _____

2. Please indicate the extent to which the following words would describe your feelings after the race, by circling the number 1-9 on the scales provided below.

	1	2	3	4	5	6	7	8	9
--	---	---	---	---	---	---	---	---	---

Happy

Not at all		A little		Moderately		Quite a bit		Extremely
------------	--	----------	--	------------	--	-------------	--	-----------

	1	2	3	4	5	6	7	8	9
--	---	---	---	---	---	---	---	---	---

Annoyed

Not at all		A little		Moderately		Quite a bit		Extremely
------------	--	----------	--	------------	--	-------------	--	-----------

	1	2	3	4	5	6	7	8	9
--	---	---	---	---	---	---	---	---	---

Satisfied

Not at all		A little		Moderately		Quite a bit		Extremely
------------	--	----------	--	------------	--	-------------	--	-----------

	1	2	3	4	5	6	7	8	9
--	---	---	---	---	---	---	---	---	---

Frustrated

Not at all		A little		Moderately		Quite a bit		Extremely
------------	--	----------	--	------------	--	-------------	--	-----------

	1	2	3	4	5	6	7	8	9
--	---	---	---	---	---	---	---	---	---

Pleased

Not at all		A little		Moderately		Quite a bit		Extremely
------------	--	----------	--	------------	--	-------------	--	-----------

Miserable	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Delighted	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Sad	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Content	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Depressed	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Relieved	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Gloomy	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Glad	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Dis- appointed	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Proud	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely

Guilty	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Determined	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely
Regretful	1	2	3	4	5	6	7	8	9
	Not at all		A little		Moderately		Quite a bit		Extremely

3. Please indicate how likely you think the following thoughts would come to your mind regarding what had happened in the story, using the scale provided below.

1) If only the accident hadn't happened. _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

2) If only I had bet on another horse. _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

3) Captain Dunne almost won the race and it will have a good chance to win next time. _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

4) At least I didn't place a bigger bet. _____

	1	2	3	4	5	6	7	8	9
Extremely unlikely			Quite		Neither likely or unlikely		Quite		Extremely likely

5) At least I didn't bet on the horse that was injured. _____

	1	2	3	4	5	6	7	8	9
Extremely unlikely			Quite		Neither likely or unlikely		Quite		Extremely likely

6) Even if Captain Dunne hadn't stumbled, it wouldn't have won the race. _____

	1	2	3	4	5	6	7	8	9
Extremely unlikely			Quite		Neither likely or unlikely		Quite		Extremely likely

7) Captain Dunne performed well and had the potential to win the race. _____

	1	2	3	4	5	6	7	8	9
Extremely unlikely			Quite		Neither likely or unlikely		Quite		Extremely likely

8) Captain Dunne performed poorly and barely got a chance to win the race.

	_____	1	2	3	4	5	6	7	8	9
Extremely unlikely				Quite		Neither likely or unlikely		Quite		Extremely likely

9) It just wasn't my lucky day. _____

	1	2	3	4	5	6	7	8	9
Extremely unlikely			Quite		Neither likely or unlikely		Quite		Extremely likely

10) That horse which ran into Captain Dunne really annoyed me. _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

11) I made a bad decision. _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

12) I wouldn't care much about losing £50 anyway. _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

4. Please indicate how likely you think the horse you bet on (*Captain Dunne*) would have won the race **if it hadn't stumbled** 100 metres from the finishing line, using the number 1 to 9 on the scale provided below _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

5. Please indicate which of the following figures best represents the race that your horse (*Captain Dunne*) just had _____



6. What do you think of the performance of the horse you bet on (*Captain Dunne*)?

1	2	3	4	5	6	7	8	9
Extremely bad		Bad		Neither good nor bad		Good		Extremely good

7. Please indicate how likely you think it would be that the horse you bet on (*Captain Dunne*) would win a second race run one week later against the same opponents apart from the one that fell out of the course? _____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite		Neither likely or unlikely		Quite		Extremely likely

8. How close or far away do you think your horse **was** to (from) winning the race?

1	2	3	4	5	6	7	8	9
Extremely far away		Quite		Neither far or close		Quite		Extremely close

Appendix E Experimental Materials for Experiment 5

The Information sheet and the consent form are the same as used in Experiment 1

Questionnaire for Future Possibility: Low Condition

Please read the story below carefully and answer the questions that follow.

