

Functions of Speculative Thinking

By

Yibo Xie

A thesis submitted to

The University of Birmingham

For the degree of

DOCTOR OF PHILOSOPHY

School of Psychology

The University of Birmingham

December 2019

UNIVERSITY OF
BIRMINGHAM

University of Birmingham Research Archive

e-theses repository

This unpublished thesis/dissertation is copyright of the author and/or third parties. The intellectual property rights of the author or third parties in respect of this work are as defined by The Copyright Designs and Patents Act 1988 or as modified by any successor legislation.

Any use made of information contained in this thesis/dissertation must be in accordance with that legislation and must be properly acknowledged. Further distribution or reproduction in any format is prohibited without the permission of the copyright holder.

Abstract

Speculative thinking is the thinking about things that are not currently real, which includes counterfactual thinking, prefactual thinking, and some other kinds of thinking. Through four experimental chapters (10 experiments), I explored the functions of speculative thinking from a general perspective.

Experiment 1 showed that learning that a protagonist had engaged in counterfactual thinking (compared to no counterfactual thinking) resulted in participants inferring that the past event was closer in time to the protagonist. Experiment 2 demonstrated that participants were not affected by the number of counterfactual statements they read when inferring temporal closeness. Experiment 3 demonstrated that participants who learned that a protagonist had engaged in counterfactual thinking (compared to no counterfactual thinking) were more likely to infer that the protagonist experienced the controllable event. Experiment 4 indicated that participants who learned that a protagonist had engaged in counterfactual thinking (compared to no counterfactual thinking) were more likely to infer that the protagonist experienced the exceptional event. Experiment 5 showed that construal level of describing far psychological distance activities were higher than that of describing close psychological distance activities, and construal level of describing past activities were higher than that of describing future activities. Experiment 6 demonstrated that participants doing Realistic Prefactual Thinking elicited more controllable modifications than participants doing Hypothetical Prefactual Thinking. Experiment 7 indicated that, participants doing Hypothetical Prefactual Thinking focused on more controllable modifications than participants doing Counterfactual Thinking. Experiment 8 showed that thinking about closeness did not lead to more controllable modifications than thinking about distance. Experiment 9 showed that participants were more likely to say that a protagonist experiencing a controllable event would lie than protagonist experiencing an uncontrollable

event. Experiment 10 showed that participants expected protagonists to lie about controllable events rather than uncontrollable events.

To conclude, this thesis not only explored the traditional function of improving future performance that speculative thinking serves (i.e., the preparatory function), but also studied the functions that have not been widely discussed (i.e., the function to convey information through others' counterfactuals, and the function of generating lies), also explored the different functions between speculative thinking of the past and future.

Acknowledgements

On the beautiful campus of the University of Birmingham, I've spent several years of my life on completing my thesis and my studies. Recalling the journey I have been through, my gratitude cannot help but arise.

I am very grateful to my supervisor, Dr. Sarah Beck. The successful completion of the thesis would not have been possible without the excellent guidance from Sarah. From the topic selection, thesis writing, to the finalization of the final thesis, Sarah has devoted a lot of effort. In the past few years, Sarah has taught me systematic training of scientific research, profound knowledge, keen academic insight, and spirit of unremitting exploration. These have become the precious assets in my life.

Thank my friends in our lab: Clare Whalley, Catherine Darnell, Damien Needle, Elisa Bandini, Eva Reindl, Leila Iliffe-Hodgetts, Sonia Rishi, for support and encouragement. The friendship between us has provided a good inspiration for my thesis, and I sincerely thank you for your concern and help in my life.

Finally, I want to thank my parents, thank you for your patience and love for me over the years. Your support behind me is the driving force for me, giving me happiness and sweetness, and teaching me how to take responsibility for the family. Here, I wish you good health and happy moods!

Contents

Chapter 1	12
Introduction.....	12
1.1. Speculative thinking.....	13
1.1.1. Speculative Thinking about the Past and Future.....	13
1.1.2. The Relationship between Thinking about the Past and Future.....	14
1.2. Counterfactual Thinking.....	18
1.2.1. The Classification of Counterfactual Thinking.....	18
1.2.2. Function of Counterfactual Thinking.....	19
1.2.3. Functional Theory of Counterfactual Thinking	20
1.2.4. Determinants of Counterfactual Thinking	24
1.2.5. Understanding Counterfactual Statements.....	25
1.3. This Thesis.....	27
Chapter 2.....	30
The Bidirectional Relation between Counterfactual Thinking and Closeness, Controllability, and Exceptionality	30
2.1. Abstract.....	31
2.2. Introduction	32
2.3. Experiment 1: Closeness	39
2.3.1. Method.....	39

2.3.2. Results & Discussions.....	41
2.4. Experiment 2: Closeness Follow-up.....	44
2.4.1. Method.....	45
2.4.2. Results & Discussions.....	46
2.5. Experiment 3: Controllability.....	48
2.5.1. Method.....	49
2.5.2. Results & Discussions.....	51
2.6. Experiment 4: Exceptionality.....	52
2.6.1. Method.....	52
2.6.2. Results & Discussions.....	54
2.7. Discussions of Experiments 1, 2, 3, and 4.....	55
2.7.1. Conclusion.....	57
Chapter 3.....	59
Both Temporal Distance and Temporal Asymmetry Lead to Different Construal Levels.....	59
3.1. Abstract.....	60
3.2. Introduction.....	60
3.3. Method.....	67
3.3.1. Participants.....	67
3.3.2. Design.....	68
3.3.3. Materials.....	68
3.3.4. Procedure.....	69

3.4. Results	70
3.4.1. Open-Ended Questionnaire	70
3.4.2. Forced-Choice Questionnaire	72
3.5. Discussions of Experiment 5	73
3.5.1. The Functional Asymmetry between Thinking about the Past and Future	76
3.5.2. Conclusion	77
Chapter 4.....	79
The Function of Speculative Thinking: Comparisons of Temporal and Reality Dimensions .	79
4.1. Abstract.....	80
4.2. Introduction	80
4.3. Experiment 6	86
4.3.1. Method	86
4.3.2. Results & Discussions.....	88
4.4. Experiment 7	93
4.4.1. Method	93
4.4.2. Results & Discussions.....	94
4.5. Experiment 8	96
4.5.1 Method	97
4.5.2. Results & Discussions.....	97
4.6. Discussions of Experiments 6, 7, and 8.....	99
4.6.1. The Function of Speculative Thinking: A Broad Functional Theory.....	100

4.6.2. Conclusion	102
Chapter 5	103
Difference in Inferring Controllability between Counterfactual Thinking and Lying.....	103
5.1. Abstract	104
5.2. Introduction.....	104
5.3. Experiment 9: Inferring Controllability in Counterfactual Thinking and Lying Questions	112
5.3.1. Method.....	112
5.3.2. Results.....	114
5.4. Experiment 10: Controllability Focus in Counterfactual Thinking and Lying Questions	116
5.4.1. Method.....	117
5.4.2. Results.....	119
5.5. Discussions of Experiments 9 and 10.....	120
5.5.1. Conclusion	125
Chapter 6.....	126
General Discussion	126
6.1. Summary	127
6.2. Non-Preparatory Functions of Counterfactual Thinking.....	128
6.2.1. Function of Conveying Information	129
6.2.2 Revisiting the Function of Counterfactual Thinking Supporting Lying.....	130
6.3. Asymmetries in Functions of Speculative Thinking	131

6.3.1. Temporal Asymmetry in Construal Level of Speculative Thinking	131
6.3.2. Reality/Hypothetical difference in Speculative Thinking.....	134
6.4. Preparatory Function	135
6.4.1. Content Specific Pathway	135
6.4.2. Content Neutral Pathway	137
6.4.3. Another Possibility: Counterfactuals Do Not Have Preparatory Function	137
6.5. Limitations and Future Research.....	139
6.5.1. Participants Population	139
6.5.2. Linguistic and Cultural Differences.....	140
6.5.3. Application to Real Behavioral Changes	141
6.6. Conclusion.....	142
Appendices.....	143
Appendix A: Stories Used in Experiment 1	143
Appendix B: Stories Used in Experiment 2	146
Appendix C: Stories Used in Experiment 3	148
Appendix D: Stories Used in Experiment 4.....	149
Appendix E: Open-Ended and Forced-Choice Questionnaires Used in Experiment 5	150
Appendix F: Scrambled Word Task and Questionnaire Used in Experiment 6	155
Appendix G: Questionnaire Used in Experiment 7	163
Appendix H: Questionnaire Used in Experiment 8	166
Appendix I: Questionnaire Used in Experiment 9	169

Appendix I: Questionnaire Used in Experiment 10	170
References.....	171

List of Tables

Table 1. (*Experiment 1*) Number of participants inferring that the counterfactual version or reality version was closer in time. 43

Table 2. (*Experiment 2*) Number of participants inferring that the event was close or distant in time. 48

Table 3. (*Experiment 3*) Number of participants inferring that the event was controllable. 52

Table 4. (*Experiment 4*) Number of participants inferring that the event was exceptional. 55

Table 5. (*Experiment 5*) Condition means (averaged over participants) and standard errors of those means in the open ended questionnaire. 72

Table 6. (*Experiment 5*) Mean scores in the forced-choice questionnaire. 73

Table 7. (*Experiments 6, 7, and 8*) Total number of modifications in three experiments. 91

Table 8. (*Experiments 6, 7, and 8*) Total number of first modifications in three experiments. 92

Table 9. (*Experiment 9*) Number of participants choosing the protagonist who experienced controllable and uncontrollable events in two questions. 116

Table 10. (*Experiment 10*) Number of participants choosing the controllable or uncontrollable event in two conditions. 120

Chapter 1

Introduction

1.1. Speculative thinking

1.1.1. Speculative Thinking about the Past and Future

In our daily life, we often think how things would have been different in the past, and how things would or will be different in the future. For example, you rush to the train station, but found that your train left 5 minutes ago. You may think about how things would have been different in the past, like “if I was not delayed by the traffic jam, I could have arrived at the train station on time”; or you may think about how things would or will be different in the future, like “if next time I leave home earlier, I would arrive at the train station on time”.

Imagining how things would have been different in the past is called *Counterfactual Thinking* (e.g. Beck, & Riggs, 2014; Byrne, 2002; Kahneman & Tversky, 1981; Roese, 1997).

Kahneman and Tversky (1981) first proposed the concept of counterfactual thinking in a paper discussing heuristic simulation. They suggested that, heuristic simulation could be thought of as a conscious reactivation of past behaviours that had been stored in memory.

Imagining how things would or will differ in the future is called *Prefactual Thinking* (e.g. Epstude, Scholl, & Roese, 2016; Schacter, Addis, & Buckner, 2007). Both counterfactual and prefactual thinking are two types of general speculative thinking: by which I mean thoughts about things that are not currently real.

The purpose of this thesis is to explore the functions of speculative thinking of past and future. Through four experimental chapters, I will explore the functions of speculative thinking from a general perspective. Specifically, these experimental chapters not only explore the traditional function that speculative thinking serves (i.e., improving future performance), but also study the functions that have not been widely discussed (i.e., the function to convey information through others’ counterfactuals, and the function of generating lies), also explore the different functions between speculative thinking of the past and future. In the introductory chapter, firstly I will review the literature on thinking about the

past and future). Then I will focus on reviewing the literature on counterfactual thinking (as speculative thinking about the past).

1.1.2. The Relationship between Thinking about the Past and Future

There are many studies that focus on the relationship between thinking about the past and future, showing a diversity of evidence. The evidences include different areas such as neuropsychology, developmental psychology, and research on aging. These evidences not only demonstrate the connection between thinking about the past and future, but also demonstrate the difference between thinking about the past and future.

From a neuropsychology perspective, research has shown that thinking about the past and future have common cognitive neural basis. Some researchers have demonstrated that patients with damaged hippocampus have difficulty in both the thinking about the past and future, and their thinking about the past and future lack scene details compared to the age-matched control group (Hassabis, Kumaran, Vann, & Maguire, 2007). Many neuroimaging researchers have suggested that a common neural network will be activated when thinking about the past and the future (e.g. Hassabis & Maguire, 2007; Klein, Loftus, & Kihlstrom, 2002; Schacter & Addis, 2002; Viard et al., 2011). For example, through an fMRI experiment, Viard et al. (2011) systematically studied the common neural network basis and the phenomenological differences between thinking about the past and future. Neuroimaging results showed that bilateral parieto-fronto-temporal networks are activated when recalling the past and envisioning the future, which indicates thinking about the past and future are based on the same brain activation areas. The main activated brain regions include: posterior cingulate cortex, anterior cranial lobes, and medial prefrontal cortex, which are mainly involve the process of recalling the past and anticipating the future. The central and top frontal gyrus are also activated, which can control the retrieval of semantic information and recall the spatiotemporal environment of situational information. Also, the hippocampus is

activated to combine different details to construct a coherent scene about past or future events (e.g. Botzung, Denkova, & Manning, 2008; Hassabis, Kumaran, & Maguire, 2007; Northoff & Bermpohl, 2004; Raposo, Han, & Dobbins, 2009). Berryhill, Picasso, Arnold, Drowos, and Olson (2010) explored the relationship between two brain regions (i.e. posterior parietal cortex and prefrontal cortex) and the ability of thinking about the past and future. Participants who have unilateral prefrontal lesions or bilateral posterior parietal lesions were asked to describe past and future events. The results showed that participants who suffered damage in these two brain regions were both impaired in their ability to recall the past and imagine the future. This suggests that these two brain regions are activated both when thinking about the past and future.

Also, some researchers suggested that the aging effects on the quality of thinking about the past and future seem to be the same – older people produce fewer details than young people when both recalling the past and anticipating the future (e.g. Addis, Wong, & Schacter, 2008). Specifically, Addis et al. (2008) interviewed young and elderly participants. All participants in the interview need to recall some events that happened in the past (i.e. past few weeks and past few years), and imagine some events that may happen in the future (i.e. next few weeks and next few years). Participants were asked to give as many details as possible when describing these events. Researchers then counted the total number of details of the events described by participants. Results showed that elderly participants gave fewer details on both past and future events than young participants.

In addition, thinking about the past and future are also related in child development. Busby and Suddendorf (2010) suggested that thinking about the past and future developed together in child development. The researchers explored the ability of children to describe past and future events. In one study, children needed to read stories that describe a character who obtained an item “yesterday” and a character who will obtain an item “tomorrow”.

Children were asked to determine which character now has the item. For four-year-olds, results showed that the correct rates of answering past or future stories were not significantly different, and neither were different to chance. For five-year-olds, the correct rates of answering to past or future stories were also similar, which are both higher than that of four-year-olds. Researchers suggested that thinking about the past and future are developing together. Suddendorf (2010) explored the relationship that exists in children's development between remembering the past and planning the future. In the study, children participants aged 3 and 4 were asked to report what they did yesterday (i.e. "tell me something that you did yesterday?"), and what they will do tomorrow (i.e. "tell me something that you are going to do tomorrow?"). By checking with children's parents about what children did and will do, the researchers found that four-year-old participants (compared to three-year-old participants) reported more correct answers for both past and future events. The results also showed that there is a correlation between the number of past and future events reported by participants. This demonstrates that thinking about the future and thinking about the past are both developing with age. Naito and Suzuki (2011) also suggested that there is a developmental relationship between thinking about the past and future, suggesting thinking about the future is developed from thinking about the past.

Despite the similarity between the thinking about the past and future, there are differences between the two – the past events are real experiences, while the future events are based on predictions or judgments. Anderson and Dewhurst (2009) found that past events contain more perceptual details than future events. Specifically, adults participants needed to imagine future events or recall past events. Participants in the past group completed the sentence "Last year I...", and participants in the future group completed the sentence "Next year I ...". Results showed that participants in the future group generated more general events (e.g. "Next year I will have the best summer"), while participants in the past group generated

more specific events (“Last year I took my driving test”). Researchers suggested that these results reflect that when individuals think about the past, they can more access to direct experiences based on events. Therefore, thinking about the past (compared to thinking about the future) will have clearer representations of temporal and spatial information, and more coherent storylines.

Furthermore, the difference between thinking about the past and future is also reflected in the tendency that people are more inclined to imagine future events (compared to recalling past events) as positive events, suggesting there is an optimistic bias in thinking about the future (e.g. D’Argembeau & Van der Linden, 2006; Taylor & Brown, 1988). For example, D’Argembeau and Van der Linden (2006) explored individual differences in evaluating the valence of past and future events. Researchers asked participants to remember some past events (e.g., yesterday, a week ago, a month ago, etc.), or imagine some future events (e.g., tomorrow, in a week, in one month, etc.). Participants needed to write a short description for each event, and then evaluated the valence on a seven-point scale for each event (“When/if this event happened, my emotions were/would be: -3 = very negative, 0 = neutral, $+3$ = very positive”). Results showed that participants tended to think that future events are more positive than past events.

There are also neuroimaging studies that explored the differences between thinking about the past and future. For example, Addis, Wong, and Schacter (2007) explored the activation of brain regions when people think about the past and future. Specifically, the researchers asked participants to imagine an event that occurred in a specific time period (a week, a year, 5-20 years) in the past or in the future. The results showed that the left hippocampus and posterior visuospatial regions often are both engaged in past and future event thinking. However, thinking about the future also leads to activation of the right hippocampus. Also, some researchers suggested that thinking about the future (compared to

thinking about the past) has a higher activation level in the posterior parietal cortex that plays a role in the attention process. Therefore, this indicates that thinking about the future requires more attention resources than thinking about the past (e.g. Cabeza, 2008; Ciaramelli, Grady, & Moscovitch, 2008).

In section 1.1 I reviewed literature on comparing thinking about the past and future, and literature on general speculative thinking about the past and future. Among speculative thinking, counterfactual thinking and prefactual thinking are two typical kinds of speculative thinking, and there are also other types of speculative thinking. In general, speculative thinking refers to thoughts about things that are not currently real.

1.2. Counterfactual Thinking

Research on counterfactual thinking is the main research area of speculative thinking, and there is relatively less research on other kinds of speculative thinking (e.g. prefactual thinking). Discussing the research and theories of counterfactual thinking can provide theoretical background for the exploration of general speculative thinking in later chapters. Therefore, in the following literature review, I will focus on counterfactual thinking (as a specific kind of speculative thinking of the past), discussing some research and theories of counterfactual thinking.

1.2.1. The Classification of Counterfactual Thinking

Roese and Olson (1993) suggested that counterfactual thinking includes three types: additive counterfactual thinking, the subtractive counterfactual thinking, and the substitutive counterfactual thinking. Among them, additive counterfactual thinking refers to counterfactual thinking that adds some imaginary antecedents, subtractive counterfactual thinking refers to counterfactual thinking that takes out some imaginary antecedents, and substitutive counterfactual thinking refers to counterfactual thinking that replaces the original antecedents with alternative imaginary antecedents and reconstructs the event in mind. For

example, a student could think counterfactually that “if I had come to the review class, I could have passed the exam this time”, which is an additive counterfactual statement because “come to the review class” did not actually happen. The counterfactual sentence “if we did not have a drink, we would have caught the train” is a subtractive counterfactual sentence. Also, the counterfactual sentence “if I studied instead of playing video game, I would have passed this exam” is a substitutive counterfactual sentence. Markman, Gavanski, Sherman, and McMullen (1993) classified counterfactual thinking into upward and downward counterfactual thinking. Upward counterfactual thinking focuses on how past outcomes could have been better. For example, athletes can generate upward counterfactual thoughts like “If we did more practice, we could have won the match”. Downward counterfactual thinking focuses on how past outcomes could have been worse. For example, athletes can also generate downward counterfactual thoughts like “We would have lost the game if we did not practice”.

1.2.2. Function of Counterfactual Thinking

According to the research on functions of counterfactual thinking, the functions include the preparatory function and non-preparatory function (Byrne, 2016; Roese & Epstude, 2008). Many studies had focused on the preparatory function of counterfactual thinking, such as the functional theory (Roese & Epstude, 2008) (I will discuss the functional theory in detail in the section 1.2.3.). For the non-preparatory functions, many studies had focused on the emotional function of counterfactual thinking. For example, upward counterfactual thinking can lead to negative emotions, while downward counterfactual thinking can lead to positive emotions (Roese, 1997). For the same event, different counterfactual thinking can lead to different emotions. Niedenthal, Tangney, and Gavanski (1994) found that thinking counterfactually about personality would be likely to lead to shame, and thinking counterfactually about actual behaviors would be likely to lead to guilt.

However, previous research had overlooked other non-preparatory functions of counterfactual thinking. Therefore in this thesis I will discuss some non-preparatory functions of speculative thinking that have not been widely discussed, which are the function of conveying information, and the function of supporting lying.

1.2.3. Functional Theory of Counterfactual Thinking

The functional theory of counterfactual thinking was proposed by Epstude and Roese (2008). This theory focused on how counterfactual thinking affects subsequent behaviours. The functional theory suggests that when people fail to achieve one goal, they will try harder to achieve this goal in future. According to the functional theory (Epstude & Roese, 2008), this function of counterfactual thinking to change future behaviours is the preparatory function. Specifically, although counterfactual thinking is about events that have happened in the past, it has the function to prepare for future events. Epstude & Roese (2008) proposed that counterfactuals affect future behaviors through the content-specific pathway and the content-neutral pathway (n.b. I return to the two pathways proposed in the functional theory in the later paragraphs). People who think counterfactually can usually infer the antecedents of the outcome, resulting in an intention to change, and finally a change in behavior.

Some researchers suggested that counterfactual thinking can lead to behavioral regulation because of comparison. For example, Medvec, Madey and Gilovich (1995) explored the emotional reactions of the silver and bronze medal winners of the 1992 Summer Olympics. They found that the bronze medal winners were happier than the silver medal winners, because the bronze medal winners compared themselves with the players who did not win any medals. The feelings of bronze medal winners focused on how things could have been worse (i.e. "I would have not won any medal if I focused less"), which is downward counterfactual thinking. However, the silver medal winners compared themselves with the

gold medal winners. The feeling of silver medal winner focused on that how things could have been better (i.e. “I could have won the gold medal if I took different strategies”), which is upward counterfactual thinking.

1.2.3.1. Content-Specific Pathway

According to the functional theory, people use a content specific pathway to generate specific behavioural intentions from their counterfactual thoughts. These intentions can then affect subsequent behaviours. For example, if a person gets wet in the rain, then this person might think counterfactually that “I could have avoided this if I remembered to bring an umbrella”, and in future she/he will bring an umbrella to avoid getting wet. The content specific pathway suggests that, in counterfactual thoughts, specific information related to the situation can lead to subsequent behavioural intentions, which can lead to changes in future behaviours.

Smallman and Roese (2009) used a sequential priming paradigm to study how counterfactual thoughts affect behavioural intention. Specifically, participants read a negative event (e.g., milk spilled on the floor). Then in the counterfactual trial, participants read a counterfactual statement on screen (e.g., “I could have been more careful”); while in the control trial, participants needed to evaluate whether this negative event happens frequently in their life. After that, all participants needed to make a behavioural intention judgement by indicating “yes” or “no”. For example, participants saw a behavioural intention like “in future I will be more careful” on screen and indicated “yes” or “no”. Participants reading counterfactual statements showed shorter reaction time for the behavioural intention judgment, compared to participants who did not read counterfactual statements. This result suggests that the participants who read counterfactual statements found it easier to generate behaviour intention than the participants who did not read counterfactual statements.

Combining research on the relationship between behavioural motivation and actual

behaviour can help us to better understand how the behavioural motivation generated by counterfactual thinking can lead to actual behaviour change. Webb and Sheeran (2006) conducted a meta-analysis about the relationship between behavioural intentions and actual behaviours, although this study did not explicitly talk about counterfactual thinking. In the meta-analysis of 47 experiments, half of participants were asked to make explicit a behavioural intention about something specific, and other half of participants did not have a behavioural intention. Results of the meta-analysis showed that participants who had a behaviour intention were more likely to conduct subsequent behaviours than participants who did not have a behaviour intention. Brandstätter, Lengfelder and Gollwitzer (2001) also explored the relationship between behavioural intention and actual behaviours. Researchers chose one group of opiate withdrawal participants (i.e. high cognitive load) and one group of opiate post-withdrawal participants (i.e. low cognitive load). All participants were told that their task was to compose their vitae. Then half of the participants were told to generate a plan that was not related to the main task. The other half of participants generated a plan that was related to the main task. The results showed that even under high cognitive load, participants having specific behavioural intentions related to the task were more likely to do the task (i.e. composing vitae) than participants having no specific behavioural intention.