Henry and John are at Doncaster Racecourse and are in the middle of the horse racing event *Racing Post Trophy*. The upcoming race is a 5-furlong (1 kilometre) flat race consisting of 8 horses. Henry has bet £30 on the horse *Captain Dunne* to win the race and John instead, has bet £30 on *Silver Line* to win the race (see Betting Table below).

Henry	•Captain Dunne
John	•Silver Line

Betting Table

Both horses they bet on were considered to have a moderate chance of winning and Henry and John will get their stake of £30 back plus a bonus of £30 if the horse they bet on does win. If their horse does not win, they will lose the total stake of £30. Now, all the 8 horses are ready in the stalls and the race is about to begin.

The gates were opened and the horses set off (see Figure 1)!

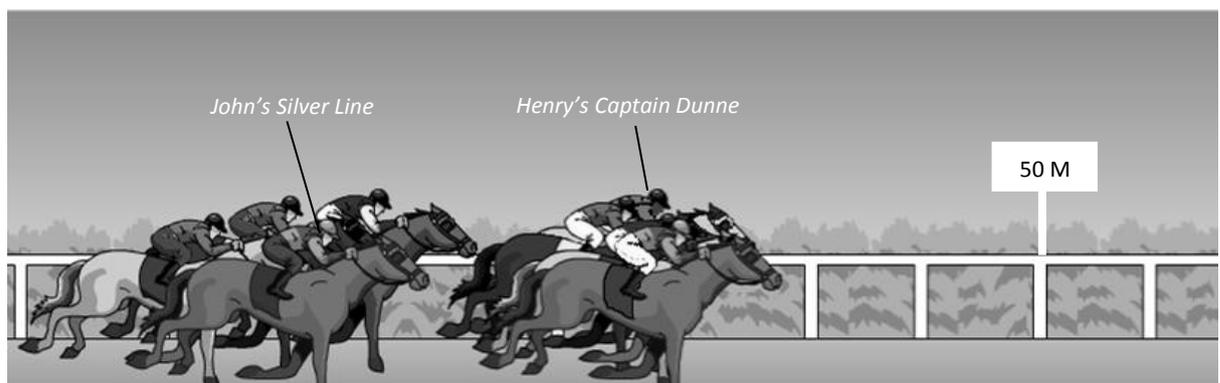


Figure 1 Start off

Henry's horse *Captain Dunne* started strongly. It obtained 2nd place and was 1 metre short of the leader *Cosmic Sun*. *Cosmic Sun* sustained this advantage throughout the first half of the race and at the half-way point (500 metres), *Captain Dunne* was still 1 metre short (see Figure 2).

On the other hand, John's horse *Silver Line* had a fairly weak start and was in 5th place at the half way point (500 metres), 7 metres short of the leading horse *Cosmic Sun* (see Figure 2).



Figure 2 Half way

The finishing line was getting closer and the 1 metre deficit between Henry's horse *Captain Dunne* and *Comic Sun* remained constant. However, John's horse *Silver Line* started to increase its pace at the beginning of the second half of the race. It overtook its opponents one after another and advanced rapidly to the leading horse *Cosmic Sun* and 2nd place *Captain Dunne* (see Figure 3).

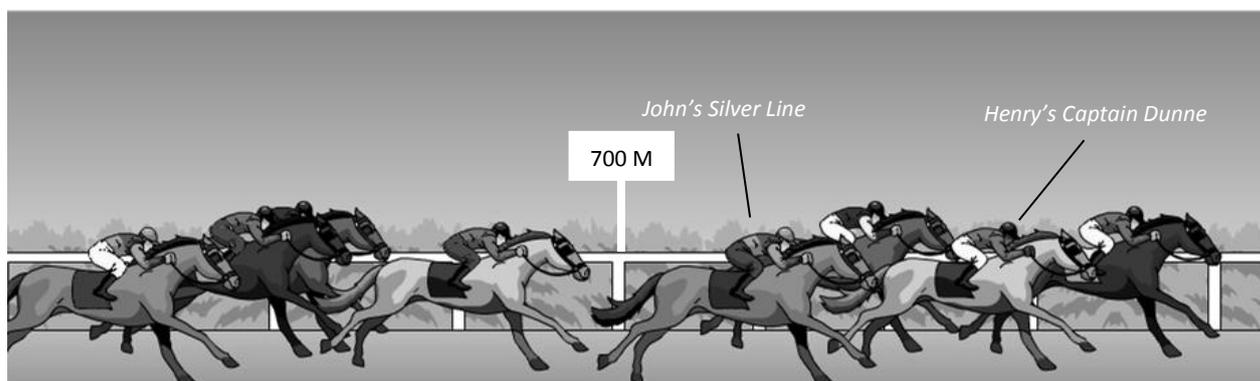


Figure 3 300 metres from finishing

Silver Line was closing the gap between itself and the leading horse in a rapid and steady rate – 6 metres, 4 metres, 2 metres – and 100 metres from the finishing line, *Silver Line* was neck and neck with Henry's horse *Captain Dunne* in 2nd place and they were both 1 metre short of the leader *Cosmic Sun* (see Figure 4).

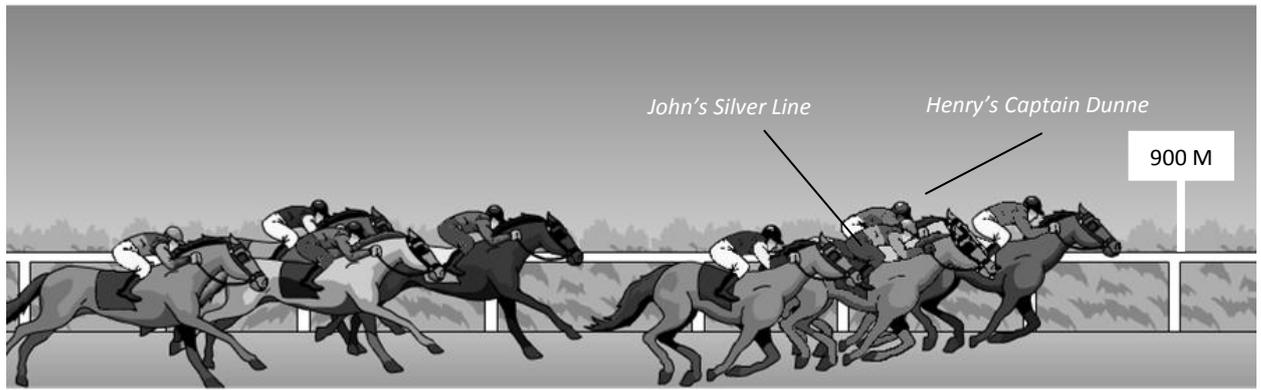


Figure 4 100 metres from finishing

Suddenly the horse in 4th place went out of control and ran into the backs of Henry and John's horses. This incident caused both *Captain Dunne* and *Silver Line* to lose their step and stumble slightly. Although both horses were not injured and the jockeys of both horses responded quickly and succeeded in avoiding a total fall over, they clearly lost pace and lost ground on the leading horse. As a result, Henry's horse *Captain Dunne* and John's horse *Silver Line* finished the race at almost the same time, 4 metres behind the winner *Cosmic Sun* (see Figure 5). Henry and John both lost their £30 stake.