1.2.3.2. Content Neutral Pathway

Through the content-specific pathway, information in counterfactual thinking only affects subsequent behaviours that are associated with the specific information. Through the content neutral pathway, counterfactual thinking can affect people's motivation and emotion, and thus affect people's behaviours. Kray et al. (2006) demonstrated that counterfactuals that are not related to the task can still lead to better task performance. Researchers assigned participants to either counterfactual or non-counterfactual group. Participants in different groups read some counterfactual and non-counterfactual stories respectively. Then all

participants completed a logical reasoning task that was not related to the stories. Results showed that participants in the counterfactual group performed better in the logical reasoning task than the non-counterfactual group.

Kray and Galinsky (2003) suggested that counterfactual mindset can be effective in promoting group decision making. Participants were assigned to counterfactual or non-counterfactual groups. The counterfactual group read a story about a protagonist who changed her seat number, and a lottery result was her previous seat number (i.e. She could have won the lottery). The non-counterfactual group read a similar story, in which a protagonist did not change her seat number and did not win the lottery. After reading this pilot story that is unrelated to the main task, all participants imagined they were in the decision-making team after the Space Shuttle Challenger disaster, and they needed to seek information to make right decision. Specifically, participants needed to find the relationship between temperature and engine failure of Space Shuttle, and then decide to stop launching the shuttle. Results showed that participants assigned to counterfactual condition were more likely to make right decisions than participants in non-counterfactual thinking condition. Kray, Galinsky, and Wong (2006) suggested that, by identifying and criticizing information that is critical for group decision making, counterfactual mindset can improve the accuracy of group decision-making, and help team cooperation.

By thinking counterfactually about events, people can think about how to avoid a negative outcome. Through this process, self-efficacy, self-control, and overconfidence would change. For example, when a teacher educates a student, the teacher is not only educating, but also experiencing the feeling that the situation is under control. This feeling of control is can be helpful for improving future education of that student. Nasco and Marsh (1999) explored how counterfactual thinking leads to the sense of control, and then leads to better performance. After an exam, participants thought counterfactually about how the exam

outcome could have been different. Then one month later participants recalled their counterfactual thoughts, and they were told that they will take a second exam. Participants were then assessed how much control they have over the next exam. Results showed that participants who did upward counterfactual thinking after the first exam perceived more control over the exam than participants who did downward counterfactual thinking. This perception of control was in turn positively correlated with subsequent performance in the second exam. In general, functional theory takes into account the factors like mentality, motivation, etc., and emphasizes the role of counterfactual thinking in regulating behaviours.

1.2.4. Determinants of Counterfactual Thinking

Early research on counterfactual thinking focused on what determinants can lead to counterfactual thinking (e.g. Kahneman & Miller, 1986). For example, Kahneman and Tversky (1981) found that an exceptional outcome that people did not expect to happen is more likely to lead people to think counterfactually than normal outcome that is in line with people's expectations. In one experiment, researchers asked participants to read both an exceptional or unexceptional story, and answer in which story the protagonist was more likely to think counterfactually. The exceptional story was that protagonist chose an exceptional route to home but suffered an accident; the unexceptional story was that protagonist chose a usual route to home but suffered an accident. Results showed that participants suggested the protagonist in the exceptional story was more likely to think counterfactually than the protagonist in the unexceptional story.

Last paragraph discussed the impact of exceptional events on counterfactual thinking. In addition, there were studies focusing on the effect of negative outcome valence on counterfactual thinking. For example, Landman (1987) suggested that negative outcome is more likely to lead to counterfactual thinking than positive outcome, finding participants who suffered negative outcome experienced more regret and had more counterfactual thinking

than participants who had positive outcome. She suggested that this is because negative outcome is more likely to be exceptional outcome than positive outcome. Davis, Lehman, Wortman, Silver, and Thompson (1995) did a long term research to study people who suffered traumatic event of losing their spouse or children. Participants were interviewed after they lost their spouse or children in a traffic accident. Researchers found that negative emotion reported by participants can accurately predict participants' frequency of counterfactual thoughts.

Roese (1997) suggested that the generation of counterfactual thinking can be divided into the activation stage and the content stage. Activation of counterfactual thinking refers to whether a person thinks counterfactually or not when encountering an event, and content of counterfactual thinking refers to the specific idea of people's counterfactual thoughts. For example, when a person was very close to catch a plane, he may think about how things could have been different next time, which is the activation of counterfactual thinking. Furthermore, counterfactual thoughts generated by this person may be "if I went out earlier I could have been able to catch the plane", which is the content of counterfactual thinking. According to Roese (1997), the content of counterfactual thinking can be varied, but it can only be either activated or not in the activation stage. Roese (1997) also suggested that, different counterfactual determinants may affect these two stages differently. In general, outcome valence is the main determinant of counterfactual thinking activation, and exceptionality is the main determinant of counterfactual thinking content.

1.2.5. Understanding Counterfactual Statements

Byrne (2002) suggested that that people follow some principles to understand counterfactuals, due to the limitations of working memory (Johnson-Laird & Byrne, 1991). One principle is that people hold in the mind only the true possibilities when reading counterfactual conditionals. For example, for a counterfactual conditional "if I came home

earlier, I could have been able to get the delivery”, people represent the true possibilities “If I came earlier, then I got the delivery”, and “If I did not come earlier, then I did not get the delivery”. However, people do not hold any false possibilities in mind, such as “If I came home later, then I got the delivery”. Also, when reading counterfactual conditionals, people can understand what is false, but would have been true (Byrne, 1997), which is counterfactual reasoning. For instance, people would store two possibilities for the counterfactual statement that “he could have chosen the usual routes”. One possibility is the presupposed fact that the protagonist did not choose the usual route. The other possibility is that the protagonist chose the usual route, which was possible in the past.

De Vega, Urrutia and Riffo (2007) explored the difference between processing counterfactual and factual information. They asked participants to read a story about one protagonist buying a lottery ticket. The story started with a context about a protagonist hearing lottery information from a radio, followed by either a factual or counterfactual sentence. The counterfactual sentence was “If Mary had won the lottery, she would have bought a Mercedes car”. The factual sentence was “As Mary had won the lottery, the first thing she did was to buy a Mercedes car”. Finally, participants read the outcome of story. The outcome was either about the protagonist tearing up the lottery ticket, or about the protagonist sitting in the car and felt like a queen. Participants’ reading time for the story was measured. The results showed that when the final outcome was about the protagonist tearing up the lottery ticket, participants had shorter reading time for the story with counterfactual sentence than the story with factual sentence. However, when the final outcome was about the protagonist sitting in the car and felt like a queen, participants had shorter reading time for the story with factual sentence than the story with counterfactual sentence. These results suggested that after reading counterfactual statements, both factual and counterfactual information of statements is temporarily available. The counterfactual or factual information

will only disappear when the final outcome occurs.

Ferguson and Jayes (2018) explored the factors that affect people processing counterfactuals. They asked participants to read a counterfactual sentence about a person preparing dinner. The counterfactual sentence was written in either first person or third person perspective. The researchers also controlled the plausibility of the sentences, including the plausible, implausible, and anomalous versions of the counterfactual sentences. This study was a two (self / other perspective) by three (plausible / implausible / anomalous counterfactuals) design. For example, for the “other-anomalous” version, participants read “if Sophie had used a pump, she would have prepared the carrots in time for dinner”; for the “self-plausible” version, participants read “if you had used a knife, you would have prepared the carrots in time for dinner”; while for the “implausible” versions, participants read the protagonist used axe to prepare dinner. Participants’ reading time was measured. Results showed that participants had shorter reading time when reading plausible counterfactual sentence than the implausible and anomalous counterfactual sentences. However, there was no difference in reading time between reading the first person and third person perspectives of counterfactual sentences. This implausibility effect reflects that people have more difficulty processing implausible / anomalous information than plausible information.

1.3. This Thesis

Previous research focuses on the function of counterfactual thinking, but rarely compares the functional differences between counterfactual thinking and prefactual thinking (important exceptions e.g. Ferrante, Girotto, Stragà and Walsh (2013) informed the research in comparing counterfactual and prefactual thinking. See chapter 4 for details). In addition, most functional research only focuses on the narrow sense of counterfactual thinking, and does not pay attention to the difference between the general speculative thinking for the past and future. To bridge this gap, this thesis that includes four empirical chapters to explore the

function of general speculative thinking. On the one hand, this thesis explores the preparatory function for future events. Central to the functional theory (Epstude & Roese, 2008) is that counterfactual thinking has the function of leading to a behavioural intention to change, and finally the change in future behaviour, which is the preparatory function. On the other hand, this thesis also explores other non-preparatory functions of speculative thinking (i.e. conveying information, supporting lies).

Chapter 2 discusses the function of counterfactual thinking that it can convey information from others' counterfactuals. Specifically, this chapter includes four experiments, all of which required participants to make inferences based on reading others' counterfactuals. I explored whether people can infer the closeness, controllability, and exceptionality from others' counterfactuals. In chapter 3, I take a step back from the narrow sense of counterfactual thinking, moving to the perspective of general speculative thinking for the past and future. Specifically, based on the theory related to abstractness in speculative thinking (i.e. construal level theory), I explore how abstract or specific the descriptions are when thinking of and describing past and future events. Chapter 3 compares the differences in the degree of abstraction between speculative thinking about the past and future, which helps to understand temporal asymmetry in speculative thinking. I further discuss how different levels of abstractness when thinking about the past and future may serve the preparatory function. In chapter 4, three experiments explored the different dimensions that general speculative thinking has, and the different preparatory functions that different dimensions in general speculative thinking serve. Specifically, this chapter explores the temporal asymmetry in general speculative thinking. In chapter 5, based on previous research suggesting counterfactual thinking can support lying, I use controllability to explore the relationship between counterfactual thinking and lying.

In the general discussion, I discuss these chapters from the general speculative

thinking perspective. Broadly, this thesis (i.e. chapters 2 and 5) explores whether speculative thinking serves functions beyond the traditional preparatory function (i.e., the function to convey information through others' counterfactuals, and the function of generating lies), and compares the functions of speculative thinking of the past and future (i.e. the chapters 3 and 4). I discuss the application and limitations of traditional functional theory of counterfactual thinking, and suggest that a broader functional theory is needed to cover all speculative thinking of the past and future. In summary, my thesis will add evidence to functions of general speculative thinking, from perspectives of temporal asymmetry, traditional preparatory function, and other functions.

Chapter 2

The Bidirectional Relation between Counterfactual Thinking and Closeness, Controllability, and Exceptionality

This chapter forms the basis for a paper:

Xie and Beck (2019) under revision

Author contributions: Yibo Xie conceived the main ideas of four experiments, collected the data, conducted the data analyses, and wrote the main draft of this chapter. Yibo Xie and Dr. Sarah Beck discussed the results and revised the manuscript together.

2.1. Abstract

Previous counterfactual experiments demonstrated that closeness, controllability, and exceptionality are more likely to lead participants to have counterfactual thoughts than distance, uncontrollability, and normality. In four experiments I explored the inferences people make when they learn that counterfactual thinking has occurred, specifically the relation between counterfactual thinking and closeness, controllability, and exceptionality. Experiment 1 (N=40) showed that knowing that a protagonist had engaged in counterfactual thinking (compared to no counterfactual thinking) resulted in participants inferring that the past event was closer in time to the protagonist, but there was no difference in inferring how close the past event was between knowing that a protagonist made many and single counterfactual(s). Experiment 2 (N = 80) demonstrated that participants were not affected by the number of counterfactual statements they read when inferring temporal closeness. Experiment 3 (N = 49) demonstrated that participants who learned that a protagonist had engaged in counterfactual thinking (compared to no counterfactual thinking) were more likely to infer that the protagonist experienced the controllable event, but participants were not affected by the number of counterfactual statements they read when inferring controllability. Experiment 4 (N = 120) indicated that participants who learned that a protagonist had engaged in counterfactual thinking (compared to no counterfactual thinking) were more likely to infer that the protagonist experienced the exceptional event, while participants were not affected by the number of counterfactual statements they read when inferring exceptionality. I concluded that the existence (but not the number) of counterfactual thoughts can lead people to infer that event is close, exceptional, and controllable, which suggests that the relations between closeness / controllability / exceptionality and counterfactual thinking is bidirectional. These results showed that as well as making inferences based on facts about the real world, people also make inferences about the real

world, based on hypothetical worlds.

2.2. Introduction

Counterfactual thinking is the mental simulation of events that could have occurred in the past but did not (Decety & Ingvar, 1990; Kahneman & Tversky, 1981). To think counterfactually one must ignore events that have occurred, and represent the alternative that might have occurred instead (Roese, 1997). Counterfactual thinking often takes the form of counterfactual conditionals “if ..., then” (Stalnaker, 1999). For example, we might hear the counterfactual conditional that “If you had not bought the blue dress, you would have bought the red one”. Research has mapped out the events that prompt people to engage in counterfactual thinking (e.g. Meyers-Levy & Maheswaran, 1992), but here, I explored the inferences people make after knowing that counterfactual thinking has occurred.

There is already a relatively small literature on what people understand when reading counterfactuals. Researchers have mainly used sentence probe tasks (e.g. De Vega & Urrutia, 2012; De Vega, Urrutia, & Rizzo, 2007) or measured participants’ reading times to explore what people understand when reading counterfactuals (e.g. Ferguson, 2012; Ferguson & Jayes, 2018; Ferguson and Sanford, 2008; Ferguson, Sanford & Leuthold, 2008; Santamaria, Espino & Byrne, 2005). For example, in Ferguson (2012), participants read a story starting with either factual sentence (e.g., “Because Joanne had remembered her umbrella, she had avoided the rain.”) or a counterfactual sentence (e.g., “If Joanne had remembered her umbrella, she would have avoided the rain.”). Participants then read sentences that were consistent or inconsistent with the starting sentence. This experiment had three conditions, which were the factual-consistent, counterfactual-consistent, and counterfactual-inconsistent conditions. For example, in the counterfactual-consistent condition participants read “Joanne’s hair was wet” after reading the counterfactual sentence “If Joanne had remembered her umbrella, she would have avoided the rain”; and in the counterfactual-inconsistent

condition participants read “Joanne’s hair was dry” after reading the counterfactual sentence. Participants’ reading time was measured. Participants had shorter reading time when reading factual-consistent story than the counterfactual-consistent or counterfactual-inconsistent story, and there was no difference in reading time between reading the counterfactual-consistent story and counterfactual-inconsistent story. These results showed that it is more difficult for people to process counterfactual information than factual information, reflecting that readers of counterfactual information need to take into account both counterfactual and factual information.

Santamaría, Espino, & Byrne (2005) primed participants with counterfactual or indicative conditional statements, e.g. “If there had been roses, then there would have been lilies” or “If there were roses, then there were lilies” and recorded how long they took to read subsequent conjunctions e.g. “There were roses and there were lilies”. When participants read the counterfactual conditional they were quicker to read a negative conjunction “There were no roses and there were no lilies” than when they had been primed by an indicative conditional. However, reading times for positive conjunctions “There were roses and there were lilies” were equally fast for both priming conditions. This is interpreted as showing that when people read a counterfactual conditional they hold in mind two possibilities (p and q , & not p and not q). In contrast, on reading an indicative conditional, people tend to represent only one possibility (p and q). When people read counterfactuals, they hold additional information in mind compared to when they read indicative statements. A further experiment (Ferguson & Sanford, 2008) showed that people make inferences that are consistent within the counterfactual world they are considering. For example, participants read a counterfactual statement (“If cats were vegetarians...”) followed by a continuation that was either consistent with the counterfactual world (but not reality) e.g. “Families could feed their cat a bowl of carrots...” or that was inconsistent with the counterfactual world (but was consistent with

reality) e.g. “Families could feed their cat a bowl of fish”. The first pass reading times for these sentences showed that people were slower to read information that was inconsistent with their real world knowledge (carrots). However, the inconsistency was quickly ‘neutralised’ and participants were quicker to read the continuations that were consistent with the world they were set in, regardless of their absolute relation to reality.

These experiments (e.g. Ferguson, 2012; Ferguson & Sanford, 2008; Santamaría, Espino, & Byrne, 2005) showed that people represent different alternative possibilities in mind when understanding counterfactual information compared to factual information, and that they generate inferences consistent with the counterfactual world. In this chapter, I went beyond this by looking at whether the inferences that people drawn might be biased. We already know that determinants exist that influence the tendency to engage in counterfactual thinking. Would people’s inferences be influenced in a similar way? Specifically, we know that the tendency to engage in counterfactual thinking is more likely when there are particular determinants: these include *closeness* (e.g. Medvec, Madey, & Gilovich, 1995; Medvec & Savitsky, 1997; Meyers-Levy & Maheswaran, 1992), *controllability* (e.g. Markman, Gavanski, Sherman, & McMullen, 1995; Wrosch & Heckhausen, 2002), and *exceptionality* (e.g. Gavanski & Wells, 1989; Kahneman & Tversky, 1981). This chapter studied how reading counterfactuals can lead to inferences about closeness, controllability, and exceptionality. Previous counterfactual research has widely demonstrated that these three determinants can lead to counterfactual thinking. Therefore, I chose these determinants to explore inferences about determinants based on knowing counterfactuals.

Closeness refers to the gap between the actual outcome of an event and the expected outcome that might have occurred. Closeness can refer to temporal closeness (e.g. missing a flight by just 5 minutes rather than 1 hour), spatial closeness (e.g. being robbed when only 100 meters rather than 2 kilometers from one’s home) and numerical closeness (e.g. holding

ticket number 99 in a lottery when number 100 wins the prize). For example, previous experiments (e.g, Meyers-Levy & Maheswaran, 1992, Roese & Olson, 1996 experiment 3) showed that temporal closeness to the expected outcome was more likely to lead to counterfactual thinking than temporal distance. Meyers-Levy and Maheswaran (1992) asked participants to read a story describing an apartment fire that occurred after three days (i.e. temporal closeness) or six months (i.e. temporal distance) after the owner had forgotten to buy insurance. The results suggested that, compared with the participants who read the story about the fire 6 months later, participants who read the material about the fire 3 days later were more likely to attribute counterfactual thinking to the story protagonist. In other experiments (e.g. Roese & Olson, 1996), a story described a frustrated protagonist who failed to catch a plane by only 5 minutes (i.e. temporal closeness) or 1 hour (i.e. temporal distance). Critically, in the story the airport staff informed the protagonist that the plane had taken off at the scheduled departure time (i.e. 1 hour before) or just 5 minutes before the protagonist arrived the airport, so the two protagonists' efforts to get to the airport on time were the same. The participants were asked to write down their thoughts about this story. Participants were more likely to generate counterfactual thoughts for the protagonist who missed the plane by only five minutes, i.e. was closer to catching it. Roese (1997) argued that the functional nature of counterfactual thinking means that we pay attention to events that almost happened, because these are ones we are likely to benefit from attempting to change in the future. However, it is important to note that Gilbert, Morewedge, Risen, and Wilson (2004) suggested that while the effect of closeness is seen when participants imagine hypothetical scenarios, the impact is not so strong (or does not exist) when people actually experience the events.

As for controllability, many researchers (e.g. Giroto, Legrenzi, & Rizzo, 1991) suggest that people's counterfactual thinking is more likely to focus on controllable rather

than uncontrollable events. For example, Girotto, Legrenzi, and Rizzo (1991) asked participants to generate counterfactual thoughts for one protagonist who was delayed by both controllable events (e.g. having a drink) and uncontrollable events (e.g. road blocked by a flock of sheep), and when the protagonist came home he found his wife just died because of heart attack. Researchers found that participants' counterfactual thoughts mainly focused on the protagonist's controllable action (e.g. "he could have come home earlier and saved his wife if he did not have a drink"). Mandel and Lehman (1996) asked participants to read a story about a protagonist suffering a car accident. Participants then needed to generate counterfactual thoughts for the protagonist. Results showed that participants' counterfactual thoughts mainly focused on the controllable actions that protagonist did (e.g. "he should have chosen another route"). The functional theory of counterfactual thinking (Epstude & Roese, 2008) suggested that counterfactual thinking is helpful for improving future behaviors. Following this vein, the reason why counterfactual thinking focuses on controllable than uncontrollable events is that people can only make efforts to improve controllable events in the future.

Kahneman and Tversky (1981) suggested that people are more likely to think counterfactually about the exceptional events than the unexceptional events, demonstrating that exceptionality leads to counterfactual thinking. Researchers used two versions of stories both about a protagonist who suffered a car accident on the way home. One version of the story was that the protagonist left his office at an exceptional time, and stuck to his usual route. The other version of story was the protagonist left his office at the usual time, but he chose an exceptional route to go home. Participants thought counterfactually about how this protagonist could have been able to avoid this car accident. Results showed that participants' counterfactual thoughts were more likely to focus on the exceptional than normal time or route (e.g. "If only he chose another way..."). Gavanski and Wells (1989) asked participants

to read a story about a student taking an exam. Participants read the story that either had exceptional outcome (i.e., the outstanding student did not pass the exam) or unexceptional outcome (i.e., the outstanding student passed the exam). The story also included some exceptional (e.g. mother was suddenly sick) and unexceptional events (e.g., the student was normally nervous before the exam). Counterfactual thinking generated by participants in the exceptional condition was more likely to focus on the exceptional event than counterfactual thinking generated by participants in the unexceptional condition.

Previous experiments have looked at what prompts counterfactual thinking. However, to our knowledge none have addressed whether knowledge of counterfactual thinking leads to inferring that the event was more likely to be a near miss, controllable, and exceptional. If closeness, controllability, and exceptionality to the expected outcome can lead to counterfactual thinking, the reverse pattern might be also true. This question about what inferences people draw is important, because people not only engage in counterfactual thinking themselves, they also hear other people express counterfactual thoughts and need to interpret them. Interpreting others' counterfactual thoughts allows people to make inferences about the original event. Thus, it is possible that I could influence participants' estimates of the closeness, controllability, and exceptionality by manipulating participants' exposure to counterfactual thinking.

Hence, in four experiments I explored whether knowledge of another's counterfactual thinking leads people to make inferences about closeness, controllability, and exceptionality: the reverse of the established effect that closeness, controllability, and exceptionality lead people to engage in counterfactual thought (or infer that others would engage in counterfactual thought). I tested two possibilities 1) that there may be differences in inferences based on whether characters made statements about counterfactuals or just about reality, 2) whether the extent of the thinking described (multiple versus single

counterfactuals) would affect the likelihood of drawing such an inference. Because there are these two possibilities, I used two experiments to test the two possibilities separately when exploring the first determinant (i.e. closeness) in this chapter, in order to direct the following experiments (i.e. controllability and exceptionality experiments) in this chapter.

Specifically, in Experiment 1, based on previous closeness experiments (i.e. Meyers-Levy & Maheswaran, 1992; Roese & Olson, 1996 experiment 3), I tested the possibility that whether there may be differences in inferences about closeness based on whether characters made statements about counterfactuals or just about reality. Although Experiment 1 did include conditions involving single and multiple counterfactuals, participants themselves did not directly compare single counterfactual with multiple counterfactuals. In Experiment 2, I tested the possibility whether the extent of the thinking described (multiple versus single counterfactuals) would affect the likelihood of drawing inference about closeness. In Experiment 1, participants drew inferences from directly reading and comparing counterfactual and reality statements, but did not draw inferences from directly reading and comparing multiple and single counterfactual statements. Therefore, the difference between reading multiple and single counterfactual statements may be hidden. To test the inferences from directly reading and comparing multiple and single counterfactual statements, in Experiment 2 I made direct contrast between reading multiple and single counterfactual statements. In Experiment 3, based on Girotto, et al. (1991) who demonstrated that controllability can lead people to think counterfactually, I hypothesized that the existence of counterfactual thinking can lead participants to infer that the event was controllable. Also, based on Kahneman and Tversky (1981) demonstrating that exceptional event can lead participant to think counterfactually, in Experiment 4 I hypothesized that the existence of counterfactual thinking lead participants to infer that event was exceptional. Overall, my goal is to explore that whether there is the bidirectional relation between counterfactual thinking

and counterfactual determinants. This goal will be achieved by testing whether participants can infer counterfactual determinants from reading counterfactuals.

2.3. Experiment 1: Closeness

In Experiment 1, I explored the possible bidirectional relation between closeness and counterfactual thinking, by studying whether reading counterfactuals can lead to inferring closeness. Specifically, I tested whether there may be differences in inferring closeness between reading counterfactual and reality statements. I had two hypotheses in Experiment 1. Firstly I hypothesized that knowing a protagonist made statement(s) about counterfactuals will result in participants inferring that the past event was closer in time compared to a protagonist who made statement about reality. Secondly I hypothesized that knowing a protagonist made many counterfactuals will result in participants inferring that the past event was closer in time compared to a protagonist who made single counterfactual.