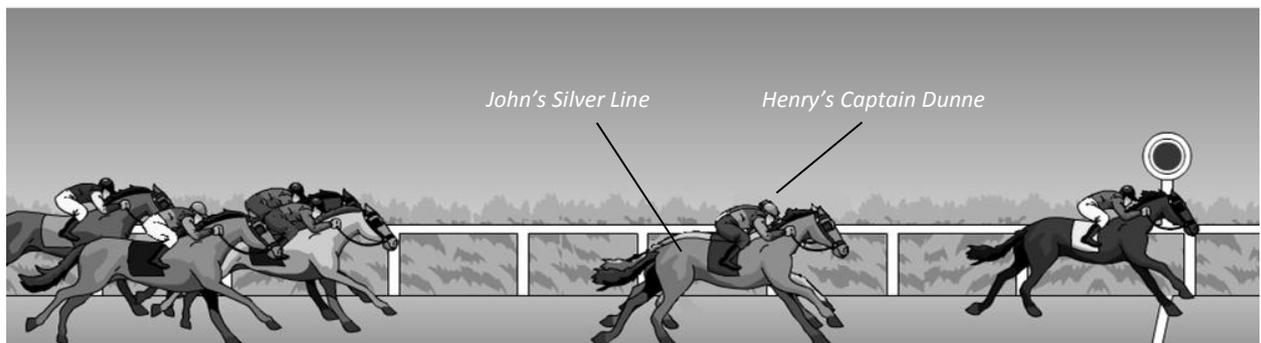


Figure 5 Finishing

Please proceed to the questions

Questions:

Please answer the following questions. You can refer back to the story if necessary.

- In general, how negative or positive do you think Henry and John will be feeling respectively after the race? Please indicate by circling a number from 1-9 on each of the scales provided below:

Henry (who bet on *Captain Dunne*) ____

1	2	3	4	5	6	7	8	9
Extremely negative		Quite negative		Neutral		Quite positive		Extremely positive

John (who bet on *Silver Line*) ____

1	2	3	4	5	6	7	8	9
Extremely negative		Quite negative		Neutral		Quite positive		Extremely positive

- Please indicate to what extent Henry and John will be experiencing each of the following **12** emotions after the race? Please indicate by circling a number from 1-9 on each of the scales provided below:

1) Happy

	1	2	3	4	5	6	7	8	9
Henry (Captain Dunne)	Not at all		A little		Moderately		Quite a bit		Extremely
	1	2	3	4	5	6	7	8	9
John (Silver Line)	Not at all		A little		Moderately		Quite a bit		Extremely

2) Annoyed

	1	2	3	4	5	6	7	8	9
Henry (Captain Dunne)	Not at all		A little		Moderately		Quite a bit		Extremely

	1	2	3	4	5	6	7	8	9
John (Silver Line)	Not at all		A little		Moderately		Quite a bit		Extremely

3) Satisfied

	1	2	3	4	5	6	7	8	9
Henry (Captain Dunne)	Not at all		A little		Moderately		Quite a bit		Extremely

	1	2	3	4	5	6	7	8	9
John (Silver Line)	Not at all		A little		Moderately		Quite a bit		Extremely

4) Frustrated

	1	2	3	4	5	6	7	8	9
Henry (Captain Dunne)	Not at all		A little		Moderately		Quite a bit		Extremely

	1	2	3	4	5	6	7	8	9
John (Silver Line)	Not at all		A little		Moderately		Quite a bit		Extremely

5) Pleased

	1	2	3	4	5	6	7	8	9
Henry (Captain Dunne)	Not at all		A little		Moderately		Quite a bit		Extremely
	1	2	3	4	5	6	7	8	9
John (Silver Line)	Not at all		A little		Moderately		Quite a bit		Extremely

6) Miserable

	1	2	3	4	5	6	7	8	9
Henry (Captain Dunne)	Not at all		A little		Moderately		Quite a bit		Extremely
	1	2	3	4	5	6	7	8	9
John (Silver Line)	Not at all		A little		Moderately		Quite a bit		Extremely