2.3.1. Method

2.3.1.1. Participants

42 psychology students (36 women, 6 men) from the University of Birmingham in Birmingham in the UK participated in Experiment 1 to gain course credits.

Participants in all experiments reported in this thesis gave consent and all experiments were approved by the STEM Ethics Review Committee of the University of Birmingham. No individual participated in more than one experiment reported in this chapter. Participants across my four experiments were predominantly female (78.8 – 91.3%), reflecting the student cohort from which they were recruited.

2.3.1.2. Design & Materials

There were two conditions in Experiment 1: a many counterfactuals condition who read about a character generating several counterfactual statements about the event, and a single counterfactual condition who read about one generating just one counterfactual statement about the event. Each condition also read a second version of the story with a character who made no counterfactual statement. Instead, this character made a statement that described reality. Each condition read a pair of plane stories (counterfactual and reality) and a pair of fire stories (counterfactual and reality).

The plane story was adapted from Roese & Olson (1996, experiment 3). In the original, airport staff informed the protagonist that the plane had taken off at 1 hour or 5 minutes before the protagonist arrived the airport. I removed this information about timing and added the protagonist's own comment on the events at the end of the story containing either many counterfactuals (many counterfactuals version), a single counterfactual (single counterfactual version), or a reality statement (reality version). The second story about an apartment fire was adapted from Meyers-Levy & Maheswaran (1992, experiment 2). In the original the protagonist's apartment suffered a fire 3 days (or 6 months) after he forgot to send the fire insurance application. This information was removed and I added either many counterfactuals (many counterfactuals version), a single counterfactual (single counterfactual version), or a reality statement (reality version) as a comment from the protagonist at the end of the story. In Experiment 1, I used same reality statement in both many and single counterfactuals conditions. The stories are included in the Appendix A.

Because I did not predict any difference between the stories I fixed their order (plane always first). I also fixed the order in which the versions of the stories were presented such that participants all have many/single version first in plane story and reality version first in fire story. It is worth mentioning that many previous counterfactual thinking experiments have used similar paradigms where participants read two versions of the same story. For

example, Roese and Olson (1996) used two similar stories that the protagonist was informed that the plane had taken off at 1 hour or 5 minutes before, to study how different temporal distances influence counterfactual thinking. Similarly, Kahneman and Tversky (1981) used two stories about a protagonist experiencing an exceptional or unexceptional event before the car accident, to study how exceptionality influences counterfactual thinking.

In summary, the comparison between counterfactual and reality statements was tested in all participants, but half the participants compared many counterfactuals and reality and half compared a single counterfactual and reality.

2.3.1.3. Procedure

The experimenter greeted the participants and asked them to complete the consent form. Participants completed the experiment in a quiet room alone.

After reading the pair of plane story versions (i.e. “many” and “reality”, or “single” and “reality”), participants were asked, “Although you cannot tell for sure from the reading materials, judging from what Michael/John said, who was closer to catching the flight?” Then they were asked “Please give any reasons why you think the protagonist who you chose (i.e. Michael or John) was closer to catching the flight?” Matched questions were used for the fire story, “Although you cannot tell for sure from the reading materials, judging from what Greg/Jack said, who might have been closer to remembering to send in the policy on time (i.e. the time the fire occurred was closer to the time that he forgot to send in the policy)?”, and “Please give any reasons why you think the protagonist who you choose (i.e. Greg or Jack) might have been closer to remembering to send in the policy on time?”.

Participants were thanked and debriefed.

2.3.2. Results & Discussions

Data files for the 10 experiments reported in this thesis are available on the Open

Science Framework website

(https://osf.io/wxhr3/?view_only=a2b14110abb4de6bbafe12bfcae8959). Data for Experiment 1 are summarized in Table 1. First, I made a comparison between the many and single conditions. There was no difference in the pattern of choosing the counterfactual or reality versions of the stories between the many and single conditions: plane story, Fisher's Exact Test (1, N = 42) $p > .999$, Cramer's V = .06; fire story, Fisher's Exact Test (1, N = 42) $p = .697$, Cramer's V = .12.

Second, I explored whether participants were more likely to attribute temporal closeness to the protagonists making counterfactual statements, using binomial tests to compare the responses in each condition. For the plane story participants were more likely to say that Michael (who made counterfactual statements) had missed the plane by a shorter time than John (who made a reality-based statement), many condition: $p = .027$, single condition $p = .007$; for the fire story, participants were more likely to say that Jack (who made counterfactual statements) might have been closer to remember to send in the policy than Greg (who made a reality-based statement), many condition $p = .001$, single condition $p = .027$.

Table 1. Number of participants inferring that the counterfactual version or reality version was closer in time

		Version judged to be close	
		counterfactual	reality
Plane Story	Single	17	4
	Many	16	5
Fire Story	Single	16	5
	Many	18	3

To sum up, in Experiment 1 I found that the existence of counterfactual thoughts (compared to their absence) did lead participants to infer temporal closeness, but there was no difference in the pattern of choosing the counterfactual or reality versions of the stories between the many and single conditions. Therefore I found a difference in inferences about temporal distance based on whether there were (or were not) any counterfactual statements in the story. The results suggest the existence of counterfactual thoughts can lead participants to infer that events are closer than the absence of counterfactual thoughts. However, multiple counterfactuals did not lead participants to infer that events are closer than single counterfactual. These results are plausible because previous experiments did not explore the difference in the number of counterfactuals generated from closeness. Specifically, previous experiments (e.g. Meyers-Levy & Maheswaran, 1992, Roese & Olson, 1996 experiment 3) reported that temporal closeness (compared with temporal distance) was more likely to lead participants to engage in counterfactual thinking, rather than temporal closeness resulting in more counterfactual thoughts (compared to fewer). So in turn, it might be that the existence

of counterfactual statements (compared to their absence) might prime judgements about temporal distance.

The alternative possibility for the lack of a difference between many and single counterfactuals might be that Experiment 1 did not allow participants directly to compare many counterfactuals with single counterfactual. This lack of direct contrast may hide the possible difference between many and single counterfactuals. That is, Experiment 1 only allowed participants to compare counterfactuals (many/single) with a reality statement, but did not make direct contrast between inferences made after reading multiple and single counterfactual statements. Therefore, to minimize the impact of lacking direct contrast on participants' inference, direct comparison between many and single counterfactuals is needed in Experiment 2.

2.4. Experiment 2: Closeness Follow-up

In Experiment 1, I demonstrated that the existence of counterfactual thoughts led participants to infer that events are closer in time. However I did not find a difference in inferring closeness based on reading many and single counterfactuals. As I mention above, one possibility is that the difference between multiple and single counterfactual statements may be hidden because participants did not directly compare multiple counterfactuals with single counterfactual. However, an alternative possibility is that there is no difference in inferring closeness based on reading many and single counterfactuals. It may be because, when someone generates multiple counterfactual thoughts they are simply exploring different counterfactual events, but this does not necessarily indicate that the “degree” of counterfactual thinking is deeper. Take the plane story as an example, the protagonist's counterfactual statements in the many counterfactuals version story involve mental mutation of the departure time (e.g. “I should have left earlier”), the traffic (e.g. “If I thought about the traffic in advance, I would have not been blocked on the road”), and the ticket information

(e.g. “If I booked earlier tickets, then I would have avoided this traffic jam”). On the other hand, the protagonist’s counterfactual statements in the single counterfactual version story only involve mental mutation of the departure time (e.g. “I should have left earlier”), which is only one aspect of the counterfactual events.

Therefore, in Experiment 2 I checked Experiment 1’s results that there was no difference in inferring closeness based on reading many and single counterfactuals, by making direct contrast between multiple and single counterfactual statements. I hypothesized that knowing that a protagonist had generated multiple counterfactuals would result in participants inferring that the past event was closer in time compared to a protagonist who had generated a single counterfactual.

2.4.1. Method

2.4.1.1. Participants

80 psychology students (63 women, 17 men) from the University of Birmingham participated to gain course credits.

2.4.1.2. Design & Materials

All participants completed both the many and single statements conditions. Each participant read *plane* and *fire* counterfactual stories which were same as Experiment 1 (see Appendix B). Each story had a “many counterfactuals” version and a “single counterfactual” version. I counterbalanced the order of the “many counterfactuals” and “single counterfactual” versions, and I fixed the story order of the plane story (always first) and fire story. Therefore, each participant read either “single counterfactual” version of plane story and “many counterfactuals” version of fire story, or “many counterfactuals” version of plane story and “single counterfactual” version of fire story. After reading each story, participant were required to judge when the flight left (or when the fire occurred), and then explain their

reasons. Although participants explained their reason, I have not analysed them and do not report it in this thesis.

2.4.1.3. Procedure

After reading the many or single counterfactuals version of the plane story (depending on their allocated condition), participants were asked “Although you cannot tell for sure from the reading material, judging from Michael’s description, when do you think the plane took off: A. At the scheduled time, an hour before Michael arrived at the airport; B. 5 minutes before Michael arrived at the airport, 55 minutes later than scheduled”. Then participants were asked, “Please give any reasons why you think this is when the flight took off before Michael arrived”.

After reading single or many counterfactuals versions of the fire story (the complementary version to that read for the plane story), participants were asked “Although you cannot tell for sure from the reading material, judging from Greg’s description, when do you think the fire occurred: A.3 days after he forgot to send the policy document; B.6 months after he forgot to send the policy document.” Participants were then asked, “Please give any reasons why you think this is when the fire occurred.”

After each participant completed the questionnaire, the researchers presented a debrief sheet to the participant.

2.4.2. Results & Discussions

Data for Experiment 2 are summarized in Table 2. I compared the number of participants judging that the missed event was close or distant in time, when they read many or single counterfactuals. For the plane story, a Chi Square test (with continuity correction) showed that there was no difference in the likelihood of inferring temporal closeness or distance, depending on whether participants read many or single counterfactuals, $\chi^2 (1, N =$

80) = .22, $p = .636$, Cramer's $V = .08$. For the fire story, a Chi Square test (with continuity correction) showed that there was no difference in the likelihood of inferring temporal closeness or distance, depending on whether participants read many or single counterfactuals, $\chi^2(1, N = 80) = .50, p = .482$, Cramer's $V = .11$.

Table 2. Number of participants inferring that the event was close or distant in time

		Event judged to be	
		Close	distant
Plane Story	Single	15	25
	Many	12	28
Fire Story	Single	28	12
	Many	24	16

To sum up, Experiment 2, as a check on Experiment 1, showed that participants did not infer greater temporal closeness when reading stories with multiple counterfactuals rather than a single counterfactual. I conclude that there is no difference in inferring closeness between multiple and single counterfactuals, instead of that the difference between multiple and single counterfactual statements was hidden in Experiment 1. These results were counter to the prediction that multiple counterfactuals should be more salient than single counterfactual in inferring an outcome was closer.

2.5. Experiment 3: Controllability

The functional theory of counterfactual thinking (Epstude & Roese, 2008) suggested that counterfactual thinking focusing on controllable events or actions is helpful for promoting future performance, because people can only make efforts to improve the controllable parts. Giroto et al. (1991) showed that participants thought counterfactually when they learned events were controllable. In Experiment 3 I explored if the reverse inference is true. Giroto et al. (1991) asked participants to generate counterfactual thoughts for one protagonist who was delayed by both controllable events (e.g. having a drink) and

uncontrollable events (e.g. road blocked by a flock of sheep), finding that participants' counterfactual thoughts mainly focused on protagonist's controllable action. Based on this, I hypothesized that the existence of counterfactual thinking can lead participants to infer that the event was controllable. In the original experiment (Giroto, et al., 1991), participants read that a protagonist was postponed by some controllable and uncontrollable events, and participants' counterfactual thoughts mainly focused on the uncontrollable events. In Experiment 3, I explored participants' inferences about controllability by presenting counterfactual statements or narrative statements to participants. I hypothesized that knowing a protagonist made statement(s) about counterfactuals (compared to a protagonist who made statement about reality) would be more likely to result in participants inferring that the past event was controllable.

2.5.1. Method

2.5.1.1. Participants

Experiment 3 was an online experiment using Sona System. 49 psychology students (40 women, 9 men) of the University of Birmingham participated this experiment to gain course credits.

2.5.1.2. Design & Materials

The results of first two experiments (in which Experiment 1 found that there was difference in inference between counterfactuals and reality, while Experiment 2 found that there was no difference in inference between many and single counterfactuals) directed the design of Experiments 3 and 4. Thus, the design of Experiment 3 was identical to that of Experiment 1. There were two conditions in Experiment 3: a many counterfactuals condition who read about a character generating several counterfactual statements about the event, and a single counterfactual condition who read about one generating just one counterfactual

statement about the event. Each condition also read a second version of the story with a character who made a reality statement. Each condition read a pair of counterfactual controllability stories (counterfactual and reality) which adapted from previous experiment (Giroto et al., 1991 experiment 1).

The original story (Giroto et al., 1991 experiment 1) was about a protagonist was delayed by some uncontrollable events (e.g. a flock of sheep in the middle of the road) and controllable own decisions (e.g. own decision to have a drink), and when he came home he found his wife had a heart attack and she was dying. The specific controllable and uncontrollable events in the story were concealed, and I added either many counterfactuals (many counterfactuals version), a single counterfactual (single counterfactual version), or a reality statement (reality version) as a comment from the protagonist at the end of the story. (see Appendix C). Participants in the many condition read two versions of the story: one with many counterfactuals and one with a reality statement. Participants in the single condition read two versions of the story: one with a single counterfactual and one with a reality statement. I also counterbalanced the order of the versions (counterfactual or reality statements) between stories. In Experiment 3, I used same reality statement in both many and single counterfactuals conditions.

2.5.1.3. Procedure

Participants first read the pair of controllability story versions (i.e. “many” and “reality”, or “single” and “reality”). Participants were then asked, “Although you cannot tell for sure from the reading materials, judging from what Mr. Bianchi/Williams said, which person was delayed by his own decision to go to a bar?” Then they were asked “Please give any reasons why you think the protagonist who you chose (i.e. Mr. Bianchi/Williams) was delayed by his own decision to go to a bar whereas the other person was delayed by a flock of sheep in the road”.

Finally, participants received online debrief information.

2.5.2. Results & Discussions

Data for Experiment 3 are summarized in Table 3. First I made a comparison between the many and single conditions. There was no difference in the likelihood of inferring controllability between the many and single conditions, Fisher's Exact Test (1, N = 49) $p = .495$, Cramer's $V = .19$.

Second, I explored whether participants were more likely to attribute controllability to the protagonist who made counterfactual statements. In the many condition, a Binomial test ($p < .001$) showed that participants were significantly more likely to say that Mr. Bianchi (who made counterfactual statements) was delayed by his own decision to go to a bar than Mr. Williams (who made a reality statement). In the single group, a Binomial test ($p < .001$) showed that participants were significantly more likely to say that Mr. Bianchi (who made a counterfactual statement) was delayed by his own decision to go to a bar than Mr. Williams (who made a reality statement).

Overall, these results supported my hypothesis that the existence of counterfactual thinking can lead participants to infer controllability. These results indicated that, as long as counterfactual thinking occurs, there was no significant difference in inferring controllability based on different numbers of counterfactuals.

Table 3. Number of participants inferring that the event was controllable

	Version judged to be controllable	
	counterfactual	reality
Single	25	2
Many	22	0

2.6. Experiment 4: Exceptionality

In the above experiments, I have explored two types of inference participants made from reading counterfactual statements, inferences about closeness and about controllability. In Experiment 4, I look at the third type of inference, that is inference about exceptionality. Based on Kahneman and Tversky (1981) demonstrating that exceptional event can lead participants to think counterfactually, in Experiment 4, I explored whether reading counterfactual thoughts would in turn lead to inferring exceptionality. Specifically, I assumed that the existence of counterfactual thinking can enable the participants to infer that event was exceptional. The experimental paradigm that previous experiments (e.g. Kahneman & Tversky, 1981) used was to present participants with a story in which the protagonist underwent several exceptional and usual events, and then the protagonist did not obtain the expected outcome.

2.6.1. Method

2.6.1.1. Participants

Experiment 4 was also an online experiment using Sona System. 120 psychology students (103 women, 17 men) of the University of Birmingham participated this experiment

to gain course credits.

2.6.1.2. Design & Materials

Design of Experiment 4 was similar to that of Experiment 1. There were also two conditions in Experiment 4: a many counterfactuals condition and a single counterfactual condition. Each participant read two counterfactual exceptionality stories which adapted from Kahneman and Tversky (1981). The original story was about a protagonist who chose an exceptional (or unexceptional) route, however later he unfortunately suffered a traffic accident in the route he chose. As in Experiments 1 and 3, in Experiment 4 I also wrote either many or single counterfactuals as a character's own statements, accompanied with another story using reality statement as the protagonist's own statement (see Appendix D).

Participants in the many condition read two versions of the story: one with many counterfactuals and one with a reality statement. Participants in the single condition read two versions of the story: one with a single counterfactual and one with a reality statement. I also counterbalanced the order of the versions (counterfactual or reality statements) between stories. In Experiment 4, I used same reality statement in both many and single counterfactuals conditions.

2.6.1.3. Procedure

After reading both versions of story, participants were asked "Although you cannot tell for sure from the reading materials, judging from what Mr. Jackson/Jones's wife said, which person was more likely to drive home by the exceptional route (rather than stick to the regular route that he used to drive)". Participants then were asked "Please give any reasons why you think this person (which you selected) was more likely to drive home by the exceptional route (rather than stick to the regular route that he used to drive)".

Participants were thanked and debriefed online.

2.6.2. Results & Discussions

Data for Experiment 4 are summarized in Table 4. First I made a comparison between the many and single conditions. A Chi Square test showed that there was no significant difference in inferring exceptionality between the many and single conditions, $\chi^2 (1, N= 120) = 1.63, p = .202, \text{Cramer's } V = .14$.

Second, I explored whether participants were more likely to attribute exceptionality to protagonist who made counterfactual statements. In the many condition, a Binomial test showed that participants were more likely to say that Mr. Jones (who made many counterfactuals) was more likely to drive home by the exceptional route than Mr. Jackson (who made reality statement), $p < .001$. In the single condition, a Binomial test showed that participants were significantly more likely to say that Mr. Jones was more likely to drive home by the exceptional route than Mr. Jackson, $p = .045$.

Overall, these results supported my hypothesis that the existence of counterfactual thinking can lead to inferring exceptionality. These results indicated that, there was no significant difference in inferring exceptionality based on different numbers of counterfactual statements.

Table 4. Number of participants inferring that the event was exceptional

	Version judged to be exceptional	
	counterfactual	reality
Single	36	20
Many	49	15

2.7. Discussions of Experiments 1, 2, 3, and 4

To understand how people make inferences based on knowing that someone making counterfactual statements, this chapter explored the possible bidirectional relation between counterfactuals and counterfactual determinants, which is based on previous research demonstrating that closeness, controllability, and exceptionality are more likely to lead participants to have counterfactual thoughts than distance, uncontrollability, and normality (e.g. Giroto, et al., 1991; Kahneman & Tversky, 1981; Meyers-Levy & Maheswaran, 1992; Roese & Olson, 1996). In four experiments I tested whether people infer that the event was more likely to be a near miss, controllable, and exceptional when they hear someone using counterfactual statements to describe an event. I found that the existence of counterfactual thoughts (compared to their absence) did lead participants to infer temporal closeness in Experiment 1. Experiment 2, as a check on Experiment 1, demonstrated that there is no difference in inferring closeness based on reading multiple and single counterfactuals, rather than that the difference between multiple and single counterfactual statements was hidden in Experiment 1. Experiment 3 demonstrated that the existence of counterfactual thinking can lead people to infer controllability. Experiment 4 demonstrated that the existence of

counterfactual thinking can lead people to infer exceptionality.

To consider the power of my experiments to detect the effects of interest, I compared the sample sizes of Experiments 1, 2, 3, and 4 with the sample sizes of previous experiments. In Experiment 1 (N = 42 with two conditions) and Experiment 2 (N = 80 with two conditions), I adapted Roese and Olson's experiment (1996, experiment 3) in which they recruited 183 participants for two conditions, and I adapted Meyers-Levy and Maheswaran's experiments (1992, experiment 2) in which they recruited 63 participants for two conditions. In Experiment 3 (N = 49 with two conditions), I adapted Girotto, et al.'s experiment (1991) in which they recruited 108 participants for two conditions. In Experiment 4 (N = 120 with two conditions), I adapted Kahneman and Tversky's experiment (1981) in which they recruited 123 participants for two conditions. The sample sizes in my experiments are slightly smaller than those in previous experiments. It would give me less power to identify a significant effect, although in fact I have found the effects.

In summary, my results suggest that the relation between closeness / controllability / exceptionality and counterfactual thinking is bidirectional. I already knew that events that were closely missed, controllable, and exceptional lead to counterfactual thinking. I show that the reverse pattern is also true: when people hear someone using counterfactual statements to describe an event they infer that the event was more likely to be a near miss, controllable, and exceptional. My findings advance our knowledge of counterfactual bidirectional relation in showing that as well as making counterfactual inferences based on facts about the real world, people also make inferences about the real world, based on counterfactual worlds.

I interpret these results in the light of norm theory (Kahneman & Miller., 1986). A norm is general knowledge from and expectation of specific events, which is formed from many past experiences. Norm theory suggests that people assess that whether an event is normal or exceptional based on to what extent this event matches general knowledge and

expectation. Norm theory further suggests that, the more an event is consistent with general knowledge and expectation, the less likely this event would lead to thinking counterfactually. In contrast, when an event deviates from the general knowledge and expectation, people will evaluate this event to be exceptional. Therefore people will construct how the event could match the norm, and thinking counterfactually is how people restore the exceptional event to the norm (Kahneman & Miller., 1986). From the norm theory perspective, closeness and controllability may be similar to exceptionality. Specifically, controllable or near miss events account for relatively small proportion of the various events (i.e., the probability of encountering a controllable or near miss event is relatively low). Therefore, the occurrence of controllable or near miss events is relatively exceptional.

In turn, my results showed that reading counterfactuals can lead to inferring closeness, controllability, and exceptionality, which may be because people can tell from counterfactuals that the original event did not meet the norm. Counterfactual thinking can help to understand the norm, indicating how the original event was deviated from the norm. Therefore, the specific forms of norm deviation (i.e. closeness, controllability, and exceptionality) can then be inferred from counterfactuals.

2.7.1. Conclusion

In four experiments I explored the inferences people make when they learn that counterfactual thinking has occurred. Compared with knowing someone made a statement about reality, knowing that someone made counterfactual statements was more likely to lead to inferring closeness, controllability, and exceptionality. Previous research showed that events that were closely missed, controllable, and exceptional lead to counterfactual thinking, and my experiments indicated that the reverse pattern is also true. Together, these results indicated that inferential relation between counterfactual thinking and its determinants was bidirectional. To conclude, people can make inferences about the real world based on

counterfactual worlds.

Chapter 3

Both Temporal Distance and Temporal Asymmetry Lead to Different Construal Levels

3.1. Abstract

This chapter explores speculative thinking about the past and future. Specifically, based on construal level theory (i.e. CLT) that discusses abstractness in speculative thinking, I explore how abstract or specific the descriptions are when thinking about and describing past and future events. CLT suggested that thinking about far psychological distance leads people to have more abstract thoughts than close psychological distance; while thinking about close psychological distance leads people to have more specific thoughts than far psychological distance. CLT also suggested that thinking about different psychological distances have different functions. Previous studies have not discussed the difference in psychological distance between thinking about the past and future.

In one experiment (N = 80), I used one open-ended questionnaire and one forced-choice questionnaire, using two (Close / Far) by two (Past / Future) design. Results of open-ended questionnaire showed that construal level of describing far psychological distance activities were higher than that of describing close psychological distance activities ($p < .001$), and construal level of describing past activities were higher than that of describing future activities ($p = .041$). However, results of the forced-choice questionnaire did not show any difference in choosing different construal-level options between Far and Close conditions ($p = .180$), or between Past and Future conditions ($p = .073$). I concluded that both the far / close difference and past / future difference (i.e. temporal asymmetry) can lead people to use different levels of construal to represent activities. I discussed whether thinking about the future may have closer psychological distance than thinking about the past, and temporal asymmetry in abstractness is helpful for understanding the functions of speculative thinking.

3.2. Introduction

When people are planning for the future, they can consider a distant future (e.g. in one year) or a near future (e.g. tomorrow). Also, people can recall an event in near past (e.g.

yesterday) or a distant past (e.g. last year). The distant and near events in temporal dimension represent different temporal distance. For example, Liberman, Trope, and Wakslak (2007) suggested that future temporal distance is related to people's savings, buying things for future use, and taking actions to achieve future goals (e.g. self-control); while events in the past temporal distance may cause regrets. The dimension of temporal distance is included in general psychological distance (e.g. Trope & Liberman, 2003; Trope & Liberman, 2010). Construal level theory (CLT) (e.g., Trope & Liberman, 2010) focuses on the effect that people's representation of events is affected by different psychological distance, suggesting that the further psychological distance could lead our thinking to be more abstract; and the closer psychological distance could lead our thinking to be more specific. Early CLT research (e.g., Liberman & Trope, 1998) focused on temporal distance, suggesting people use more abstract, general, decontextualized, and goal directed description to represent distant future or past events, which is high-level construal. On the contrary, people use the specific, contextualized, and means-related features to construe close future or past events, which is low-level construal (Liberman & Trope, 1998; Liberman, et al., 2007; Trope & Liberman, 2010). In this chapter, based on previous construal level and temporal asymmetry research suggesting thinking about past and future can lead to different temporal distances, I explored whether thinking about the past and future would lead to different construal levels.

The research goal for this thesis is to explore the function of general speculative thinking. In this thesis, what I mean by speculative thinking is the thoughts about things that are not currently real. Therefore, thinking about events in the future and past with different temporal distances are also belongs to the category of speculative thinking. In this chapter, exploring the past and future speculative thinking from construal level perspective will add to research on general speculative thinking. I am interested in different construal levels because different construal levels (i.e. abstract or specific) have been found to affect people's

behaviors. For example, McCrea, Liberman, Trope, and Sherman (2008) explored the relationship between construal level and people's intention to do action. Participants in the low construal level condition described 10 activities in specific language, while participants in the high construal level condition described the 10 activities in abstract language. On a scale from 1 (not at all) to 7 (very much), participants then evaluated how convenient it would be for them to complete these activities. Participants in the low construal level condition rated the activities were more convenient than participants in the high construal level condition will not postpone completing these activities. Researchers suggested low construal level is less likely to make people to postpone activities than high construal level. Combined with CLT, my research on construal levels of speculative thinking about the past and future can help us to understand how different construal levels can affect people's behavioral intentions for future events.

In this chapter, I adapted Liberman and Trope's experiment (1998) of the relationship between temporal distance and construal level. The original experiment is about speculative thinking about the future, exploring the different construal levels between speculative thinking of the distant and close future. In this chapter, I introduce the speculative thinking of the past, exploring whether there are different construal levels between speculative thinking of the past and future. Liberman and Trope (1998) suggested that high-construal-level descriptions have the structure "[description] by [activity]", while low-construal-level descriptions have the structure "[activity] by [description]". Taking the activity "spending a weekend with family" as an example, a high-level description "improving our relationship" fits the high-construal-level structure (i.e., "I improve our relationship by spending a weekend with family") better than the low-construal-level structure. It is strange to say "I spend a weekend with family by improving our relationship". On the other hand, the description "going to the park together" fits the low-construal-level structure better (i.e., "I

spend a weekend with family by going to the park”) than the high-construal-level structure.

Liberman and Trope (1998, study 1) used one future-distant condition (i.e. next year) and one future-close condition (i.e. tomorrow) to study construal level for thinking about the future. The first part of their study was an open-ended questionnaire. Participants described some close or distant future activities (e.g. reading a science fiction book). There were more high-construal-level descriptions in the future distant condition than the future close condition, and there were more low-construal-level descriptions in the future close condition than the future distant condition. The second part of this study was the personal agency questionnaire adapted from Vallacher and Wegner (1989), which was a forced-choice questionnaire. Participants thought about some activities (e.g. making a list) happening in tomorrow or next year, and chose the description that they thought was most suitable. One of the descriptions was about the means to achieve this activity (e.g. writing things down), and the other was about the goals of this activity (e.g. getting organized). According to the researchers, the descriptions about means and goals reflect low and high construal levels respectively. There were more high-construal-level descriptions chosen in the distant condition than the close condition, and there were more low-construal-level descriptions chosen in the close condition than the distant condition.

Previous research compared construal levels between thinking about different psychological distances, but did not compare construal level between thinking about the future and past. For example, Semin and Smith (1999) in their study 1 found participants used more abstract languages to describe distant past events than recent past event, and in their study 2 found abstract language led participants to think about more distant past than specific language. In their study 1, researchers asked participants to think about events happened in recent (i.e. a week ago) and distant past (i.e. at least one year ago), and then describe these events. Researchers found that distant events stored in memory were described

in more abstract language than recent events, and recent events were described in more specific language than distant events. In their study 2, depending on different trials, researchers gave participants abstract or specific retrieval cues to prime different levels of abstractness, and analyzed the dates of events that participants answered. Participants in the abstract trial needed to describe their personality traits; and in the specific trial participants needed to describe an event that reflects this personality trait. For example, participants in the specific trial answered question “Think about an occasion when you helped somebody”, and described this event. Participants in the abstract trial answered question “How helpful a person are you”, and describe an event that showed their helpfulness. Finally, participants needed to indicate when the event that they described had occurred by writing down a date. Results showed that participants who were primed by abstract language described events that were more distant than participants who were primed by specific language.

These studies on CLT for close / distant distance treated the past and future as if they are symmetrical. However, other research suggests there are temporal asymmetry between past and future. For example, Caruso, Van Boven, Chin, and Ward (2013) found that participants thought future events were psychologically closer than the same events in the past. In their study 2, participants in the future condition participated in the study a week before Valentine’s Day, and they described what they planned to do on Valentine’s Day. Participants in the past condition participated a week after Valentine’s Day, and they described what they had done on Valentine’s Day. All participants then evaluated the psychological distance they felt for Valentine’s Day on a seven-point scale (from *very short time* to *very long time*). Participants in future condition evaluated the Valentine’s Day closer than participant in past condition, even though the dates were in fact the same temporal distance away. Rinaldi, Locati, Parolin, and Girelli (2017) found similar results in people with anxiety. Researchers asked all participants in the control, anxiety, and depression groups

to think about one month from today in the future and to think about one month ago in the past. All participants then needed to evaluate how psychologically close they felt about one month ahead in future, and one month ago in past. Specifically, participants needed to indicate on a 10-point scale, from 1 (“really close to now”) to 10 (“really far from now”). Results showed that, participants in the control and anxiety groups thought that thinking about future was psychologically closer to past, but participants in the depression group did not show this pattern.

Although previous CLT studies had explored the temporal distance effect on construal levels in the future and past respectively, there is no study making direct comparison between past and future construal levels. As I mentioned above, there might be temporal asymmetry in psychological distance, therefore it is important to explore whether thinking about past and future would lead to different construal levels. Furthermore, some CLT researchers suggested that high and low interpretation level serve different functions. For example, Trope and Liberman (2010) suggested that high and low levels of construal serve different cognitive functions. The reason why people use high construal levels to represent distant events is that people need to preserve the fundamental and stable properties of events to help long-term prospection and retrospection. In contrast, low construal levels that preserve many applied details and information are helpful for immediate action and specific performance regulation.

Furthermore, some researchers explored the functions of speculative thinking of the past and future from the counterfactual thinking instead of construal level perspective, which provides a comprehensive view to understand the functions of speculative thinking of the past and future. For example, Smallman and McCulloch (2012) explored speculative thinking about the past and future events in different psychological distances. In two experiments, researchers explored the link between psychological distance and counterfactual thinking’s function that can generate behavioral intention. In their experiment 1, they studied whether

manipulating past psychological distance can change how counterfactual thinking facilitates behavioral intentions. Specifically, participants saw negative events (e.g., getting sunburn) on screen. Participants then imagined the negative events either happened in last year (i.e. distant past) or on yesterday (i.e. close past). After that, participants were either primed by counterfactual thinking information (e.g., “Could have worn sunscreen”). Finally, participants evaluated whether they will change their behaviors (e.g., “Now I will use sunscreen”) by indicating “yes” or “no”. Results showed that imagining distant past events lead participants to have longer reaction time to indicate they will change behaviors than imagining close past events. Researchers suggested that the function of counterfactual thinking (which produces relevant behavioral intention) is affected by different temporal distances.

In Smallman and McCulloch (2012)’s experiment 2, researchers studied whether manipulating future psychological distance can change the likelihood of counterfactual thinking to form behavioral intentions. Participants also looked at some negative events on the screen (e.g., getting sunburn), and then received a counterfactual or factual prime that is similar to the previous experiment. In the near future trial, participants see action intention related to negative events happened in the near future (e.g. ‘If this happens next week, I will wear sunscreen’). In the far future trial, participants see action intentions related to negative events that happened in the far future (e.g. ‘If this happens next year, I will wear sunscreen’). The researchers found that participants responded more quickly to action intentions in the near future. In summary, researchers suggested that thinking counterfactually (i.e. speculative thinking about the past) about close psychological distance is more likely to generate an action-changing plan than thinking counterfactually about far psychological distance.

Above two experiments showed that the preparatory function of counterfactual thinking (i.e. generating future behavioral plans) is sensitive to changes in the temporal distance of related behavioral intentions, regardless of whether the temporal distance is in the

past or in the future. Also, compared to the behavioral intentions in the distant future, counterfactual thinking can better facilitate behavioral intentions in the near future. As speculative thinking about the past, the function of counterfactual thinking is affected by different temporal distances, which indicates that the function of general speculative thinking may be affected by temporal distance. So in this chapter, I plan to further explore whether temporal distance has different effects on speculative thinking of the past and future. Specifically, this chapter will study whether temporal distance will show that speculative thinking of the past and future have different construal levels. Furthermore, I will further discuss different functions that speculative thinking with different psychological distances/interpretation levels serve.

Overall, I suggest that exploring the temporal asymmetry in construal levels can help to understand the functional difference between thinking about the future and past from construal level perspective. Therefore, this chapter aims to explore the function of speculative thinking from the perspective of psychological distance/construal level, studying the temporal asymmetry in the function of speculative thinking. In this chapter, I adapted the open description and personal agency questionnaires from Liberman and Trope' study (1998, study 1). My experiment 5 had a 2 (past / future) by 2 (close / distant) design, making direct comparison between close and distant conditions, and direct comparison between future and past conditions.

3.3. Method

3.3.1. Participants

80 psychology students (63 women, 17 men; 15.2% Asian, 6.3% African or Caribbean, 72.6% Caucasian, 6.3% described ethnicity in another way or did not say) from the University of Birmingham participated to gain course credits. I used sample sizes (around $n = 20$ per condition) comparable with those used in the original study (Liberman & Trope,

1998) to detect similar effect sizes. Participants in this study were predominantly female (78.8 %) and White British (56.3 %), reflecting the student cohort from which they were recruited. In the original study, participants completed the questionnaires in groups of 2-8 participants. In this study, participants completed the questionnaire individually.

3.3.2. Design

I used a 2 (Past / Future) by 2 (Close / Distant) between-subjects design. Participants were alternately assigned to one of four experimental conditions.

3.3.3. Materials

The open-ended questionnaire in this study was adapted from Liberman and Trope's study 1 (1998). The original questionnaire asked participants to imagine and describe seven activities (e.g. reading a science fiction book) either happened tomorrow or in next year. In my experiment, I added "Past - Close" and "Past - Distant" versions of questionnaires that asked the participants to imagine and describe the activities either happened yesterday or in last year.

The second part of this study used an adapted personal agency level questionnaire from Vallacher and Wegner's study (1989), as also used by Liberman and Trope's study 1 (1998). This questionnaire is a forced-choice questionnaire. Each item on the questionnaire represents one activity, followed by two statements which are one low-level statement and one high-level statement respectively (e.g. For the activity "making a list", the low-level statement might be "writing things down", while the high-level statement might be "Getting organized"). Participants chose the one that best described the activity. The original questionnaire included 25 activities. In this study, I used the modified version of Liberman and Trope's study (1998), where they deleted 6 items that they thought were unsuitable for student participants. See the Appendix E for full questionnaires in all conditions.

3.3.4. Procedure

As in the Liberman and Trope's study 1 (1998) that used the open-ended and forced-choice questionnaires, my participants in all conditions also completed both questionnaires.

Depending on different conditions, the open-ended questionnaire and adapted personal agency level questionnaire had different time indicators with different temporal distances (i.e. yesterday, last year, tomorrow, and next year). Participants in the Future - Close condition read the instruction that "Your task is to imagine that you will do seven activities tomorrow, and to describe these activities". Then participants wrote descriptions for 7 imaginary tomorrow activities including "reading a science fiction book", "moving into a new apartment", "spending a weekend with your family", "taking an exam", "having a party", "writing a letter to your family", and "watching TV". After completing the open-ended questionnaire, participants went on to complete the forced-choice questionnaire. Participants read the instruction that "You will find several different behaviours listed. After each behaviour will be two choices of different ways in which the behaviour might be identified. Here is an example:

Attending class

_a. sitting in a chair

_b. looking at the board

Your task is to choose the identification, a or b, that best describes the behaviour for you." Then participants made decisions for 19 imaginary tomorrow activities such as "making a list tomorrow", "reading tomorrow", and "washing clothes tomorrow".

The experiment procedures of the other three conditions (i.e. Future - Distant condition, Past - Close condition, Past - Distant condition) were similar to that of Future -

Close condition. The only difference was that participants in the other three conditions were asked to imagine activities happening in different times. For example, participants in the Future - Distant condition read the instruction that “Your task is to imagine that you will do seven activities next year”, and wrote descriptions for the same 7 activities happening in next year. Then participants went on to complete the forced-choice questionnaire, making decisions for same 19 imaginary activities happening in next year. Similarly, participants in the Past - Close condition and Past - Distant condition completed questionnaires imagining activities yesterday and last year.

3.4. Results

3.4.1. Open-Ended Questionnaire

Consistent with the original study (Liberman & Trope, 1998), there were two independent coders coding the open-ended descriptions. The coding strategy was that descriptions with high construal level have the structure “[description] by [activity]”, while descriptions with low construal level have the structure “[activity] by [description]”. For example, for the activity “washing clothes”, a high-level description “removing odours from clothes” fits the high-construal-level structure (i.e., “I remove odours from clothes by washing clothes”) better than the low-construal-level structure. On the other hand, the description “going to the park together” fits the low-construal-level structure better (i.e., “I wash clothes by putting clothes into the machine”) than the high-construal-level structure. This coding strategy was same as the original study.

Our two coders classified the open descriptions into three types, which were “high level” descriptions, “low level” descriptions, and “both or neither high / low level” descriptions. There was a total of 560 open descriptions that participants gave (i.e. 80 participants times 7 questions). There were 331 out of 560 descriptions that two coders gave same classifications, accounting for 59.1%. In addition, there were 220 questions (39.3%)

that one coder classified them as one of the two descriptions, and the another coder classified them as the “both or neither high / low level” descriptions. As in the original study, in this case it was coded as the specific one that chose a specific high or low level of classification. Also, there were 9 descriptions (1.6 %) that one coder classified them as one of the two descriptions (i.e. high or low level descriptions), and another coder classified them as the other kind of description. Following the original study, a third coder (who was blind to the conditions from which these descriptions came) resolved the dispute.

As in the original study, I scored the high-level descriptions as 1, neither high-level nor low-level description and both high-level and low-level descriptions were scored as 0, and low-level descriptions were scored -1. I summed over the total score of seven description questions for each participants. I ran a repeated measures ANOVA with two between participant factors (time: past or future; distance: close or far) on the total score of the open descriptions. As predicted, there was a main effect for distance: scores for distant activities ($M = .78$) were higher than scores for close activities ($M = -3.25$), $F(1, 76) = 23.01, p < .001$, partial $\mu^2 = .23$. There was also a main effect of time: scores for past activities ($M = -.38$) were higher than scores for future activities ($M = -2.05$), $F(1, 76) = 4.30, p = .041$, partial $\mu^2 = .05$. For example, in the distant conditions (i.e. Future - Distant and Past-Distant conditions) and the past conditions (i.e. Past-Close and Past Distant conditions), “spending a weekend with family” might be described as “improving relationship”; while in the close conditions and the future conditions, the same activity might be described as “going to the park”. There was no interaction between the two factors, $F(1, 76) = .61, p = .44$, partial $\mu^2 = .01$.

Table 5. Condition means (averaged over participants) and standard errors of those means in the open ended questionnaire

		Participants' Descriptions	
		Means	Standard Errors
Conditions	Future-Close	-3.8	.75
	Future-Distant	-.38	.99
	Past-Close	-2.75	.91
	Past-Distant	2.05	.70

3.4.2. Forced-Choice Questionnaire

For the forced-choice responses, consistent with the original study, I scored the high-construal-level option as 1 and the low-construal-level option as 0. I then summed these scores to give a total of high construal choices for each participant, from 0 to 19. I ran a repeated measures ANOVA with two between participant factors (past / future; close / distant) on these scores. There was no main effect of distance (distant activities $M = 11.88$, close activities $M = 10.80$), $F(1, 76) = 1.83, p = .180$, partial $\mu^2 = .02$, which was inconsistent with the original study. Also, there was no main effect of time, $F(1, 76) = 3.31, p = .073$, partial $\mu^2 = .04$; and there was no interaction effect between the factors, $F(1, 76) = 1.84, p = .179$, partial $\mu^2 = .02$.

Table 6. Mean scores in the forced-choice questionnaire

		Participants' Forced-Choice	
		Means	Standard Errors
Conditions	Future-Close	12.05	.94
	Future-Distant	11.90	.67
	Past-Close	9.55	.84
	Past-Distant	11.85	.67

3.5. Discussions of Experiment 5

For the open - description questionnaire, participants in the Close conditions elicited more low-level descriptions than participants in the Distant conditions. Also, participants in the Future conditions elicited more low-level descriptions than participants in the Past conditions. These results suggested that thinking about far psychological distance can lead to higher construal level than thinking about close psychological distance, and thinking about the past can lead to higher construal level than thinking about the future. My study replicated the open-description results of original study (Liberman & Trope, 1998 study 1), and made direct comparison between past and future construal level. These results suggest that construal level is not only influenced by temporal distance but also the direction of time (i.e. past / future).

To consider the power of Experiment 5 to detect the effects of interest, I compared the sample size of Experiment 5 with the sample size of previous research. In Experiment 5 (N = 80 with two conditions), I adapted Liberman and Trope's experiment (1998) in which they recruited 32 participants for two conditions. The sample size of Experiment 5 is larger than

the sample size of previous experiment. It would give me more power to identify a significant effect.

As for the forced-choice questionnaire, participants in the Close conditions did not elicit more low-level descriptions than participants in the Distant conditions, and participants in the Future conditions did not elicit more low-level descriptions than participants in the Past conditions. These results were inconsistent with the results of the original study. I suggested that this may be because participants were less attentive when answering the forced-choice questionnaire than open description questionnaire. First, I cannot identify whether any of the participants just randomly chose answers for the forced-choice questions by looking at the options that they chose, and the participants may be less attentive because of knowing this. On the other hand, (compared to answering the forced choice questionnaire), when answering the open description questionnaire, participants needed to put more effort into describing an event. Second, the forced-choice questionnaire was always the second questionnaire that participants answered, which was the same in the previous study (Liberman & Trope, 1998). Participants may be more tired and less focused on answering the second questionnaire than the first questionnaire.

My work on CLT links into discussion about function of thinking about the past and future. CLT (e.g. Trope & Liberman, 2010) suggested that close psychological distance can lead to lower construal levels than far psychological distance. Based on this, my results indicate that thinking about future may lead to closer psychological distance than thinking about past. Difference in psychological distance fits with the idea that people think differently about the past and future. Caruso et al., (2013) suggested that the temporal asymmetry effect that seeing future events as closer in time than past events may be because people emphasize future events than past events, which is consistent with the suggestion that people more value near future than distant future (e.g., Liberman & Förster, 2008; Trope & Fishbach, 2000).

This future orientation is functional for changing future behaviors because future events are open to change but past events cannot be changed (I will return to this point in the general discussion).

Moreover, some research on temporal asymmetry found that people have different feelings about thinking about the future and past. For instance, five studies by Van Boven and Ashworth (2007) showed that people reported stronger emotions when thinking about events in the future than past. For example, in study 1, participants imagined the enjoyment of the Thanksgiving holiday in the past or future, and evaluated their emotional intensity about their Thanksgiving holidays. Researchers found that participants reported more intense emotions for future than thinking about the past. In addition, Van Boven, Kane, McGraw, and Dale (2010) found that events generating more intense emotion have a closer psychological distance than events generating less intense emotion. In their study 2, participants imagined visiting a dentist in past or future and described this event either emotionally or neutrally. Participants then rated how close they felt about this event from “very close” to “very distant”. Participants in the emotional group rated a closer psychological distance than participants in the neutral group. This evidence (e.g. Van Boven and Ashworth, 2007; Van Boven et al., 2010) not only reflects the temporal asymmetry in thinking about the future and past, but also consistent with my findings that the future is thought of as closer than the past. However, currently we do not know whether more intense emotion leads to closeness, or closeness leads to more intense emotion.

Experiment 5 found that thinking about the past leads to higher construal level than thinking about the future, which suggested that thinking about the past might lead to further psychological distance than the future according to the CLT perspective. These results paralleled the finding that thinking about the same event in past or future can generate different emotions (e.g. Caruso, Gilbert, & Wilson, 2008). Caruso et al. (2008) suggested

that, people value future events more than past events. In their study 1, participants either imagined they will do a teaching assistant job in the next month, or imagined they had done a teaching assistant job in the past month. All participants evaluated how much payment they should receive. The payments evaluated by participants in the future condition were higher than the payments evaluated by participants in the past condition. Therefore, I suggest that there may be two possible mechanisms in the temporal asymmetry in thinking about the future and past. One is that thinking about past/future leads directly to different emotional intensity, the other may be thinking about the past and future lead to different psychological distance which then leads to different emotional intensity.

3.5.1. The Functional Asymmetry between Thinking about the Past and Future

I suggest that thinking about the future is more likely to serve preparatory function for future events than thinking about the past, because thinking about the future has lower construal level than thinking about the past. CLT suggests that psychologically close events are more likely to lead to specific action plans than psychologically distant events (e.g. Trope & Liberman, 2010). Trope and Liberman (2010) suggested that high construal level corresponds those stable and central features, and low construal level corresponds those unstable and surface features. Therefore, the function of high construal level is to maintain those stable features of events. Specifically, as the psychological distance increases, the high construal level characteristics (i.e. central features that are not easy to change with time) will become more and more prominent; as the psychological distance decreases, the low construal level characteristics (i.e. surface features that are easy to change with time) will become more and more prominent. Also, Kivetz and Tyler (2007) suggested that low construal level reflects a realistic state that is easy to change, while high construal level reflects an idealistic state that is not easy to change.

Using high construal level to represent psychologically distant events can help people

to learn from the past. This may be because those features that are stable and not easy to change over time can be easily grasped by people and become people's experiences, and thus can be applied to future practice. On the other hand, those features that are unstable and easy to change over time would be not easy to apply to the practice of improving the future, because they change frequently. This may be the reason why thinking about the past has a higher construal level than thinking about the future. On the other hand, low construal level contains specific information about how actions to be performed, which is helpful for completing upcoming tasks. Therefore, I suggest that the low construal level / close psychological distance than high construal level / far psychological distance may serve more preparatory function for improving future performance. I suggest that this is because the low construal level contains more details, which is helpful for future performance (Trope & Liberman, 2010).

In addition, the above suggestion that thinking about the future is more functional than thinking about the past is line with some studies that demonstrates differences between counterfactual and prefactual thinking. For example, Ferrante et al. (2013) found that prefactual thinking focuses on more controllable features of event than counterfactual thinking. Compared to uncontrollable features, controllable features allow people to change them, thus they are realistic constraints of event. Therefore this finding suggests prefactual thinking (compared to counterfactual thinking) is helpful for regulating behaviours and improving future performance. This is consistent with my chapter 4 demonstrating that prefactual thinking may serve more preparatory function than counterfactual thinking (n.b. I return to this in chapter 4).

3.5.2. Conclusion

Experiment 5 explored the temporal distance effect on construal level in past and future conditions. The results of open-ended questionnaire demonstrated that thinking about

events with far than close psychological distance leads to higher construal level, and thinking about future than past events leads to higher construal level. I discussed that thinking about the future may have closer psychological distance than thinking about the past, and low construal level / close psychological distance may be more functional for improving future performance than high construal level / far psychological distance. Combining these findings, my research contributes to exploring the function of general speculative thinking of past and future.