7) Content

	1	2	3	4	5	6	7	8	9
Henry (Captain Dunne)	Not at all		A little		Moderately		Quite a bit		Extremely
	1	2	3	4	5	6	7	8	9
John (Silver Line)	Not at all		A little		Moderately		Quite a bit		Extremely

8) Disappointed

	1	2	3	4	5	6	7	8	9
Henry (Captain Dunne)	Not at all		A little		Moderately		Quite a bit		Extremely

	1	2	3	4	5	6	7	8	9
John (Silver Line)	Not at all		A little		Moderately		Quite a bit		Extremely

9) Proud

	1	2	3	4	5	6	7	8	9
Henry (Captain Dunne)	Not at all		A little		Moderately		Quite a bit		Extremely

	1	2	3	4	5	6	7	8	9
John (Silver Line)	Not at all		A little		Moderately		Quite a bit		Extremely

10) Regretful

	1	2	3	4	5	6	7	8	9
Henry (Captain Dunne)	Not at all		A little		Moderately		Quite a bit		Extremely

	1	2	3	4	5	6	7	8	9
John (Silver Line)	Not at all		A little		Moderately		Quite a bit		Extremely

11) Elated

	1	2	3	4	5	6	7	8	9
Henry (Captain Dunne)	Not at all		A little		Moderately		Quite a bit		Extremely

	1	2	3	4	5	6	7	8	9
John (Silver Line)	Not at all		A little		Moderately		Quite a bit		Extremely

12) Discouraged

	1	2	3	4	5	6	7	8	9
Henry (Captain Dunne)	Not at all		A little		Moderately		Quite a bit		Extremely

	1	2	3	4	5	6	7	8	9
John (Silver Line)	Not at all		A little		Moderately		Quite a bit		Extremely

3. How likely do you think that after the race, Henry and John will be thinking how things could have been **DIFFERENT**? Please indicate by circling a number from 1-9 on each of the scales provided below:

Henry (who bet on *Captain Dunne*) ____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

John (who bet on *Silver Line*) ____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

4. How likely do you think that after the race, Henry and John will be thinking how things could have been **BETTER**? Please indicate by circling a number from 1-9 on each of the scales provided below:

Henry (who bet on *Captain Dunne*) ____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

John (who bet on *Silver Line*) ____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

5. How likely do you think that after the race, Henry and John will be thinking how things could have been **WORSE**? Please indicate by circling a number from 1-9 on each of the scales provided below:

Henry (who bet on *Captain Dunne*) ____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

John (who bet on *Silver Line*) ____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

6. How likely do you think Henry's and John's horses would have won the race if the accident had not happened 100 metres from the finishing line? Please indicate by circling a number from 1-9 on each of the scales provided below:

Henry's horse *Captain Dunne* ____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

John's horse *Silver Line* ____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

7. How likely do you think it would be that Henry's and John's horses would win a second race run one week later against the same opponents (not including the injured horse that caused the accident who has been disqualified)? Please indicate by circling a number from 1-9 on each of the scales provided below:

Henry's horse *Captain Dunne* ____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

John's horse *Silver Line* ____

1	2	3	4	5	6	7	8	9
Extremely unlikely		Quite unlikely		Neither likely or unlikely		Quite likely		Extremely likely

8. How lucky or unlucky do you think Henry and John were? Please indicate by circling a number from 1-9 on each of the scales provided below:

Henry (who bet on *Captain Dunne*) ____

1	2	3	4	5	6	7	8	9
Extremely unlucky		Quite unlucky		Neither lucky or unlucky		Quite lucky		Extremely lucky

John (who bet on *Silver Line*) ____

1	2	3	4	5	6	7	8	9
Extremely unlucky		Quite unlucky		Neither lucky or unlucky		Quite lucky		Extremely lucky

9. What do you think of the performance of Henry's and John's horses? Please indicate by circling a number from 1-9 on each of the scales provided below:

Henry's horse *Captain Dunne* ____

1	2	3	4	5	6	7	8	9
Extremely bad		Bad		Neither good nor bad		Good		Extremely good

John's horse *Silver Line* ____

1	2	3	4	5	6	7	8	9
Extremely bad		Bad		Neither good nor bad		Good		Extremely good

10. How close or far away do you think Henry's and John's horses were from winning the race? Please indicate by circling a number from 1-9 on each of the scales provided below:

Henry's horse *Captain Dunne* ____

1	2	3	4	5	6	7	8	9
Extremely far away		Quite far away		Neither far or close		Quite close		Extremely close

John's horse *Silver Line* ____

1	2	3	4	5	6	7	8	9
Extremely far away		Quite far away		Neither far or close		Quite close		Extremely close

Please tell us more about yourself:

1. Are you male or female? ____
 - C) Male
 - D) Female
2. What is your age?
 - A) 17 or below
 - B) 18-21
 - C) 22-25
 - D) 26-30
 - E) 31-40
 - F) 41-50
 - G) 51-60
 - H) 61 or over
3. What is your first language? _____

Please tell us how you think of our study:

1. Was the content of the story easy to understand?
(Yes/No)
2. Were the instructions clear and easy to follow?
(Yes/No)
3. Were the questions clear and easy to understand?
(Yes/No)
4. Any more comment (optional)?

End of the Questionnaire

Debriefing Sheet for Participants

Thanks for your contribution to the study!

As stated in the information sheet, the current research explores how people react to successes and failures in daily life. To be more specific, the experiment was designed to investigate how people react to close outcomes (e.g. almost won, nearly fail). It was suggested by the earlier research that the outcome closeness would induce people to think about the alternatives to the reality. For example, a student who failed an important exam merely by 1 point may ruminate on how he or she could have passed. The outcome closeness could also induce people to make high probability judgments regarding the outcomes that didn't happen. For example, failing the exam by 1 point could make people feel that passing the exam was once highly probable. Some previous research has demonstrated that simulating a once probable but unrealized outcome could exert profound impacts on people's emotional reactions, self-evaluations and future expectations.

The current experiment explores: firstly, what factors influence people's perception that something almost happened as well as their probability judgment regarding the unrealized outcome. You were presented with a story involving two gamblers in a horse racing event. Both of them saw their horse stumbled before the finishing line and fail to win by the same amount of the distance. However, one of them (Henry) saw his horse keep a constant distance behind the leading horse all the way from the beginning of the race while the other person (John) saw his horse started the race weak but then catch up rapidly. The previous research suggested that people's perception of "almost" and probability judgment regarding the unrealized outcome could be derived from people's perceived propensity towards a focal outcome. In our story, although the two horses stumbled with the same distance from the leading horse and then both finished the game in the second place, we posit that John's horse displayed a stronger propensity towards winning compared to Henry's horse in the sense that John's horse was gaining on the leading horse at a higher rate. So we predict that people would perceive John's horse had the higher chance of winning than Henry's horse. We also predict that people would judge John to be more likely to think about the alternatives to the reality after the race (thoughts like "I almost won" or "I could have won") than Henry.

The second question of concern is that how those imaginations about the alternative outcomes as well as probability judgments would influence people's emotional reactions. In our experiment, some of you were informed that there was going to be two races and the gamblers could have won their money if their horse had won either of the two races. The other participants were told that there was going to be only one race. We predict that in the former circumstance, where people feel that they still of chance to win, thinking about what could have happen could lift one's future expectations of winning and thus makes one feel better. On the other hand, in the latter circumstance, when chance of winning has been closed, thinking about what could have happen would mainly make people feel worse because people would make comparison between the reality and possible worlds.

Appendix F Experimental Materials for Experiment 6

Information Sheet for Participants

TITLE OF PROJECT: Understanding People's perception of closeness

This experiment is conducted by a research postgraduate in the Department of Psychology as part of the requirements for the doctoral degree.