Chapter 4

The Function of Speculative Thinking: Comparisons of Temporal and Reality Dimensions

This chapter forms the basis for a paper:

Xie and Beck (2019) under submission

Author contributions: Yibo Xie conceived the main ideas of three experiments, collected the data, conducted the data analyses, and wrote the main draft of this chapter. Yibo Xie and Dr. Sarah Beck discussed the results and revised the manuscript together.

4.1. Abstract

People can speculate about past and future events that they believe have or will happen and those that they think did not or will not happen. Previous studies suggested that thinking about future events focuses on more controllable features than past events, serving more preparatory function. However, these studies did not consider whether the speculative thinking was about real or hypothetical events. I explored whether Realistic Prefactual Thinking focuses more on controllable features than Hypothetical Prefactual Thinking, and whether Hypothetical Prefactual Thinking focuses on more controllable features than Counterfactual Thinking. Experiment 6 (N=45) demonstrated that participants doing Realistic Prefactual Thinking elicited more controllable modifications than participants doing Hypothetical Prefactual Thinking. Experiment 7 (N=51) indicated that participants doing Hypothetical Prefactual Thinking focused on more controllable modifications than participants doing Counterfactual Thinking. Experiment 8 (N=35) explored whether Hypothetical Prefactual Thinking about psychological closeness rather than distance can lead participants to have more controllable modifications; however, results did not support this hypothesis. I concluded that both temporal and reality dimensions may impact on people's speculative thoughts, resulting in significant differences in controllable modifications.

4.2. Introduction

In our daily life, we often think how things would have been different in the past, and how things would or will be different in the future. Imagining how things would or will differ in the future is called *Prefactual Thinking* (e.g. Epstude, Scholl, & Roese, 2016; Schacter, Addis, & Buckner, 2007), and imagining how things would have been different in the past is called *Counterfactual Thinking* (e.g. Beck, & Riggs, 2014; Roese, 1997; Roese & Olson, 1993; Byrne, 2002). Both counterfactual and prefactual thinking are two types of speculative thinking: by which I mean thoughts about things that are not currently real. In this chapter, I

explore the function of speculative thinking.

One function of speculative thinking seems likely to be helping people to perform better in future similar events. In this case, the content of speculative thoughts need to be things that the individual can control. For example, if a student fails an exam and speculates about how things might go better at the resit, she is more likely to improve her future behavior if she thinks “I should start my revision earlier” rather than “The questions should be easier”.

The functional theory of counterfactual thinking proposed by Epstude and Roese (2008) focused specifically on how counterfactual thinking about what might have been can influence future behavior. The main idea of this theory is that by imagining a better past one prepares for similar future events with the goal of achieving a better future outcome. Researchers suggested that people learn from their past failures when they expect to encounter similar situations again in the future. Markman, Gavanski, Sherman, & McMullen (1993) showed that people were more likely to generate upward counterfactuals, which suggested ways in which the outcome of an event could have been better, when they anticipated that a similar event would be encountered in the future than when they thought it would not be repeated.

Not all speculative thoughts focus on past events, however. We can also speculate directly about the future, entertaining what might happen. Common sense suggests that these thoughts are likely to be involved in preparing our future behavior. One possibility then is that speculative thoughts about the past and future share a common purpose: to inform future behavior. But some evidence suggests that there may be important differences in the way people think about past and future events that call this into question.

Evidence that leads us to doubt that counterfactual thoughts are functional for changing future behavior comes from Pighin, Byrne, Ferrante, Gonzalez, and Giroto (2011).

The researchers asked participants to do a multiplication task, and then to think counterfactually about how their performance could have been better in the task. Participants were likely to imagine changing uncontrollable aspects of the situation (e.g., “things could have been better if I had more time to solve the task”) rather than controllable aspects such as their choices (e.g., “things could have been better if I had chosen the other envelope”). In other words, the content of the majority of thoughts that they had could not have directly led to different future behavior (n.b. I return to the content neutral pathway proposed in the functional theory in the General Discussion).

Subsequently, Ferrante, Giroto, Stragà, and Walsh (2013) suggested that when people speculate about future events they are more likely to think about controllable aspects of the event than when they think counterfactually. These findings are important and challenging for the functional theory. For example, Ferrante et al. (2013, study 1) asked participants to attempt a scrambled word task and then think counterfactually about their performance or prefactually about a future attempt. The researchers found that participants who answered the counterfactual thinking question (i.e. “things would have been better for me if...”) were more likely to focus on the uncontrollable features of the task (e.g., “...if I had longer time”) than participants who answered the prefactual thinking question (i.e. “things will be better for me in the next game if...”). Participants who did prefactual thinking were more likely to focus on the controllable features (e.g., “...if I used another strategy”) than participants who answered the counterfactual thinking question. The researchers suggested that prefactual thinking focuses on more controllable premises than counterfactual thinking, and thus prefactual thinking is more likely to serve a preparatory function for the future than counterfactual thinking. In sum, this study indicates that types of speculative thinking may differ in how well they prepare us for the future.

These findings were replicated by Mercier, Rolison, Stragà, Ferrante, Walsh, and

Giroto (2017) with a similar design as Ferreante et al. (2013). In their study 1a, after the word search task, participants answered the counterfactual thinking question (e.g. “things would have been better for me if...”) or the prefactual thinking question (e.g. “things will be better for me in the next game if...”). They also found that participants answering counterfactual thinking questions generated more uncontrollable modifications than participants answering prefactual thinking question, while participants answering prefactual thinking question generated more controllable modifications than participants answering counterfactual thinking questions.

These findings have been interpreted as showing that speculative thinking about the future is more functional than corresponding speculative thinking about the past. However, there is another dimension on which speculative thoughts can differ: whether they are about real or hypothetical events. In the Ferrante et al. (2013) study 1, participants in the prefactual condition were told that they *would* do another similar scrambled-word task in few minutes. I label this Realistic Prefactual Thinking as the event about which they were speculating was expected to happen. However, in the counterfactual condition, participants were speculating about an event that they knew did not happen. Indeed, the knowledge that a counterfactual event did not happen, even though it could have, is often thought of as a defining feature of counterfactual thinking. Thus, counterfactual thinking, is necessarily Hypothetical Counterfactual (past) Thinking. It is possible that the difference Ferrante and colleagues found between prefactual and counterfactual thinking actually reflects differences in whether the individual is thinking about real or hypothetical events, rather than past or future events. By testing this possibility experimentally, I aim to provide a more comprehensive picture of speculative thinking.

To do this, I also introduced a third type of speculative thinking: Hypothetical Prefactual Thinking, in which someone is directed to think about a future event that could

happen, but is not expected. Although some studies (e.g. Ferrante et al., 2013; Mercier et al., 2017) take prefactual thinking to be about an anticipated future reality, others construe prefactual thinking as more hypothetical. Epstude, Scholl, and Roese (2016) suggested that prefactual thoughts have the form “If action X is taken, it will lead to outcome Y”, defining prefactual thinking as thinking about how things will be different to current reality, without a firm commitment to a specific future event.

In order to understand when people generate controllable thoughts that could be functional in improving future behavior, I consider this dimension of speculative thinking: whether the event one is speculating about is taken to be real (something that will happen in the future, Realistic Prefactual Thinking) or hypothetical (something that is not expected to happen in the future, Hypothetical Prefactual Thinking, or, something that did not happen in the past, Counterfactual Thinking). Note that there seems to be a fourth type of speculative thinking, Realistic Counterfactual Thinking, but this is not the same type of speculation: if one thinks about the events that really happened in the past it is an act of remembering, rather than speculation about a possible event. Memory may indeed be a constructive process, but for the purposes of this chapter I do not consider it a type of speculative thinking about how things might be (or have been).

The real/hypothetical dimension is known to be psychologically important. Some researchers have expressed concern about the tasks used in many decision making studies being hypothetical, as decisions about real events might differ from decisions about hypothetical events (e.g. Camerer and Mobbs, 2017; Galotti, 1989; Galotti, Ciner, Altenbaumer, Geerts, Rupp, & Woulfe, 2006). Empirical evidence seems to justify this concern. For example, Bostyn, Sevenhant, & Roets (2018) asked one group of participants to imagine that a cage of five mice will receive an electric shock in 20 seconds, but the participant could pull a lever to change the outcome to shock to a cage containing just one

mouse. Participants in the other group were given the same dilemma, but were led to believe that their decision was about real mice that they could see in front of them (even though in fact the mice were not shocked). Participants in the real group were less likely to decide to pull the lever than those in the hypothetical group. Robinson, Pendle, Rowley, Beck, and McColgan (2009) also found differences between real and hypothetical versions of game that involved making decisions about chance events. Specifically, researchers divided participants into a real die-throwing group and a hypothetical die-throwing group. Participants chose whether to guess the number rolled before it was thrown or after it was thrown. There were different preferences for when the two groups preferred to guess what number would be thrown: Participants in the real group were more likely to prefer to guess after die-rolling, but participants in the hypothetical group showed the opposite preference.

To sum up, although researchers have sought to explain the function of speculative thinking, they have focused on differences between past and future in the content of speculative thoughts. Research has neglected whether participants are thinking about events they believe will happen (real) or those they believe will not or did not happen (hypothetical). In three experiments, I attempted to provide a more comprehensive picture of how different types of speculative thinking might influence future behaviors. Experiment 6 explored the effect of reality / hypothetical thinking dimension on controllable modifications, and Experiment 7 explored the effect of past / future thinking dimension on controllable modifications. If my hypothesis that the reality-hypothetical dimension influences the number of controllable thoughts was (exclusively) true, participants doing Realistic Prefactual Thinking would focus on more controllable features of the task than participants doing Hypothetical Prefactual Thinking and there should be no difference between participants doing Hypothetical Prefactual Thinking and Counterfactual Thinking. If Ferrante's conclusion that the past-future dimension is critical, I would expect no difference between

conditions in Experiment 6, but a difference in Experiment 7. A third possibility was that both dimensions may impact on people's speculative thoughts, resulting in significant differences in both studies. In Experiment 8, I further tested whether the past-future effect might be explained by a different dimension, psychological distance, based on the temporal asymmetry literature I discussed in last chapter (e.g. Caruso et al., 2013).

4.3. Experiment 6

Experiment 6 adapted Ferrante et al.'s study 1 (2013) to explore the hypotheticality dimension. I used two prefactual thinking conditions. Participants in the Realistic Prefactual condition were told they would do the activity in few minutes, and participants in the Hypothetical Prefactual condition were told just to imagine they would do the task. Based on Ferrante et al.'s findings that Realistic Prefactual Thinking leads to more controllable modifications than Hypothetical Counterfactual Thinking, my hypothesis was that participants doing Realistic Prefactual Thinking would have more controllable modifications than participants doing Hypothetical Prefactual Thinking.

4.3.1. Method

4.3.1.1. Participants

55 psychology students (46 women, 9 men) of the University of Birmingham participated to gain course credits. No individual participated in more than one experiment reported in this chapter.

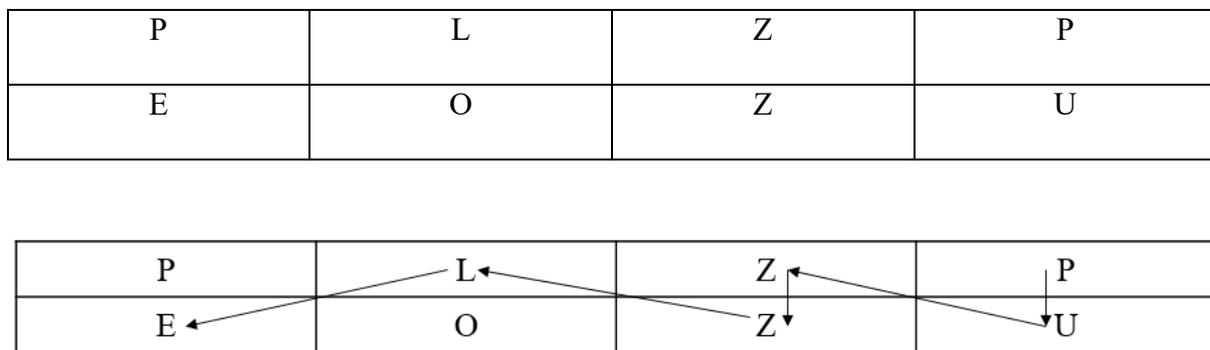
4.3.1.2. Design & Materials

Participants were alternately assigned to one of two conditions: Realistic Prefactual and Hypothetical Prefactual conditions.

The scrambled-word task used in the original paper (Ferrante et al., 2013) was in Italian so I developed a new scrambled-word task in English for my participants. The task

was to find a 6-letter English word in each of 12 grids. This word must be readable by moving from one letter to another. Participants should write the word down in the space provided next to the grid once they found it. Participants should only look for a 6 letter word (there may also be 2, 3, 4 or 5 letter words). The first letter of the word can be any of the 8 letters present in the grid, and the letters can be linked either vertically, horizontally, and diagonally. For example in Figure 1, the answer is PUZZLE. There was not necessarily only one answer to every puzzle. Participants had 2 minutes and 15 seconds to complete this task.

Figure 1. One example of scrambled-word question and solution



See the Appendices F, G, and H for materials used in Experiment 6, 7, and 8.

4.3.1.3. Procedure

As in Ferrante et al (2013)’s study 1, participants in both conditions were presented with 12 scrambled-word questions. No participant solved all scrambled-word questions. After completing the task, participants in both conditions scored their performance on a 7-point scale from -3 (poor performance) to 3 (perfect performance). Next, participants answered either Realistic Prefactual Thinking or Hypothetical Prefactual Thinking questions.

Participants in the Realistic Prefactual condition read the instruction, “You have just played the “Scrambled-word game”. In a few moments you will play the game with new words again”. Then these participants answered a Realistic Prefactual Thinking question, “things will be better for me in the next game if ... Write at least one way in which you would complete this sentence”. After completing the question, these participants went on to

complete a new set of scrambled-word puzzles.

On the other hand, participants in the Hypothetical condition read the instruction that “You have just played the ‘Scrambled-word game’. The game is over, and there will be no more scrambled-word puzzles in this study. However, please imagine that in a few moments you will play the game with new words again.” Then these participants answered a Hypothetical Prefactual question, “things would be better for me in the next game if ... Write at least one way in which you would complete this sentence”. Participants in the Hypothetical condition did not do further scrambled-word puzzles after answering the question.

4.3.2. Results & Discussions

In order to minimise the impact of English proficiency on task performance and thinking modification questions, my data analysis excluded non-native English speakers’ data. Nine participants’ data were excluded from the analysis, leaving 46 native English speakers’ data.

There was no difference in the rates of correct solutions to the scrambled word game between participants in two conditions (Realistic Prefactual $M = .64$; Hypothetical Prefactual $M = .71$), $t(44) = .24$, $p = .809$, $d = .07$. I compared the self-evaluation performance rating participants gave on the 7-point scale, finding there were similar negative self-evaluations in two conditions (Realistic Prefactual $M = -2.68$; Hypothetical Prefactual $M = -2.50$), $t(44) = .94$, $p = .351$, $d = .28$.

Participants’ answers about changing focus and attention (e.g., “If I was more focused on the task”), and answers about changing strategies used to answer the puzzles (e.g., “If I did not waste too much time on one puzzle”) were coded as controllable modifications.

Responses that involved changing task features (e.g., “If I had more time”, “If the letters didn’t have to join right next to each other”), participants’ psychological and physical status (e.g., “If I was not tired”), abilities that participants cannot improve before the following

game (e.g., “If I knew more 6 letters words”), participants’ stable personal traits and characteristics (e.g., “If I was smarter”), and the situation (e.g., “If I could have done it in a group”) were coded as uncontrollable modifications. The few remaining responses were coded as ambiguous modifications.

In Experiment 6, two independent coders, who were both unaware of the hypothesis, coded the total 93 responses for 46 English-speaker participants. Their agreement rate was 96% in Experiment 1, Cohen’s $\kappa = .88$, $p < .001$. Disagreements were resolved in two ways. If one modification was coded as an ambiguous modification by one coder and was coded as controllable modification or uncontrollable modification by the other coder, then I followed the latter coding. If one modification was coded as controllable modification by one coder and was coded as uncontrollable modification by the other coder, then the disagreement was solved by the third coder who was blind to the conditions. In total, there were 40 modifications coded as controllable modification, 52 modifications coded as uncontrollable modification, and 1 modification coded as ambiguous modification.

Participants in the Realistic Prefactual condition ($n = 22$) produced 1.86 modifications and participants in the Hypothetical Prefactual condition ($n = 24$) produced 2.17 modifications (See Table 7). There was no difference in the number of modifications produced, $t(44) = 1.17$, $p = .249$, $d = .35$. There was 1 modification that both coders coded as an ambiguous modification, thus the subsequent data analysis for the modifications did not include this modification. In addition, one participant did not provide any modifications, so the number of modifications for this participant was considered as 0. I included this participant in the above comparisons of correct solutions and self-evaluation performance, but I excluded them from the following analysis comparing controllable modifications, leaving 45 native English speakers.

In order to address the main research question of Experiment 6, I compared the total

number of controllable modifications for each condition. The Reality condition elicited more controllable modifications than the Hypothetical condition, Mann–Whitney $U = 170.50$, $p = .048$, $r = .30$. I then compared the first modifications that participants gave in the two conditions (See Table 8). For the first modifications, participants in the Reality condition elicited more controllable modifications than participants in the Hypothetical condition, although this did not reach significance when I made the continuity correction for a 2x2 Chi Square test, $\chi^2(1, N = 44) = 3.06$, $p = .080$, Cramer's $V = .31$.

Tables 7 and 8 contain data for Experiments 6, 7, and 8.

Table 7. Total number of modifications in three experiments

		Participants' answers	
		Controllable modifications	Uncontrollable modifications
Experiment 6	Hypothetical Prefactual (n = 24)	15	37
	Realistic Prefactual (n = 22)	25	15
Experiment 7	Hypothetical Prefactual (n = 23)	26	24
	Hypothetical Counterfactual (n = 28)	10	50
Experiment 8	Far Hypothetical Prefactual (n = 19)	15	22
	Close Hypothetical Prefactual (n = 16)	9	21

Table 8. Total number of first modifications in three experiments

		First modifications	
		Controllable modifications	Uncontrollable modifications
Experiment 6	Hypothetical Prefactual (n = 24)	7	17
	Realistic Prefactual (n = 22)	12	8
Experiment 7	Hypothetical Prefactual (n = 23)	12	11
	Hypothetical Counterfactual (n = 28)	4	23
Experiment 8	Far Hypothetical Prefactual (n = 19)	7	12
	Close Hypothetical Prefactual (n = 16)	6	10

To sum up, in Experiment 6, participants did Realistic Prefactual Thinking or Hypothetical Prefactual Thinking about how they could do better in the next task. Results showed that participants doing Realistic Prefactual Thinking focused on more controllable features than participants doing Hypothetical Prefactual Thinking. Experiment 6 showed that there is a reality / hypothetical difference in speculative thinking. This result challenges the view that counterfactual thinking is functional for improving future performance (e.g. Epstude & Roese, 2008). This finding went beyond Ferrante et al.'s finding (2013, study 1) that prefactual thinking focuses on more controllable features than counterfactual thinking,

because Experiment 6 demonstrated the reality / hypothetical difference in prefactual thinking.

4.4. Experiment 7

Experiment 6 showed that there was a reality / hypothetical difference leading to difference in participants' controllable modifications.

As I mentioned in the introduction (section 4.2), the difference Ferrante and colleagues found between prefactual and counterfactual thinking could reflect either differences in whether the individual is thinking about real or hypothetical events, differences in whether the individual is thinking about past or future events, or both these differences.

Therefore, my finding in Experiment 6 might be the cause of the difference in Ferrante et al.'s finding (2013, study 1), suggesting that there is no temporal asymmetry. The alternative is that there is a temporal asymmetry as well as the reality / hypothetical difference.

To test this, I ran Experiment 7 exploring whether there is the temporal asymmetry in speculative thinking, leading participants to have different numbers of controllable modifications. Based on the original study (Ferrante et al., 2013) that found temporal asymmetry, I hypothesized that participants doing Hypothetical Prefactual Thinking would focus on more controllable features than participants doing Counterfactual Thinking condition.

4.4.1. Method

4.4.1.2. Participants

59 psychology students (58 women, 1 men) the University of Birmingham participated to gain course credits.

4.4.1.3. Design & Materials

Participants were alternately assigned to one of two conditions: Hypothetical Counterfactual and Hypothetical Prefactual conditions. The scrambled-word tasks for both conditions were same as that in Experiment 6.

4.4.1.4. Procedure

As in Experiment 6, all participants attempted 12 scrambled-word questions, and evaluated their performance using a 7-point Likert scale (from -3 to 3). No participant solved all scrambled-word questions.

Next, participants in both conditions considered their performance before answering Hypothetical Prefactual Thinking or Counterfactual Thinking questions. Participants in the Hypothetical Prefactual condition read that “You have just played the ‘Scrambled-word game’. The game is over, and there will be no more scrambled-word puzzles in this study. However, please imagine that in a few moments you will play the game with new words again.” Then participants answered the Hypothetical Prefactual Thinking question “things would be better for me in the next game if ... Write at least one way in which you would complete this sentence”.

Participants in the Hypothetical Counterfactual condition read that “You have just played the ‘Scrambled-word game’. The game is over, and there will be no more scrambled-word puzzles in this study.” Then participants answered the Hypothetical Counterfactual Thinking question “things would have been better for me if ... Write at least one way in which you would complete this sentence”.

4.4.2. Results & Discussions

As in Experiment 6, I excluded non-native English speakers’ data. Eight participants’ data were excluded from the analysis, leaving 51 native English speakers’ data. Participants in both conditions had similar numbers of correct solutions (Hypothetical Counterfactual $M =$

1.54; Hypothetical Prefactual $M = 1.48$), $t(49) = .14$, $p = .893$, $d = .04$, and similar negative self-evaluation ratings (Hypothetical Counterfactual $M = -2.54$; Hypothetical Prefactual $M = -2.35$), $t(49) = -.69$, $p = .495$, $d = .20$.

The coding strategy for modifications was same as Experiment 6. Two independent coders, unaware of the hypotheses, coded the 110 responses. Their agreement rate was 97.7%, Cohen's kappa = .94, $p < .001$. Disagreements were resolved in the same way as in Study 1. In total, there were 36 modifications coded as controllable modification, 71 modifications coded as uncontrollable modification, and 3 modifications coded as ambiguous modification. Participants in the Hypothetical Counterfactual condition ($n = 28$) produced an average of 2.14 modifications and participants in the Hypothetical Prefactual condition ($n = 23$) produced an average of 2.17 modifications (See Table 7), $t(49) = -.16$, $p = .872$, $d = .05$.

I compared the total number of controllable modifications for each condition. Participants in Hypothetical Prefactual condition elicited more controllable modifications than Past condition, Mann-Whitney $U = 176.50$, $p = .002$, $r = .43$. I then considered only the first modifications for each condition (See Table 8). For the first modifications, a Chi Square test with continuity correction showed that participants in Hypothetical Prefactual condition elicited more controllable modifications than Hypothetical Counterfactual condition, $\chi^2(1, N = 51) = 6.34$, $p = .012$, Cramer's $V = .40$.

In summary, participants in Experiment 7 did Hypothetical Prefactual Thinking or Hypothetical Counterfactual Thinking about their performance. Participants doing Hypothetical Prefactual Thinking focused on more controllable features than Hypothetical Counterfactual Thinking. Experiment 7 indicated that, thinking about the future (compared to thinking about the past) had more emphasis on controllable features even when we had controlled the reality / hypothetical difference, suggesting a temporal asymmetry effect. In line with Ferrante et al.'s finding (2013), this result challenges the view that counterfactual

thinking focuses on controllable features (e.g. Epstude and Roese, 2008).

4.5. Experiment 8

Experiment 7 showed that participants' Hypothetical Prefactual Thinking was more likely to focus on controllable features than Hypothetical Counterfactual Thinking. Before accepting that this results from a straightforward difference between thoughts about the past and future I considered an alternative possibility, which is whether close / far distance could account for temporal asymmetry effect in controllable features. Some studies suggested that thinking about future events lead to closer psychological distance than past events, i.e. that the future events are construed as being closer to the person's current experience. For example, Caruso, Van Boven, Chin, and Ward (2013) asked participants to consider and report a specific time (e.g. one year) and an event (e.g. Valentine's Day) in the future or in the past. Participants reported that the future event felt closer in time than the past event. This result was interpreted as indicating that people are more future-oriented than past-oriented. Caruso et al., (2013) also suggested that this future orientation is functional for changing future behaviors because future events are open to change but past events cannot be changed. In Experiment 8, I hypothesized that, if the past / future difference found in Experiment 7 is really the result of the psychological distance difference between thinking about the future and past, Hypothetical Prefactual Thinking about event in far psychological distance would generate more controllable modifications than Hypothetical Prefactual Thinking about event in close psychological distance. Otherwise, Hypothetical Prefactual Thinking about event in far psychological distance would generate similar number of controllable modifications with Hypothetical Prefactual Thinking about event in close psychological distance.