Experimenter: Qiyuan Zhang
Supervisor: Dr Judith Covey

The participants are asked to read all of the following information

- This experiment is designed to investigate gambling behaviours.
- You will be given some credits at the beginning of the experiment (which can later be traded for real money) and use those credits to bet in a number of trials of a computer-simulated coin-flipping game. You are also going to answer some questions after each trial.
- Please be advised that your participation in the experiment is absolutely voluntary and you are free to withdraw at anytime without having to give a reason for withdrawing or affecting your position in the University.
- If you withdraw before completing the experiment, you will not be able to trade your credits for money but still entitled to receive the participant time you've worked for or monetary compensation, whichever has been promised by the experimenter.
- All the data collected during the process of the experiment will be treated with full confidentiality and used for academic purpose only.
- If you consent to take part in this study please leave your name and signature on the **CONSENT FORM** overleaf.

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Consent Form

TITLE OF PROJECT: Understanding how people respond to success and failure

This experiment is conducted by a research postgraduate in Department of Psychology as part of the requirements for the doctoral degree.

Experimenter: Qiyuan Zhang
Supervisor: Dr Judith Covey

The participants are asked to answer all of the questions below independently and sign where appropriate.

- Have you fully read the information sheet for participants? (Yes / No)
- Have you had an opportunity to ask questions and to discuss about the study? (Yes / No)
- Have you received enough information about the study? (Yes / No)
- Do you consent to participate in the study? (Yes / No)
- Do you understand that you are free to withdraw from the study at any time without having to give a reason for withdrawing or affecting your position in the University? (Yes / No)

SignedDate.....

NAME IN BLOCK LETTERS.....

Signature of witness.....Date.....

NAME IN BLOCK LETTERS.....

Filler Question Pool

1. To what extent do you agree with the following statement: "I should change the current strategy for pressing buttons." Please indicate by pressing a number from 1-9 (1=extremely disagree, 9=extremely agree).
2. To what extent do you agree with the following statement: "I should stick to the current strategy for pressing buttons." Please indicate by pressing a number from 1-9 (1=extremely disagree, 9=extremely agree).
3. To what extent do you agree with the following statement: "I've been very lucky so far." Please indicate by pressing a number from 1-9 (1=extremely disagree, 9=extremely agree).
4. To what extent do you agree with the following statement: "I've been very unlucky so far." Please indicate by pressing a number from 1-9 (1=extremely disagree, 9=extremely agree).
5. To what extent do you agree with the following statement: "I've seen more heads than tails so far." Please indicate by pressing a number from 1-9 (1=extremely disagree, 9=extremely agree).
6. To what extent do you agree with the following statement: "I've seen more tails than heads so far." Please indicate by pressing a number from 1-9 (1=extremely disagree, 9=extremely agree).

Debriefing Sheet for Participants

Thanks for your contribution to the study!

This experiment investigates how the temporal order of incidents would affect people's retrospective probability judgment about the past (e.g. Could I have won?) as well as the expectations for the future (e.g. Can I win next time?).

The participants were randomly assigned to two experimental conditions. In *sequential* condition, participants press the space key once and all three coins start flipping. Then participants press the space key for another 3 times to stop the coins flipping one by one. In contrast, in *simultaneous* condition, participants press the space key 3 times to flip the coins one by one and then press "space" for a fourth time to stop the 3 coins flipping all at once.

In sequential condition, we predict that participants' estimation on counterfactual probability (Could I have won that trial?) will be affected by the order with which the outcomes of the flipping of the 3 coins are revealed. That is, if the revelations of the outcomes imply a progression towards winning (e.g. Head, Head, Tail; Tail Tail Head), one's perception that "I could have won" and "I will win next time" will be inflated, in comparison with the situation when the revelations of the outcomes of the three coins doesn't imply such trend (e.g. Head, Tail, Head or Head, Tail, Tail), even though participants are always one coin away from winning in both cases.

This effect however, should be minimized in *simultaneous* condition because the outcomes of the flipping were revealed at the same time and thus the order effect should not be potent.