4.5.1 Method

4.5.1.1. Participants

44 psychology students (38 women, 6 men) of the University of Birmingham participated to gain course credits.

4.5.1.2. Design & Materials

Participants were alternately assigned to the Far Hypothetical Prefactual condition and the Close Hypothetical Prefactual condition respectively. The scrambled-word task used in this study was same as the one used in Experiment 6.

4.5.1.3. Procedure

As in Experiment 6, participants in both conditions completed the scrambled-word task and evaluated their performance.

After completing the scrambled-word task, participants in the Close Hypothetical Prefactual condition read instruction that “You have just played the ‘Scrambled-word game’. The game is over, and there will be no more scrambled-word puzzles in this study. However, please imagine that in a few moments you will play the game with new words again.” Then they answered question “things would be better for me in the next game if ... Write at least one way in which you would complete this sentence”.

Participants in the Far Hypothetical Prefactual condition read instruction that “You have just played the ‘Scrambled-word game’. The game is over, and there will be no more scrambled-word puzzles in this study. However, please imagine that in a year you will play the game with new words again.” Then they answered question “things would be better for me in the next game if ... Write at least one way in which you would complete this sentence”.

4.5.2. Results & Discussions

Data analysis of Experiment 8 excluded non-native English speakers’ data. Nine

participants' data were excluded from the analysis, leaving 35 native English speakers' data. Participants in both two conditions had similar rates of correct solutions (Close Hypothetical Prefactual $M = 1.44$; Far Hypothetical Prefactual $M = 1.26$), $t(33) = .34$, $p = .733$, $d = .12$. Participants in two conditions had similar negative self-evaluation ratings (Close Hypothetical Prefactual $M = -2.50$; Far Hypothetical Prefactual $M = -2.47$), $t(33) = -.08$, $p = .938$, $d = .03$.

The coding instruction for the modifications was same as that in Experiment 6. In Experiment 8, two independent coders, unaware of the hypotheses, coded the total 67 responses. Their agreement rate was 89.8%, Cohen's kappa = .79, $p < .001$. Disagreements were resolved by same way as that in Study 1 and 2. In total, there were 24 modifications coded as controllable modification, 43 modifications coded as uncontrollable modification. Participants in the Close Hypothetical Prefactual condition ($n = 16$) generated an average of 1.88 modifications and participants in the Far Hypothetical Prefactual condition ($n = 19$) generated an average of 1.95 (See Table 7), $t(33) = -.27$, $p = .789$, $d = .09$.

I compared the total number of controllable modifications for each condition. Participants in Close Hypothetical Prefactual condition generated similar rates of controllable modifications with Future Hypothetical Prefactual condition, Mann-Whitney $U = 143.00$, $p = .739$, $r = .06$. As in Experiments 6 and 7, I then considered only the first modifications for each condition (See Table 8). For the first modifications, participants in Close Hypothetical Prefactual condition generated similar number of controllable modifications with the participants in Far Hypothetical Prefactual condition, $\chi^2(1, N = 35) < .01$, $p > .999$, Cramer's $V < .01$.

To conclude, participants in Experiment 8 did Hypothetical Prefactual Thinking about their performance in close or far psychological distance. However, I did not find differences in controllable features between Close Hypothetical Prefactual and Far Hypothetical

Prefactual conditions. Study 3 indicated that close / far distance did not account for temporal asymmetry effect in controllable features.

4.6. Discussions of Experiments 6, 7, and 8

To explore whether different types of speculative thinking vary in their potential to be functional, I studied the extent to which these different types generate controllable modifications. My goal was to explore Ferrante et al. (2013)'s claim that thoughts about future events have more controllable modifications than corresponding thoughts about past events; with my concern being that this reflected a difference in the hypotheticality of the events rather than their temporal status. My three experiments suggested that there is not only a temporal dimension (i.e. past / future difference), but also a reality dimension (i.e. reality / hypothetical difference) in the function of speculative thinking. Experiment 6 indicated that Realistic Prefactual Thinking generated more controllable modifications than participants doing Hypothetical Prefactual Thinking. Experiment 7 demonstrated that Hypothetical Prefactual Thinking generated more controllable modifications than Hypothetical Counterfactual Thinking. Experiment 8 showed that Hypothetical Prefactual Thinking in close or far psychological distance resulted in similar numbers of controllable modifications. This final result showed that the temporal dimension has a real effect that is not caused by psychological distance. In the following discussion, I discuss a broad functional view of speculative thinking.

I consider the power of my experiments to detect the effects of interest. One concern is that my sample sizes were smaller than those used by Ferrante et al. (2013), although two of my experiments produced significant results. In Experiment 6 ($N = 45$ with two conditions), I replicated Ferrante et al.'s finding (2013, study 1) in which they recruited 86 participants for two conditions. Effect sizes for the key comparisons of interest in my first two experiments were reasonably similar ($r = .30$ and $r = .43$). This suggests that the effects

of the two dimensions in speculative thinking I demonstrated (i.e. the reality/hypothetical dimension, and the past/future dimension) are comparable. It is worth noting that the sample in Experiment 8 (N = 35 with two conditions) is slightly smaller than those in Experiment 6 (N = 45 with two conditions) and Experiment 7 (N = 51 with two conditions). It would give me less power to identify a significant effect. It is possible that this resulted in the lack of a significant difference between the Close and Far Hypothetical Prefactual groups. However, consideration of the raw data of Experiment 8 does not suggest that there is a difference between these two groups.

4.6.1. The Function of Speculative Thinking: A Broad Functional Theory

According to the functional theory, counterfactual thinking generates thoughts that help to regulate behaviors and improve future performance (Epstude & Roese, 2008). Based on this, one might expect that counterfactual and prefactual thinking will focus on controllable modifications to the same extent (this possibility was the starting point for Ferrante's (2013) study). However, my results diverged from this, suggesting that prefactual thinking leads to more controllable modifications than counterfactual thinking. In Experiment 7, participants thought counterfactually about their unsatisfactory scrambled word performance. According to functional theory, it is the perfect time for generating goal-directed counterfactual thinking. However, participants' counterfactual thoughts had fewer controllable modifications than prefactual thoughts. Similar results were reported by Ferrante et al. (2013). They suggested that counterfactual thinking might be less likely to serve a preparatory function than prefactual thinking, because counterfactual thinking focused on less controllable features than prefactual thinking.

My results also showed that there is another important dimension in speculative thinking. Specifically, participants' speculative thoughts about an event they expected to happen (i.e. Realistic Prefactual Thinking) had more controllable modifications than thoughts

about a hypothetical event (i.e. Hypothetical Prefactual Thinking). This result suggests that thinking about reality serves more preparatory function than thinking about hypotheticals. This makes sense because when we know an event is going to happen, there is scope for our behaviors to change the outcome. Whereas when an event is hypothetical, this is not the case. I suggest that as long as people realize that an outcome remains open to change (i.e. thinking about future) and realize that an outcome can actually be changed (i.e. thinking about reality) people would prepare for the outcomes by generating controllable modifications that are the content people can use to improve the outcomes.

Therefore, my findings are the first to demonstrate that there are two dimensions of speculative thinking that influence the controllability of the modifications. These are the temporal dimension, where people are more likely to generate controllable modifications about future events, and the hypothetical dimension, where people are more likely to generate controllable modifications about real events. Previous research (e.g. Ferrante et al., 2013; Epstude et al., 2016) did not distinguish between real and hypothetical events in prefactual thinking. If we want people's speculative thoughts to change future behaviour, my results suggest that they should think about future events rather than past, but equally importantly, they should think about real anticipated events, rather than hypothetical ones. This fits with a growing body of literature showing that thinking about real events differs from thinking about hypothetical events (e.g. Camerer and Mobbs, 2017).

Epstude & Roese's (2008) functional theory proposed that counterfactuals affect subsequent behaviors through the content-specific pathway. The subsequent behaviors are related to the specific information in counterfactual thinking. For example, if a person gets wet because they forgot to bring an umbrella, then this person might think counterfactually that "I could have remembered to bring umbrella", and will prepare an umbrella to avoid getting wet in future. In order for thoughts to influence behaviour through the content-

specific pathway, they must have controllable modifications. Other types of speculative thought can include controllable modifications and, thus, could also use this content-specific pathway. In fact, my results suggest that speculative thinking about the future and about real events (compared to counterfactuals that are past and hypothetical) might be more likely to generate the kind of controllable thoughts that would be suitable for this pathway.

4.6.2. Conclusion

Overall, I showed that both temporal and reality dimensions have impact on people's speculative thoughts, resulting in significant differences in controllable modifications. I confirmed the existence of the temporal dimension, as reported by Ferrante et al. (2013), demonstrating that it did not reduce to a reality/hypothetical dimension or a psychological distance dimension. But, I also found evidence for a reality/hypothetical dimension. Previous research has overlooked whether participants are thinking about events they believe will happen (real) or those they believe will not or did not happen (hypothetical), while I provided a more comprehensive picture of how different types of speculative thinking might influence future behaviors. My findings add to Ferrante et al.'s findings (2013) about the function of counterfactual thinking, and speculative thinking more broadly. I discussed whether and how counterfactual thinking may influence future behaviors through the content-specific or content-neutral pathway. To conclude, I demonstrated different types of speculative thinking have different potential to be functional. Overall, I propose a broad functional view of speculative thinking that includes counterfactual and prefactual thinking.

Chapter 5

Difference in Inferring Controllability between Counterfactual Thinking and Lying

5.1. Abstract

In two experiments, I explored whether counterfactual thinking and lying are closely related as previous studies suggested. Specifically I explored whether lying, like counterfactual thinking, focuses on events that were under the agent's control. Participants read short vignettes about protagonists who encountered controllable and uncontrollable events and were asked whether they would 1) think counterfactually and 2) lie. Experiment 9 (N=47) showed that in line with expectations, participants were more likely to say that a protagonist experiencing a controllable event would lie than protagonist experiencing an uncontrollable event. However, surprisingly, the pattern for counterfactual thinking was reversed. Participants were more likely to say that protagonists who experienced uncontrollable events would think counterfactually. Experiment 10 (N=110) showed that participants expected protagonists to lie about controllable events rather than uncontrollable events. But there was no bias in whether participants thought that protagonists would think counterfactually about the controllable or uncontrollable events. I concluded that people's expectations about lies are influenced by the controllability of events and that counterfactual thinking may not be as closely linked to lying as some previous studies suggested.

5.2. Introduction

Counterfactual thinking is the thinking activity that people use for imagining past events that could have occurred but did not. People think counterfactually about how things could have been different in the past (e.g. Beck, & Riggs, 2014; Beck, Weisberg, Burns, & Riggs, 2014; Byrne, 2002; Roese, 1997). Some studies have explored the link between counterfactual thinking and deception. For example, Debey, De Houwer, and Verschuere (2014) explored whether thinking about the truth forms the basis of lies. In short, the researcher asked participants to answer some simple questions (e.g. "Are you a student?") by

indicating “yes” or “no”. Participants were required to lie in response to all the questions. For example, student participants should give a “no” answer when answering the question “Are you a student?”. Researchers recorded participants’ reaction time and accuracy of answering these questions. Furthermore, when answering each question, participants were shown random “YES” or “NO” words along with the question they answered. For example, for the question “Are you a student?” (in which student participants need to answer “no” to lie in order to fulfil the experimental requirement), a “YES” or “NO” word appeared to distract the participants’ attention. Researchers measured the reaction time and accuracy of participants’ answers. Results showed that, compared with when the distraction word represented the lie, participants seeing questions when the distraction word represented the truth had shorter reaction time and higher accuracy rates for lying. For example, when answering the question “Are you a student”, student participants who saw “Yes” gave “No” answer faster and more accurately than participants who saw “No”. Researchers suggested that, the activation of truth (i.e. seeing the word that represents truth) forms the base of lying (i.e. shorter reaction time and higher accuracy rates for lying). Briazu, Walsh, Deepröse, and Ganis (2017) suggested that this heuristic mechanism that lies are based on activation of truth is similar to counterfactual thinking. This is because even though thinking counterfactually is about things that are not true, it is based on what was meant to have happened.

Shalvi, Dana, Handgraaf, and De Dreu (2011) found that seeing a possible alternative outcome to an event can lead to lying. They suggested that is because seeing the alternative possible alternative outcome allows people to generate counterfactual thoughts. Specifically, researchers used a “die under cup” task, allowing participants to roll a die and check the die number in private. In one condition, participants were told that they can only roll the die once, and the larger the die number they threw, the more monetary rewards they received. In another condition, participants were told that they could roll the die three times, and the first

rolled number determined their rewards. Participants in this condition were told that the last two rolls were to test that whether the dice are normal. The researchers found that the rolled numbers reported by participants in the multiple rolling condition was higher than the normal distribution, and higher than in the control condition. Researchers suggested that seeing an alternative outcome that participants could have had but did not allowed participants think counterfactually about how they could have rolled different number. They further suggested that counterfactual thinking generated after seeing the other numbers that they rolled (e.g., “I could have rolled larger number”) might lead participants to lie about their rolling number, because counterfactual thinking may give people a sense of justification for lying. That is, observing the desired alternative can reduce the extent to which people believe that lying is unethical, even if these alternatives are not true in the reality (e.g., additional rolls did not determine rewards). People use this self-justification to reduce their unethical feeling for lying, so that they can feel better about lying.

However, Briazu et al. (2017) suggested that, generating counterfactuals requires people to imagine alternatives in their mind. On the other hand, observing desired alternatives (e.g. an additional rolled number that is larger than the actual number) allows participants to actually see a desired alternative outcome that almost happened, so participants did not need to rely on thinking counterfactually about the desired alternatives in their minds. To further explore the direct link between counterfactual thinking and lying, Briazu et al. (2017) conducted a series of studies, using stories that can prime counterfactual thinking. Their stories were based on previous studies (e.g. Roese & Olson, 1996; Kahneman, & Tversky, 1982) that indicated closeness and exceptionality are determinants that increase people’s likelihood to think counterfactually, as I explored in chapter 2. Based on previous research, in one study Briazu et al. (2017) explored whether participants would generate different numbers of lies between high counterfactual thinking and low counterfactual thinking groups.

Specially, participants in the high counterfactual thinking group read stories with counterfactual determinants, while participants in the low counterfactual thinking group read stories without counterfactual determinants. For example, for closeness, one story with closeness was about imagining a car that was hit had only been parked for few moments, and the corresponding story without closeness was about imagining a car that was hit had been parked for a long time. For exceptionality, one story with exceptionality was about imagining you are a person who rarely watches movies that chooses to go to the cinema rather than attend your neighbors' party. The corresponding story without exceptionality was about imagining you are a person who often watches movies that chooses to go to the cinema rather than attend your neighbors' party. After reading stories, participants answered some questions about spontaneous lying (e.g. "write down anything you would say to the police..." for the closeness stories; "write down anything you would say to the neighbour if asked why you failed to attend the party..."). The results showed that participants reading stories with counterfactual determinants generated more lies than participants reading stories without counterfactual determinants.

In another study, Briazu et al. (2017) explored whether, when reading both stories with and without counterfactual determinants, participants think that the protagonist in the story with counterfactual determinants would be more likely to lie than the other protagonist. Participants read some stories with and without exceptionality (as a counterfactual determinant). For example, one story with exceptionality was about a protagonist crashing his car on the daily route, and the corresponding story without exceptionality was about a protagonist crashing his car on a new route. After that, participants answered a question about which protagonist was more likely to lie. The results showed that participants tended to think that the protagonist experiencing the exceptional events rather than the unexceptional events were more likely to lie. These results suggested that people are more likely to think that the

situation that counterfactual alternatives are available in (i.e. counterfactual determinants) can lead to lying compared to situation that counterfactual alternatives are less available.

Researchers suggested that it reflects the close link between counterfactual thinking and lying.

However, Briazu et al. (2017) did not explore whether these counterfactual determinants (e.g. closeness and exceptionality) would lead to participants lying and thinking counterfactually to different extents, because there was no question about counterfactual thinking in their studies. Therefore, there are possibilities that closeness (or exceptionality) is more likely to lead to counterfactual thinking than lying, or closeness (or exceptionality) is more likely to lead to lying than counterfactual thinking. The general goal of this chapter is to revisit the relationship between counterfactual thinking and lying. That is because research on the relationship between counterfactual thinking and lying lacks direct comparison between counterfactual thinking and lying, although there is increasing research in this area. Based on this general goal, the specific goal of this chapter is to explore whether same counterfactual determinant can lead to different extents of counterfactual thinking and lying. Especially, I chose controllability as the variable to compare the relationship between counterfactual thinking and lying, exploring whether controllability as one specific counterfactual determinant would lead participants to infer counterfactual thinking and lying differently. In this chapter, I look at controllability (as a different determinant of counterfactual thinking) to broaden the research that had gone before.

Research on controllability suggested that controllability can lead to counterfactual thinking. For example, Mandel and Lehman (1996) explored people's counterfactual thoughts when reading both controllable (e.g., the protagonist chose an irregular route to go home) and uncontrollable events (e.g., A truck did not obey the traffic rules and hit). Researchers asked participants to read a story about a protagonist suffering a car accident. Participants then

needed to generate counterfactual thoughts for the protagonist. Results showed that participants' counterfactual thoughts mainly focused on the controllable actions that protagonist did (e.g. "he should have chosen another route"), rather than uncontrollable events. Girotto, Legrenzi, and Rizzo (1991) asked participants to generate counterfactual thoughts for one protagonist who was delayed by both controllable events (e.g. having a drink) and uncontrollable events (e.g. road blocked by a flock of sheep), and when the protagonist came home he found his wife had just died because of heart attack. Researchers found that participants' counterfactual thoughts mainly focused on protagonist's controllable action (e.g. "he could have come home earlier and saved his wife if he did not have a drink"). The functional theory of counterfactual thinking (e.g., Epstude & Roese, 2008; Roese & Epstude, 2017) focused on controllability. This theory suggested that counterfactual thinking focusing on controllable events or actions is helpful for promoting future performance, since people can only make efforts to improve the controllable parts.

On the other hand, there have been some contrasting results suggesting counterfactual thinking does not focus on controllable features. These studies suggested that controllability may not be as effective in generating counterfactual thinking. Girotto, Ferrante, Pighin, and Gonzalez (2007) divided participants into actor and reader conditions. Participants in the actor condition needed to choose either a simple or difficult task to perform, while participants in the reader condition read a story about one protagonist choosing either a simple or difficult task and experiencing task failure. All participants were then asked to generate counterfactual thoughts about their task performance or the story they read. Results showed that participants in the actor rather than reader condition generated more counterfactual thoughts focusing on uncontrollable features. Researchers suggested that this is due to the difference between reader and actor. A reader of a counterfactual story can understand how the outcome could have been different from the story, and thus know exactly

what action can change the outcome. But a person who has actual experience may easily retrieve many experiences from memory. These experiences can often include many situational aspects that are not controllable for people themselves. Researchers further suggested that previous findings that counterfactual thinking tends to focus on controllable features might be due to using reader rather than actor paradigms. Furthermore, Pighin, Byrne, Ferrante, Gonzalez, and Giroto (2011) adapted this design, dividing participants into reader and observer conditions. Participants in the reader condition needed to read a story about a protagonist who chose one task and failed. Participants in the observer condition actually observed that a person chose a task and failed. Researchers found that, like actors, counterfactual thinking generated by an observer who actually observed a failed experience focused on fewer controllable features than counterfactual thinking generated by a reader who read about a failed experience.

In summary, previous research on the relation between counterfactual thinking and lying was concerned with some specific counterfactual determinants (e.g., closeness, exceptionality). In this chapter, the specific research goal is to see whether controllability (as a counterfactual determinant) specifically impacts on counterfactual thinking and lying in same was as other determinants. Furthermore, the functional theory of counterfactual thinking (e.g. Epstude & Roese, 2008) defines controllability as the key to counterfactual thinking's preparatory function. That is because people can only improve the event that is controllable. However, current counterfactual thinking research has begun to question controllability (as a counterfactual determinant) for generating counterfactual thinking. Therefore, the preparatory function that counterfactual thinking serves is challenged. The general research goal of this chapter is to look at the relationship between counterfactual thinking and lying, which can help us to understand counterfactual thinking's function in supporting lying.

My Experiment 9 explored how participants would infer controllability in questions about counterfactual thinking and lying. Specifically I explored whether participants would think that counterfactual thinking/lying is more likely to occur after controllable or uncontrollable events. In Experiment 9, participants read short vignettes about protagonists who encountered controllable and uncontrollable events and were asked whether they would 1) think counterfactually and 2) lie. If previous research (e.g., Epstude and Roese, 2008) on controllability leading to counterfactual thinking is right, and previous research (e.g., Briazu et al., 2017) on the relationship between counterfactual thinking and lying is right, then the first possibility would be that participants will think the protagonist in the controllable story is more likely to think counterfactually and lie than the protagonist in the uncontrollable story. But if previous research (e.g., Girotto et al., 2007) on controllability not leading to counterfactual thinking is right, then the second possibility would be that participants think the protagonist in the controllable story is less likely to think counterfactually and lie than the protagonist in the uncontrollable story. As I discussed earlier in section 5.2, it is possible that counterfactual determinants lead to lying and counterfactual thinking to varying extents, then the third possibility would be that participants would allocate different controllable/uncontrollable protagonist to the counterfactual thinking and lying questions.

My Experiment 10 explored that whether participants are likely to focus on the controllable or uncontrollable event when facing questions about counterfactual thinking and lying. In Experiment 10, participants read short vignettes about protagonists who thought counterfactually or lied, and they were asked whether the protagonist encounters controllable or uncontrollable events. Experiment 10 advances our knowledge from Experiment 9. Specifically, what Experiment 9 explored is participants' judgments about counterfactual thinking and lies based on knowing controllable stories and uncontrollable stories. Experiment 10 in turn explored that, based on knowing that counterfactual thinking and lying

will occur, how participants make judgments about controllable and uncontrollable events. If previous research on controllability leading to counterfactual thinking, and previous research on the relationship between counterfactual thinking and lying are right, then the first possibility would be that participants in the counterfactual and lying conditions are more likely to focus on the controllable event than uncontrollable event. But if previous research on controllability not leading to counterfactual thinking is right, then the second possibility would be that participants in the counterfactual and lying conditions are less likely to focus on the controllable event than uncontrollable event. Similarly to Experiment 9, the third possibility would be that participants would focus on different controllable or uncontrollable events for the counterfactual thinking and lying conditions. Combining Experiments 9 and 10, I can better understand the relationship between controllability and lying/counterfactual thinking from two directions (i.e. inferring lying/counterfactual thinking based on knowing controllability, and inferring controllability based on knowing lying/counterfactual).

5.3. Experiment 9: Inferring Controllability in Counterfactual Thinking and Lying

Questions

5.3.1. Method

5.3.1.1. Participants

47 psychology students (39 women, 8 men) of the University of Birmingham participated to gain course credits. No individual participated in more than one experiment reported in this chapter.

5.3.1.2. Design & Materials

I adapted the *parcel* stories from Briazu et al. (2017, experiment 2). In the original two versions of stories, two protagonists missed their parcels by 5 minutes or half hour

because they had coffee after work. In my study, I adapted the stories into that two protagonists were delayed by either their own decision of having coffee (controllable event), or by traffic light being broken (uncontrollable event). Each participant read both versions of stories, and answered both counterfactual thinking and lying questions. In order to avoid the possibility that participants might infer the two events (i.e. waiting for the broken traffic light, and having coffee) take different time, I added the same time indicators (i.e. half hour) for two events. That is, the broken traffic light and having coffee both delayed the protagonist for half an hour.

In order to avoid the potential order effect that the order of presenting controllable and uncontrollable versions of stories might affect participants' answers, I counterbalanced the order in which the controllable and uncontrollable versions of stories were presented. I also counterbalanced the order of presenting counterfactual thinking and lying. In summary, each half of participants read either a story about protagonist who was delayed by having coffee or a story about protagonist who was delayed by traffic light being broken first, in which each half of participants were first asked the counterfactual thinking or lying question.

The two stories were both on the same page, and then the two questions were presented separately on two pages.

The stories and questioned asked in Experiment 9 are included in the Appendix I.

5.3.1.3. Procedure

The experimenter greeted the participants and asked them to complete the consent form. Participants completed the study in a quiet room alone.

Depending on the controllability order, participants either read the story about the protagonist who was delayed by having coffee or the story about the protagonist who was delayed by traffic light being broken first. After that, participants were given the first question to answer. After participants returned their first answer sheet, they were given the second

question to answer. Depending on the question order, the first (second) question was the counterfactual thinking question that “Although you cannot tell for sure from the reading materials, who spends more time thinking about how things could have been different?”, and the second (first) question was the lying question that “Although you cannot tell for sure from the reading materials, who would be more likely to lie to their parents about why they were late?”

Participants were thanked and debriefed.

5.3.2. Results

In order to avoid the possible impact of participants’ different English proficiency on reading stories and answering questions, my data analysis excluded non-native English speakers’ data. Eight participants’ data were excluded from analysis, leaving 40 native English speakers’ data. Data are summarized in Table 9. There was no order effect of presenting controllable and uncontrollable versions of stories in the pattern of inferring which protagonist was more likely to think counterfactually and lie: Counterfactual thinking question, Fisher’s Exact Test (1, N = 40) $p > .999$, Cramer’s V = .03; Lying question, Fisher’s Exact Test (1, N = 40) $p = .475$, Cramer’s V = .17. Also, there was no question order effect of presenting counterfactual thinking and lying questions in the pattern of inferring which protagonist was more likely to think counterfactually and lie: Counterfactual thinking question, Fisher’s Exact Test (1, N = 40) $p = .491$, Cramer’s V = .15; Lying question, Fisher’s Exact Test (1, N = 40) $p > .999$, Cramer’s V = .15.

Second, I explored whether participants were more likely to choose the protagonist experiencing a controllable or uncontrollable event in counterfactual thinking and lying questions, using binomial tests to compare the responses in two questions. For the counterfactual thinking question, surprisingly, participants were more likely to say that the protagonist experiencing the uncontrollable event was likely to think counterfactually than

protagonist experiencing the controllable event, $p = .017$. However, in line with previous literature on lying, for the lying question participants were more likely to say that protagonist experiencing the controllable event was likely to lie than protagonist experiencing the uncontrollable event, $p < .001$.

To sum up, in Experiment 9 I found that there is a difference in inferring controllability between counterfactual thinking and lying questions.

Table 9. Number of participants choosing the protagonist who experienced controllable and uncontrollable events in two questions

		Participants' choices	
		Controllable protagonist	Uncontrollable protagonist
Questions	Counterfactual	12	28
	Lying	39	1

5.4. Experiment 10: Controllability Focus in Counterfactual Thinking and Lying

Questions

In Experiment 9, I found that participants inferred that the protagonist experiencing the uncontrollable event (compared to the controllable event) was more likely to think counterfactually. However, I found that participants inferred that the protagonist experiencing the controllable event (compared to uncontrollable event) was more likely to lie. These results are inconsistent with my expectation based on previous research with other counterfactual determinants (i.e. closeness and exceptionality).

Experiment 10 explored that, when participants know that someone is lying or thinking counterfactually, do they think the content will be controllable or uncontrollable. This design allows me to have a more comprehensive understanding of the difference between counterfactual thinking and lying in controllability. Specifically, based on Experiment 9 (demonstrating that participants were more likely to say that protagonist experiencing the controllable event was likely to lie than protagonist experiencing the uncontrollable event), I hypothesized that participants would think the protagonist was more likely to lie about the controllable event than the uncontrollable events. Also, Experiment 9

found that participants were more likely to choose the uncontrollable event when answering the counterfactual thinking question, which is inconsistent with some previous counterfactual thinking studies. Based on these contrasting findings, Experiment 10 has three possibilities for the counterfactual thinking and lying questions. If previous research on controllability leading to counterfactual thinking, and previous research on the relationship between counterfactual thinking and lying are right, then the first possibility is that participants in both counterfactual and lying conditions would think the protagonist was more likely to think counterfactually and lie about the controllable event than the uncontrollable event. But if previous research on controllability not leading to counterfactual thinking is right, then the second possibility is that participants in both counterfactual and lying conditions would think the protagonist was not more likely to think counterfactually and lie about the controllable event than the uncontrollable event. The third possibility is that participants in counterfactual and lying conditions would have different answers on whether the protagonist was more likely to think counterfactually and lie about the controllable or uncontrollable event.

5.4.1. Method

5.4.1.1. Participants

110 psychology students (97 women, 13 men) from the University of Birmingham participated in this experiment to gain course credits.

5.4.1.2. Design & Materials

Participants were alternately assigned to one of two conditions: the Counterfactual Thinking condition or Lying condition. All participants read the same story about a protagonist who was delayed by both controllable (i.e. stopping for coffee) and uncontrollable (i.e. traffic light being broken) events. The stories in Experiment 10 were similar to that in Experiment 9. The difference was that, in the story in Experiment 10 one

protagonist was delayed by a controllable event and an uncontrollable event, while in the story in Experiment 9 the two protagonists were each delayed by a controllable or an uncontrollable event respectively. Participants in the counterfactual thinking condition were asked “Alison thinks about how things could have been different. What do you think she is more likely to think about?”. Participants in the lying condition were asked “Alison lies to her parents about why she arrived home when she did. What do you think she is more likely to lie about?”

In order to avoid the possibility that participants might infer the two events (i.e. having coffee, and traffic light being broken) take different time (which might affect my results), I added the same time indicators of half hour for two events as in Experiment 9. In order to avoid the potential order effect of presenting controllable or uncontrollable event first on participants’ judgment, I counterbalanced the order in which the controllable and uncontrollable events were presented. That is, each half of participants in each condition read either the protagonist was delayed by having coffee or traffic light being broken first.

The stories and question asked in Experiment 10 are included in the Appendix J.

5.4.1.3. Procedure

The experimenter greeted the participants and asked them to complete the consent form. Participants completed the study in a quiet room alone.

Depending on the controllability order, participants either read the parcel story having the controllable event first or read the parcel story having the uncontrollable event first. After that, participants in the counterfactual thinking condition were asked, “Alison thinks about how things could have been different. What do you think she is more likely to think about: A. Things could have been better if I didn’t stop for coffee. B. Things could have been better if the traffic light wasn’t broken.” I presented the answer options in the same order as the two events were mentioned in the story, which was counterbalanced. Participants in the lying

condition were asked, “Alison lies to her parents about why she arrived home when she did. What do you think she is more likely to lie about: A. The traffic light being broken B. Stopping for coffee.”

Participants were thanked and debriefed.

5.4.2. Results

In Experiment 10, my data analysis also excluded non-native English speakers’ data. 21 participants’ data were excluded from the analysis, leaving 89 native English speakers’ data. Data are summarized in Table 10. There was no order effect of presenting the controllable or uncontrollable event first in the pattern of choosing the controllable or uncontrollable event for the counterfactual thinking and lying questions: Fisher’s Exact Test (1, N = 89) $p > .999$, Cramer’s $V < .01$.

Second, I made a comparison between the counterfactual thinking and lying conditions. A chi square test showed that, there was a difference in the pattern of choosing the controllable event option between the counterfactual thinking and lying conditions: $\chi^2 (1, N = 89) = 15.74, p < .001$, Cramer’s $V = .42$. I then explored whether participants were more likely to choose the controllable event option in counterfactual thinking and lying conditions, using binomial tests. Following the results of Experiment 9, in the counterfactual thinking condition, participants were not more likely to infer that the protagonist was likely to think counterfactually about the controllable than uncontrollable event, $p = .349$. In the lying condition, participants were more likely to say that protagonist was likely lie about the controllable than uncontrollable event, $p < .001$.

To sum up, in Experiment 10, I found that the lying did lead participants to focus more on the controllable event than the uncontrollable event, while counterfactual thinking did not lead participants to focus more on the controllable or uncontrollable event.

Table 10. Number of participants choosing the controllable or uncontrollable event in two conditions

		Participants' choices	
		Controllable event	Uncontrollable event
Conditions	Counterfactual	24	17
	Lying	45	3

5.5. Discussions of Experiments 9 and 10

This chapter uses controllability to explore the connection between counterfactual thinking and deception. In Experiment 9, I found that, after reading both controllable and uncontrollable stories, participants were more likely to choose that the protagonist in the uncontrollable story would think counterfactually than the protagonist in the controllable story; while participants were more likely to choose that the protagonist in the controllable story would lie than the protagonist in the uncontrollable story. In Experiment 10, I found that, after reading a story containing both controllable and uncontrollable information, participants who knew the protagonist planned to lie focused on controllable than uncontrollable information, while participants who knew the protagonist would think counterfactually did not focus on controllable than uncontrollable information.

To consider the power of Experiments 9 and 10 to detect the effects of interest, I compared the sample sizes of Experiments 9 and 10 with the sample size of previous research. In Experiment 9 (N = 47 with two conditions) and Experiment 10 (N = 110 with two conditions), I adapted Briazu et al.'s experiment (2017) in which they recruited 123 participants for two conditions. The sample sizes of Experiments 9 and 10 are smaller than

the sample size of previous experiment. It would give me less power to identify a significant effect, although I have found the effects. It is noteworthy that Experiment 9 showed a significant effect of the uncontrollable event on counterfactual thinking, but Experiment 10 with a bigger sample size did not show a difference between focusing on controllable and uncontrollable content when answering the counterfactual thinking question. This difference in results patterns between Experiments 9 and 10 may be explained by the different designs between Experiment 9 and Experiment 10. Specifically, in Experiment 10 participants only needed to answer one question (i.e., either the counterfactual thinking or lying question) depending on the condition they were assigned into. On the other hand, participants in Experiment 9 needed to answer both a counterfactual thinking question and a lying question. In Experiment 9, the counterfactual thinking question and lying question are different, but the answer options for the two questions are the same (i.e., “Alison” and “Ella”). There is a possibility that participants may tend to select different answer options for two different questions when they found that two different questions have the same set of answer options.

Some studies suggested that counterfactual thinking that represents how past events could have been different can lead to lies (e.g. Briazu et al., 2017; Shalvi et al., 2011). For example, Shalvi et al. (2011) found that participants were more likely to lie about die-rolling when they saw alternative dice results that can lead to counterfactual thinking. Researchers suggested that this was because seeing counterfactual alternatives can make participants feel psychologically close to the desired dice numbers, which indicated closeness. Lelieveld, Shalvi, and Crone (2016) used similar die-rolling paradigm to study participants’ neurological responses to evaluating others’ lies about dice results. They suggested that, lying about a counterfactual alternative that is closer to the truth is more likely to be considered as the justifiable lie than lying about purely imaginative alternative that is farther to the truth. Briazu et al. (2017) suggested that the reason why people lie about closeness to expected outcome is

that people think it is acceptable to themselves and others. These studies linking counterfactual thinking and lying explored the determinants of closeness and exceptionality, but not the determinant of controllability. Therefore the link between counterfactual thinking and lying might not be applicable in all situations.

As for the link between controllability and counterfactual thinking, Experiment 9 found that participants assigned uncontrollability to the counterfactual thinking question, and Experiment 10 found that participants did not focus more on controllable information when thinking counterfactually. One way to explain this is to look at Roese et al.'s research (2017). They suggested that if an activity is initiated by others rather than by people themselves, counterfactual thinking generated is more likely to focus on uncontrollable information, while counterfactual thinking is more likely to focus on controllable information if an activity is initiated by people themselves. Researchers found that when participants described self-initiated events like deciding to go to a movie, buying gifts for others, or preparing family dinner, counterfactual thinking generated by these events was more likely to focus on controllable features. On the other hand, they found that participants' counterfactual thinking was more likely to focus on uncontrollable features when describing others-initiated events like taking exams written by teachers, going to a movie chosen by friends, or having dinner prepared by others. The explanation is, being required to read the counterfactual thinking and lying stories is an activity initiated by others, rather than self-initiated activity. Although the events in the stories are self-initiated by the protagonists, the act of reading the story is initiated by another person – the researcher. Therefore I might expect participants to focus on uncontrollable events when thinking counterfactually. The previous research provides an explanation for my results that participants thought the character experiencing the uncontrollable event (compared to the controllable event) is more likely to think counterfactually (Experiment 9), and there was no difference between focusing on the

controllable and uncontrollable content when knowing the character thinking counterfactually (Experiment 10). A surprising point is that this explanation would still lead to expecting counterfactual thinking has same pattern with lying. However the results for lying questions do not follow the pattern of counterfactual thinking questions.

These different results between counterfactual thinking and lying require a new hypothesis to explain them. I proposed a blame-control hypothesis to explain the difference results for inferring controllability between lying and counterfactual thinking. This hypothesis includes two points: 1. Counterfactual thinking and lying both focus on avoiding being blamed; 2. Counterfactual thinking is a self-directed activity (i.e., things that people do to themselves), and lying is a social activity (i.e., things that people do to others). For example, when something upsetting happens, self-comfort (that is a self-directed activity) can make us feel better; while when upsetting things happen to others, we can also comfort others, which is a social activity.

When people think counterfactually about an outcome, people focus on themselves, and they are motivated to avoid blame (self-blame in this case). Therefore, people focus on the uncontrollable event. On the contrary, when people are lying about an outcome, people focus on what other people think, they are motivated to avoid blame (from others), so they lied about the controllable event. Specifically, for counterfactual thinking, if an event was controllable, but ultimately led to bad outcome, people will blame themselves (e.g. “things could have been better if I did not drink coffee”). On the other hand, for lying, if an event was controllable, but ultimately led to bad outcome, people may assume they will receive blame from others. The motivation of avoiding self-blame may lead people not to pay attention to controllable events when thinking counterfactually, because it will enable people to reduce the regret generated by counterfactual thinking (e.g. “I could have not drunk the coffee”). On the other hand, the motivation of avoiding being blamed (from others) can cause people to lie

about controllable events (e.g., “I did not have coffee”).

There is no literature specifically discussing the blame effect on the difference in controllability between lying and counterfactual thinking, mainly due to blame. But there is literature on two aspects: 1. the controllability that people perceived over events can lead to self-blame; 2. people lie to avoid blame. There is research suggesting that self-blame is related to the perceived control (e.g. Tennen, Affleck, & Gershman, 1986; Vasconcelos e Sa, Barrowclough, Hartley, & Wearden, 2017). For example, Tennen, et al. (1986) focused on self-blame among mothers whose infants were in hospital for serious perinatal complications. The mothers were interviewed in their homes about 2 months after their infants had been discharged from intensive care. The first interview question was about what they thought to be the cause of their infants’ medical problems. Participants’ answers to this question were classified into either about blaming themselves, or about blaming others, external environment, and chance. Participants also evaluated how much they thought they had control over the medical problems. They needed to indicate on a 10 point scale how much they thought they had control (1 = the outcome was not under control at all, 10 = the outcome was totally under control). Results showed that mothers’ perceived control over the medical problems and recovery of infants is positively related to parents’ self-blame after having infants discharged. For example, if a participant thought the cause of her infant’s medical problem (e.g., cervical disorder) is due to external causes (i.e., blaming others), the participant would perceive less control over the medical problems and recovery of infants; if a participant thought the cause of medical problem is due to internal causes (i.e., self-blame), the participant would perceive more control. Also, Vasconcelos e Sa, Barrowclough, Hartley, and Wearden (2017) suggested that as the level of self-blame increases, people attribute more controllability to the past events, and people will also increase their sense of control over similar future events. That is, self-blame leads to thinking that the past events were

controllable (i.e. could have been controllable).

I suggested that, counterfactual thinking that things could have been controllable can make people perceive they had control over the event, which makes people to generate self-blame for controllable events. Specifically, when answering the counterfactual thinking question, or reading a protagonist thinking counterfactually, my participants may think about self-blame. They might then think that the protagonist would need to focus on the uncontrollable event to avoid self-blame. Also, Tennen, et al. (1986) suggested that people have self-protective motives to avoid blame from others. Therefore, when answering the question about lying, or reading a protagonist thinking counterfactually, the motive of avoiding blame from others may lead participants to focus on the controllable events.

5.5.1. Conclusion

Experiment 9 showed that participants answering the counterfactual thinking question were more likely to say that the protagonist in the uncontrollable story was likely to think counterfactually than protagonist in the controllable story; while participants answering the lying question were more likely to say that protagonist in the controllable story was likely to lie than protagonist in the uncontrollable story. Experiment 10 showed that participants who knew the protagonist planned to lie focused more on controllable than uncontrollable information. Participants who knew the protagonist thought counterfactually did not focus more on controllable than uncontrollable information. Although counterfactual thinking and lying are closely related in some ways (Briazu et al., 2017), in these experiments I found that lying seemed to be influenced by the controllability of events in a way that counterfactual thinking was not. I discuss the possibilities that the motive of avoiding self-blame may lead participants not to focus on the controllable events in the questions about counterfactual thinking; and the motive of avoiding blame from others may lead participants to focus on the controllable events in the questions about lying.

Chapter 6

General Discussion

6.1. Summary

In this thesis, I explore the functions of speculative thinking through four experimental chapters. Specifically, I explore the functions of speculative thinking from a broader perspective than the traditional Functional Theory, and compare the functions of speculative thinking about the past and future. Among these four experimental chapters, two explore some non-preparatory functions of speculative thinking that have not been widely discussed, which are the function of conveying information (Chapter 2), and the function of supporting lying (Chapter 5). The other two experimental chapters explore the temporal asymmetry in speculative thinking, in which one chapter focuses on construal levels in speculative thinking about the past and future (Chapter 3) and one chapter focuses on temporal asymmetry and reality / hypothetical difference in the preparatory function of speculative thinking (Chapter 4). In general, this thesis suggests that a broader functional theory is needed to discuss non-preparatory functions and traditional preparatory function. Also, the broader functional theory should cover all speculative thinking of the past and future instead of just counterfactual thinking.

In chapter 2 (Experiments 1, 2, 3, and 4), I explored the function of past speculative thinking that is conveying information from others' counterfactuals. I found that the existence (but not the numbers) of counterfactual thoughts can lead people to infer that event is close, exceptional, and controllable, which suggests that the relation between closeness / controllability / exceptionality and counterfactual thinking is bidirectional. In chapter 3 (Experiment 5), I compared general speculative thinking about the past and future. I found that that people use different levels of construal to represent activities differently along the far / close dimension and the past / future dimension. In chapter 4 (Experiments 6, 7, and 8), I compared the preparatory function of speculative thinking about the past and future. I found that both temporal and reality dimensions may impact on people's speculative thoughts,

resulting in significant differences in controllable modifications. In chapter 5 (Experiments 9 and 10), I explored the link between lying and counterfactual thinking. I found that that people's expectations about lies are influenced by the controllability of events and that counterfactual thinking may not be as closely linked to lying as some previous studies suggested.

In general, this thesis expands the functional theory of counterfactual thinking (i.e. Epstude & Roese, 2008) that has mainly been concerned with the preparatory function of counterfactual thinking. Firstly, this thesis extends the object of interest from the narrow sense of counterfactual thinking to general speculative thinking. This thesis includes counterfactual thinking, prefactual thinking, and other speculative thinking about the past and future. Secondly, this thesis extends the function (discussed in the functional theory) from the narrow sense of preparatory function to the function of conveying information, the function of generating lies, the reality / hypothetical difference in the preparatory function, and the temporal asymmetry in the functions. My thesis can give a more comprehensive picture of functions of speculative thinking from the perspectives of inferences, general speculative thinking, construal level, and deception, which can enrich the functional theory of counterfactual thinking.

6.2. Non-Preparatory Functions of Counterfactual Thinking

The traditional functional theory (Epstude & Roese, 2008) focuses on the preparatory function of counterfactual thinking. Focusing on some non-preparatory functions of counterfactual thinking can help us to more understand the functions of speculative thinking. Specifically, my chapter 2 explores the function of counterfactual thinking to convey information. My chapter 5 revisits the function of counterfactual thinking to support lying, suggesting a different view from the traditional lying literature.

6.2.1. Function of Conveying Information

Chapter 2 showed that on knowing that someone has made counterfactual statements, people can make inferences of closeness, controllability, and exceptionality. Combining previous research (on determinants leading to counterfactual thinking), chapter 2 suggested that the relation between closeness / controllability / exceptionality and counterfactual thinking is bidirectional. The functional theory suggested that counterfactual thinking can help people to identify key determinants of outcome based on counterfactual worlds. My chapter 2 showed that this also works when people are thinking about the 3rd person. This suggests that, like our own counterfactual thoughts, others' counterfactual thoughts can also help us to identify key determinants of outcome. From reading and listening others' counterfactual thoughts, people can infer that this character who thought counterfactually could have caught the flight if they came earlier. Therefore counterfactual thinking serves a function of conveying information to listeners.

As I discussed in chapter 2, there is already a relatively small literature on how people understand others' counterfactuals. Previous experiments (e.g. De Vega & Urrutia, 2012; Ferguson & Sanford, 2008; Santamaría, Espino, & Byrne, 2005) showed that people represent different alternative possibilities in mind when understanding counterfactual information compared to factual information and that they generate inferences consistent with the counterfactual world. In chapter 2, I went beyond this by looking at the inferences that people draw from others' counterfactual thoughts. We already know that determinants exist that influence the tendency for people to generate their own counterfactual thoughts, and now I found that people's inferences drawn from others' counterfactual thoughts are influenced in a similar way. To sum up, chapter 2 demonstrated that the inferential relation between counterfactual thinking and its determinants was bidirectional. On hearing people make counterfactual statements people make inferences that go beyond the information presented.

Specifically, we are biased to think that events that prompt counterfactual statements were psychologically close, controllable, and exceptional.

6.2.2 Revisiting the Function of Counterfactual Thinking Supporting Lying

The above section discussed that counterfactual thinking has a non-preparatory function that enables people to gain information from other people's counterfactual thoughts. This section explores another non-preparatory function of counterfactual thinking to support lying. As I discussed in chapter 5, some previous studies suggested that counterfactual thinking that represents how past events could have been different can lead to lies (e.g. Briazu et al., 2017; Shalvi et al., 2011). However, in chapter 5, when exploring the potential function of counterfactual thinking to support lying, I found that counterfactual thinking and lying are not closely related in the aspect of controllability.

Based on the functional theory of counterfactual thinking (Epstude & Roese, 2008; Roese & Epstude, 2017), chapter 5 can inform ideas about preparatory function. Specifically, chapter 5 discussed the possibilities that the motive of avoiding self-blame may lead participants not to focus on the controllable events in the questions about counterfactual thinking; and the motive of avoiding blame from others may lead participants to focus on the controllable events in the questions about lying. This suggestion in chapter 5 provided a possibility that counterfactual thinking and lying may have different degrees of the preparatory function to regulate/change future behaviours. That is, according to the functional theory, controllability is the focus of preparatory function, which serves the function to improve and change future behaviours. In order for counterfactual thinking to help people perform better in future similar events, counterfactual thoughts need to focus on things that the individual can control, because people can only make efforts to improve the controllable parts. However, chapter 5 demonstrated that counterfactual thinking is less closely linked to controllability than lying. According to the functional theory, these results from chapter 5

may be surprising. On the other hand, Ferrante et al. (2013) and the results of chapter 4 in this thesis showed that counterfactual thinking does not always focus on controllable events. Following this vein, an intriguing possibility is that lying might have a larger influence on future behaviors than counterfactual thinking, suggesting that people who was lying about one action may have stronger motivation to change wrong action in future than people who was thinking counterfactually.

In chapter 5, I discussed the possibility that people's counterfactual thoughts may focus on controllable events only when some conditions are met (e.g. self-initiated activities instead of other-initiated activities), otherwise people's counterfactual thoughts may focus on uncontrollable events. Also, I proposed a blame-control hypothesis to explain the difference results for inferring controllability between lying and counterfactual thinking. In general, the motive of lying to avoid blame from others, and the motive of thinking counterfactually to avoid blame from self, both result in lying focusing more on controllable events than counterfactual thinking.

6.3. Asymmetries in Functions of Speculative Thinking

In chapters 3 and 4 I explored two asymmetries in functions of speculative thinking. First I found that there is temporal asymmetry in speculative thinking, demonstrating the difference between speculative thinking about the past and future. In addition, I found that there is a reality/hypothetical difference in speculative thinking, demonstrating the difference between speculative thinking about the reality and hypothetical events. Specifically, chapter 3 explored temporal asymmetry in the degree of abstraction people use to describe events. Chapter 4 explored the roles of both temporal asymmetry and reality/hypothetical difference on the preparatory function of speculative thinking.

6.3.1. Temporal Asymmetry in Construal Level of Speculative Thinking

In chapter 3, I found that participants who did speculative thinking about the future

elicited less abstract descriptions than participants who did speculative thinking about the past. This finding demonstrates there is a temporal asymmetry in construal level of speculative thinking, showing that speculative thinking about the past leads to higher construal level than speculative thinking about the future. Based on previous research on comparing construal levels between thinking about different psychological distances (e.g. Liberman & Trope, 1998), my chapter 5 made direct comparison between construal levels of speculative thinking about the past and future.

Temporal asymmetry in construal level may also indicate a temporal asymmetry in preparatory function of speculative thinking. Based on construal level theory, Speculative thinking about the future may serve more preparatory function than speculative thinking about the past, because thinking about the future has lower construal level than thinking about the past. Specifically, Trope and Liberman (2010) suggested that the function of high construal level is to maintain those stable and unchanged features of events, because the high level characteristics are more likely to remain unchanged than low level characteristics when psychological distance increases or decreases. Because what has happened in the past cannot be changed, using high construal level (that maintains the unchanged features of events) to represent past events can help people to learn from the past experience. Otherwise, if people use low construal level to represent and learn from past experiences, it will bring in lots of details and unnecessary burden to people's mental load. This may be the reason why thinking of the past has a higher construal level than thinking of the future. On the other hand, low construal level contains specific information about how actions to be performed, which is helpful for completing upcoming tasks.

As I discussed in chapter 3, this result can be linked into discussing about temporal asymmetry in psychological distance of speculative thinking. CLT (e.g. Trope & Liberman, 2010) suggested that close psychological distance can lead to lower construal levels than far

psychological distance. Based on this, my results suggest that speculative thinking about the future may lead to closer psychological distance than thinking about the past. This suggestion about temporal asymmetry in psychological distance fits with previous research on thinking about the future and past leads to infer different psychological distance (e.g. Caruso et al., 2013; Rinaldi, et al., 2017).

Temporal asymmetry in psychological distance may also indicate a temporal asymmetry in preparatory function of speculative thinking. Specifically, thinking about close psychological distance may be more helpful to prepare future behaviours than thinking about far psychological distance. For example, in one study, Peetz, Wilson, and Strahan (2009) explored the influence of different psychological distances on the motivation of people's academic performance. Participants in the close condition marked the distance between "today" and "graduation" on a timeline spanning 25 years, while the participants in the distant condition marked on a timeline spanning 5 years. Because the two timelines had same length, the points on the scale spanning 25 years were closer than the scale spanning 5 years. Researchers suggested that this manipulation allowed participants to think that (compared to the timeline spanning 5 years) the timeline spanning 25 years leads to closer psychological distance between the graduation event and now. Participants then evaluated their motivation level for academic performance. Compared to participants who marked the event on a timeline spanning 5 years (i.e. were primed to think far psychological distance), participants who marked the event on a timeline spanning 25 years (i.e. were primed to think close psychological distance) were more motivated to improve their academic performance. These experiments and chapter jointly suggest that, the psychological difference between speculative thinking about the future and past may be the reason that leads to that speculative thinking about the future is more functional than speculative thinking about the past.

6.3.2. Reality/Hypothetical difference in Speculative Thinking

Chapter 4 demonstrated that both temporal and reality dimensions have impact on people's speculative thoughts, resulting in significant differences in controllable modifications. I confirmed the temporal dimension in speculative thinking, as reported by Ferrante et al. (2013). I also found evidence for the reality/hypothetical dimension in speculative thinking. This is in line with some moral psychology studies that also suggested a reality/hypothetical difference in people's moral judgement. For example, FeldmanHall et al. (2012) explored how people acted differently in moral dilemma in the reality and hypothetical moral dilemma. Specifically, researchers used a "pain vs. gain" experimental design. In this design, participants were told that a stranger will receive an electric shock depending on a decision they make. Participants can choose whether to spend their participation rewards (£20) to reduce the electric shock. The greater reduction in the electric shock, the more money is needed to spend. In the hypothetical condition, participants only need to imagine what they will do. In the real condition, participants needed to do this "pain vs gain" task in person, and they were told that the stranger who receives the electric shock is sitting in the next room. Results showed that, compared to the hypothetical condition, participants in the real condition were more "selfish". Those who actually did the task were willing to spend less money to reduce the electric shock on stranger than those imagining the task. Researchers suggested that this is because people focus on the "ought self" (i.e. to achieve moral ideal, what I should do) when facing the hypothetical situation; while people focus on what action is beneficial for oneself when facing the reality situation.

My chapter 4 demonstrates the reality/hypothetical difference in speculative thinking, showing speculative thinking about the realistic events focuses on more controllable modifications than speculative thinking about the hypothetical events. This finding suggests that speculative thinking about reality may serve more preparatory function speculative

thinking about the hypothetical. This result is in line with our intuition. Specifically, for activities that we think will actually be carried out, we will focus on how to carry out this activity, so the controllable features will be our focus. For activities that we know will not actually happen, we can also focus on both the uncontrollable features that cannot be changed by ourselves. In summary, as well as temporal asymmetry, I also found the reality/hypothetical difference in speculative thinking, which helps us understand the preparatory function of speculative thinking.

6.4. Preparatory Function

Section 6.4 discusses the preparatory function from the perspective of functional theory of counterfactual thinking (Epstude & Roese, 2008). As I discussed in chapter 1, functional theory suggested that counterfactual thinking is helpful for preparing subsequent behaviours. Specifically, thinking counterfactually can result in an intention to change behaviours, which serves preparatory function for future performance. This theory suggested that counterfactual thinking serves preparatory function through two pathways (i.e. one is the content-specific pathway, and the other is the content-neutral pathway). According to the chapter 4's results, I discuss preparatory function of counterfactual thinking from the perspective of functional theory. I suggest three possibilities for counterfactual thinking to serve preparatory function. One possibility is that counterfactual thinking serves preparatory function through a content-specific pathway. Another possibility is that counterfactual thinking serves preparatory function through a content-neutral pathway. The last possibility is that counterfactual thinking has other functions than preparatory function.

6.4.1. Content-Specific Pathway

One might wonder whether counterfactual thoughts have a preparatory function. In chapter 4, the results showed that thinking counterfactually led to fewer controllable modifications than thinking prefactually. As I discussed in chapter 4, because controllable

modifications are about specific information that can be used to impact future behavior, one might accordingly anticipate that thinking counterfactually does not impact on future behavior. One possibility, though, is that counterfactuals do still use the content-specific pathway to serve preparatory function, just to a lesser degree than prefactual thoughts. That is, the content-specific pathway (Epstude & Roese, 2008) suggested that counterfactual thinking can influence behaviours by relying on the specific information and meanings contained in the original counterfactual thoughts, which is helpful for regulating behaviours and improving future performance. This may be consistent with what I discussed (in section 6.3.1.) that low construal level contains specific information and is helpful for completing upcoming tasks.

As I discussed in chapter 1, Smallman and Roese (2009) found that controllable counterfactual modifications that relate to specific information in counterfactual modifications are useful for future behavioral intention. In their study, participants read a statement describing a negative event (e.g., spilling some milk). Then in counterfactual trials, participants read counterfactual thoughts (e.g., “I could have eaten more carefully”). All the counterfactual statements participants read were related to specific information about the event. In control trials, participants rated how frequently the target behavior from the counterfactual (eating carefully) lead to the consequence (spilling milk). In other words, participants in the control condition thought only about reality, not about a counterfactual world. All participants read a statement about behavioral intention (e.g. “In future I will eat more carefully”) and were asked to respond yes or no as to whether they would perform this behavior in the future. Entertaining a counterfactual thought reduced participants’ reaction times to respond to the behavioral intention judgment compared to the control condition. This finding suggests that counterfactual thoughts prime behavioral intentions and that they could have a functional role. As the counterfactuals that participants read were about specific

causally relevant behaviors, this result may suggest that counterfactuals can have some impact via the content-specific pathway. However, this impact must be to a lesser extent than prefactuals, given the findings of Ferrante et al. and my own.

6.4.2. Content-Neutral Pathway

However, an alternative possibility is that counterfactual thoughts influence future behaviors through a content-neutral pathway (also proposed by Epstude & Roesse (2008) in their functional theory). In the content-neutral pathway, information obtained through counterfactual thinking affects people's motivation, which increases effort towards a goal and thus affects people's behaviors (Smallman & Summerville, 2018). Hammell and Chan (2016) provided evidence on this in their study which examined whether counterfactual thinking leads to actual behavioral change (c.f. behavioral intention). Participants played video games. After playing they either thought counterfactually or prefactually about their performance, or performed an unrelated filler task. Finally, all participants played the video game again. Although the researchers found that participants who thought prefactually generated more controllable modifications than participants thinking counterfactually, participants in both the prefactual and counterfactual thinking groups improved task performance compared to participants performing the filler task. The mismatch between the difference in number of controllable modifications that participants generated, but the similarity in improved performance suggests that content-neutral pathway, rather than the content-specific pathway, was the driver of their behavioral change. Overall, this study suggests that even if counterfactual thinking is less likely to focus on controllable modifications it can still be functional and impact on future behavior.

6.4.3. Another Possibility: Counterfactuals Do Not Have Preparatory Function

It remains possible that counterfactual thinking may not be as useful as prefactual thinking in serving a preparatory function for future events, or even that preparing for future

events is not the main function of counterfactual thinking. This would be in line with other claims that counterfactual thinking might have functions other than the preparatory function. For example, some researchers (Kray, George, Liljenquist, Galinsky, Tetlock, & Roese, 2010) explored how counterfactual thinking serves a function of providing meaningfulness for life events. Student participants thought about how they had made the decision to come to their current university. Participants in the counterfactual condition then thought about how this decision could have been different. Participants in the control condition were not prompted to reflect on this decision. All participants then evaluated how their choice of university is meaningful in their lives. Participants who thought counterfactually about their university choice gave higher meaningfulness ratings for coming to the specific university than participants who did not think counterfactually. This demonstrates that counterfactual thinking may have another function, different from driving future behaviour, which is to provide a sense of meaningfulness about events they have experienced.

In a similar approach, McCrea (2008) suggested that, because counterfactual thinking is concerned with finding reasons for past failed attempts, counterfactual thinking can also provide excuses for past failed attempts and poor performances. He explored whether this excuse-providing function of counterfactual thinking reduces motivation to try harder in a future task. In his study, all participants attempted a math test without enough practice. Participants in the counterfactual thinking condition thought counterfactually about how they could have performed better in the math test. Those in the control condition answered some filler questions concerning the test. All participants then took a second math test. Results showed that participants in the control condition attempted to solve more questions, and had more correct answers than those in the counterfactual thinking condition. McCrea (2008) suggested that counterfactual thinking may reduce the motivation to improve performance, and also reduce actual performance in future task. Importantly, this directly contradicts other

claims (e.g. Markman, McMullen, & Elizaga, 2008) that counterfactual thinking can improve general motivation for future tasks. For example, Markman et al. (2008) asked participants to complete a task of anagrams, then asked participants to generate either upward or downward counterfactual thoughts about the task. Results showed that both upward counterfactual thinking and downward counterfactual thinking can increase participants' motivation to work harder in the subsequent tasks. These contrasting suggestions highlight the need for future research that addresses the effect of controllable and uncontrollable counterfactual modifications on motivation more thoroughly. In short, this demonstrates counterfactual thinking may not be useful in serving a preparatory function for future events, which would be in line with my chapter 4 demonstrating that counterfactual thinking leads to fewer controllable modifications than prefactual thinking.

6.5. Limitations and Future Research

In section 6.5, I consider some of the methodological limitations for the experimental chapters of this thesis. Specifically, the experimental chapters of this thesis mainly have three limitations. Firstly, the composition of my participants does not have enough diversity. Secondly, as for data analysis, I did not compare participants with different linguistic and cultural backgrounds. Finally, I did not explore the impact of speculative thinking on actual behavioral changes, although I explored the functions of speculative thinking. Based on these limitations, I also discuss some future research directions.

6.5.1. Participants Population

Firstly, a broad participant population would be good in terms of representativeness, and the participant composition of experiments in this thesis may not have enough diversity. The participant composition was mainly female, and mainly white British. My participants were typical of Psychology students at British universities, but thus represent a rather narrow group. Focusing on WEIRD (Western, Educated, Industrialized, Rich, and Democratic)

populations limits the generalisability of the claims made from psychological experiments (Henrich, Heine, & Norenzayan, 2005). Therefore, more diverse participant population should be included in future experiments of speculative thinking to confirm what the universals are in this field.

6.5.2. Linguistic and Cultural Differences

I excluded the data of non-native English speakers when analyzing the data. The reason I did this was to avoid the possible impact of participants' different English proficiency on reading stories and answering questions. Specifically, because non-native English speakers may be not as proficient in English as native English speakers, there is a possibility that non-native English speakers may not be able to understand the directions to think speculatively in these tasks presented in English as well as native English speakers, which may result in inaccurate experimental results. In fact, there is debate as to whether language influences counterfactual thinking (e.g. Au, 1983; Au, 1984; Bloom, 1981; Feng & Yi, 2006; Liu, 1985; Jing-Schmidt, 2017; Yeh & Gentner, 2005). For example, Bloom (1981) suggested that Chinese language does not have a specific structure of subjunctive (that is the counterfactual marker to identify counterfactual thoughts), therefore native Chinese speaker may find it difficult to understand counterfactual thoughts. On the other hand, some recent studies (e.g. Jing-Schmidt, 2017) suggested that there is vocabulary and grammatical structure in Chinese to express counterfactual thoughts, which can help native Chinese speakers to understand counterfactual thoughts.

Therefore, the cultural and linguistic differences when having speculative thinking are also worth exploring. It would be useful for future studies to compare results from participants whose first language is English with those who have another first language, to see whether results about speculative thinking (as demonstrated in my empirical chapters) have similar pattern across all languages.

6.5.3. Application to Real Behavioral Changes

It remains unclear that whether behavioral intentions that are hypothetical can really lead to real behavior changes. For example, Camerer and Mobbs (2017) suggested that when thinking about events in the hypothetical situation, people's behavioral intention generated by the events would differ from actual behaviors in the real world. They reviewed some experiments in psychology and cognitive neuroscience areas that demonstrated differences between hypothetical and real choices. Camerer and Mobbs (2017) suggested that, due to the limitations of experimental conditions, many studies used hypothetical tasks that only have hypothetical consequences rather than real consequences, which may make the results less applicable to the reality. Also, as I discussed in last section (i.e. section 6.4.), although Hammell & Chan (2016) found that participants who thought prefactually generated more controllable modifications than participants thinking counterfactually, they did not find link from controllable modifications to real behavioural changes.

In my chapter 4, although I found that participants thinking prefactually focused on more controllable modifications than participants thinking counterfactually, I did not really compare whether participants thinking about event will have greater performance improvement in the second task than participants thinking about hypothetical event. That is because chapter 4 focuses on the content of speculative thoughts generated by participants rather than their actual behaviors, participants thinking about hypothetical event were not required to do the second task. Future research can build on previously published studies by testing whether the difference between thinking about the hypothetical and reality is difference in whether the events can be changed or not.

Moreover, although there has been much research about counterfactual thinking, research about general speculative thinking (including counterfactual thinking, prefactual thinking, and etc.) is rare. This thesis demonstrated that both temporal dimension and reality

dimensions influence controllable modifications. Future research can further explore the function of general speculative thinking from other dimensions such as the direction of speculative thinking (i.e. upward / downward), which can enrich the theories related to general speculative thinking.

6.6. Conclusion

My thesis provides a more comprehensive picture of the functions of speculative thinking, discussing the functions of broad speculative thinking from the perspectives of preparatory and non-preparatory functions. Chapter 2 links traditional research on counterfactual determinants with the functional theory, suggesting that one non-preparatory function that counterfactual thinking serves is conveying information from others' counterfactuals. Chapter 5 explores another non-preparatory function of counterfactual thinking, demonstrating that lying seemed to be influenced by the controllability of events in a way that counterfactual thinking was not. On the other hand, chapter 4 demonstrates that counterfactual thinking might serve no preparatory function or less preparatory function than prefactual thinking. Chapter 3 further supports the possibility that counterfactual thinking serves less preparatory function than prefactual thinking from psychological distance and construal level perspectives. To conclude, this thesis demonstrates that there are other functions than preparatory functions that speculative thinking serves, and there are difference between different speculative thinking.

Appendices

Appendix A: Stories Used in Experiment 1

Plane story used in experiment 1. Text in square brackets [] was added for the version of the story in experiment 1.

Please read the reading material and answer the following questions:

Michael [John] was 25 years old, single, and a management trainee at a national bank in downtown Toronto [London]. After his first few months on the job, he was required to participate in a training seminar out of town. This was an important seminar; after completing it he could be certified and assigned his first management position. His flight was scheduled to leave at 4PM from Pearson Airport in Toronto [Stansted Airport in London], so he left early from work to drive to the airport. Having been to the airport several times recently to pick up clients as part of his job, Michael [John] had settled on a particular route that he liked to take. He decided that today he would stick to this favoured route to the airport. However, Michael [John] was soon caught in a major traffic jam. While he was driving, the airline called him, said the flight may take off at the scheduled time but it may also be delayed a little due to aviation control reasons [(which means John might still have a chance to catch the plane)]. Michael [John] went to the airport, still hoping to catch the flight. He arrived an hour after the scheduled departure time. When he got to the ticket desk, he learned that his flight had indeed left.

No counterfactuals version: The assistant on the desk told him the flight had gone, and the assistant also told him how close to his arrival time it was. After John heard what the assistant said, John said: “The traffic to the airport was really bad, that made me late.”

Fewer counterfactuals version: The assistant on the desk told him the flight had gone, and the assistant also told him how close to his arrival time it was. After Michael heard what the assistant said, Michael said: “If I had left home earlier, I would have caught the flight.”

More counterfactuals version: After Michael heard what the assistant said, Michael said: “If I had left home earlier, I would have caught the flight. Why didn't I check the traffic conditions in advance? If only I caught the flight rather than missed it, I would have been at the destination now. If I thought about the traffic in advance, I would have not been blocked on the road. If I booked earlier tickets, then I would have avoided this traffic jam. I really feel regret.”

Fire story used in experiment 1. Text in square brackets [] was added for the version of the story in experiment 1.

Please read the following interview about home insurance, and answer the following questions:

“Because I [Greg/Jack] lived in an apartment, I [Greg/Jack] never thought that property insurance was necessary. However, after speaking with a friend who sold insurance, I [Greg/Jack] realized the importance of such insurance. Thus, I [Greg/Jack] had my [his] friend write up a policy that I [he] could examine, sign, and send in later that day. Due to my [his] busy schedule, however, I [Greg/Jack] forgot to send in the policy. This turned out to be a big mistake because later, a fire ravaged my [his] apartment. I [He] lost everything and had no cover.

No counterfactuals version: After that, Greg said: “I lost all my belongings in the fire and I was not covered by any insurance.”

Fewer counterfactuals version: After that, Jack said: “If I had remembered to send in the policy, I would have had insurance cover now.”

More counterfactuals version: After that, Jack said: “If I had remembered to send in the

policy, I would have had insurance cover now. Why didn't I send in the policy right after I decided to buy it? If only I sent in the policy rather than forgetting to do so, I would have reduced the losses the fire brought me. If I had made a note to remind me, I would have avoided forgetting to send in the policy. If only I set myself a reminder to send in the policy, I would have had insurance cover now. I really feel regret.”

Appendix B: Stories Used in Experiment 2

Plane story used in experiment 2.

Please read the reading material and answer the following questions:

Michael was 25 years old, single, and a management trainee at a national bank in downtown Toronto. After his first few months on the job, he was required to participate in a training seminar out of town. This was an important seminar; after completing it he could be certified and assigned his first management position. His flight was scheduled to leave at 4PM from Pearson Airport in Toronto, so he left early from work to drive to the airport. Having been to the airport several times recently to pick up clients as part of his job, Michael had settled on a particular route that he liked to take. He decided that today he would stick to this favoured route to the airport. However, Michael was soon caught in a major traffic jam. While he was driving, the airline called him, said the flight may take off at the scheduled time but it may also be delayed a little due to aviation control reasons. Michael went to the airport, still hoping to catch the flight. He arrived an hour after the scheduled departure time. When he got to the ticket desk, he learned that his flight had indeed left.

Fewer counterfactuals version: When he found he had missed the flight, he said: “I should have left earlier.”

More counterfactuals version: When he found he had missed the flight, he said: “I should have left earlier. Why didn't I check the traffic conditions in advance? If only I caught the flight rather than missed it, I would have been at the destination now. If I thought about the traffic in advance, I would have not been blocked on the road. If I booked earlier tickets, then I would have avoided this traffic jam. I really feel regret.”

Fire story used in experiment 2.

Please read the following interview about home insurance which is written by a college student named Greg Sawyer:

“Because I lived in an apartment, I never thought that property insurance was necessary. However, after speaking with a friend who sold insurance, I realized the importance of such insurance. Thus, I had my friend write up a policy that I could examine, sign, and send in later that day. Due to my busy schedule, however, I forgot to send in the policy. This turned out to be a big mistake because later, a fire ravaged my apartment. I lost everything and had no coverage.

Fewer counterfactuals version: I should have thought about insurance earlier.”

More counterfactuals version: Why didn't I send the policy since I decided to? If only I sent that policy rather than forgetting to do so, I would have had enough money now. If I remembered to subscribe to insurance information alerts, I would have avoided forgetting to send the insurance policy. If only I'd set myself a reminder to send off the policy, I would have obtained financial compensation from the insurance company. I really feel regret.”

Appendix C: Stories Used in Experiment 3

Controllability story used in experiment 3. Text in square brackets [] was added for the second version of the story in experiment 3.

Please read the reading material and answer the following questions:

A bank employee, Mr. Bianchi [Williams], who worked in an agency situated in a village near to the one where he lived with his wife. The day of the accident he was going home after work but his progress toward home was delayed by an event. When he arrived home, Mr. Bianchi [Williams] found his wife on the floor. He realized that she had had a heart attack and she was dying. He tried to help her, but his efforts were in vain.

No counterfactuals version: Mr. Williams very sadly said: “I feel so sad for my wife.”

Fewer counterfactuals version: Mr. Bianchi very sadly said: “If I had come home early, I might have been able to save my wife.”

More counterfactuals version: Mr. Bianchi very sadly said: “If I had come home early, I might have been able to save my wife. If I had come home earlier, I would have been able to see her one last time. If I had come home earlier, I could have been able to take her to the hospital. I feel really regret.”

Appendix D: Stories Used in Experiment 4

Exceptionality story used in experiment 4. Text in square brackets [] was added for the second version of the story in experiment 4.

Mr. Jones [Jackson] was 47 years old, the father of three and a successful banking executive. His wife has been ill at home for several months. On the day of the accident, Mr. Jones [Jackson] left his office at the regular time. He sometimes left early to take care of home chores at his wife's request, but this was not necessary on that day. Mr. Jones [Jackson] chose a route. The accident occurred at a major intersection. The light turned amber as Mr. Jones [Jackson] approached. Witnesses noted that he braked hard to stop at the crossing, although he could easily have gone through. His family recognized this as a common occurrence in Mr. Jones [Jackson]' driving. As he began to cross after the light changed, a light truck charged into the intersection at top speed, and rammed Mr. Jones [Jackson]' car from the left. Mr. Jones [Jackson] was killed instantly.

No counterfactuals version: Mr. Jackson's wife said "I feel so sad for my husband".

Fewer counterfactuals version: Mr. Jones' wife said "If it were Tuesday, he would have been working at home".

More counterfactuals version: The Jones's wife said "If only Jones chose the other route. If he went the other way, he might have been able to avoid the accident. If he had gone the other way, he might not have died. Why he had to go that route. I should have been able to remind him to follow the traffic rule. I feel so regret".

Appendix E: Open-Ended and Forced-Choice Questionnaires Used in Experiment 5

[The written instructions for *Future-Close* condition are presented on the following pages. Any deviations of *Future-Distant* conditions from *Future-Close* condition are shown in square brackets.]

Introduction: Your task is to imagine that you will do seven activities tomorrow [next year], and to describe these activities. Of course, there are no right or wrong answers. People simply differ in their descriptions of different behaviours, and we are interested in your personal descriptions.

1. Please imagine that tomorrow [next year] you will read a science fiction book, and describe this activity.

2. Please imagine that tomorrow [next year] you will move into a new apartment, and describe this activity.

3. Please imagine that tomorrow [next year] you will spend a weekend with your family, and describe this activity.

4. Please imagine that tomorrow [next year] you will take an exam, and describe this activity.

5. Please imagine that tomorrow [next year] you will have a party at your apartment, and describe this activity.

6. Please imagine that tomorrow [next year] you will write a letter to your family, and describe this activity.

7. Please imagine that tomorrow [next year] you will watch TV, and describe this activity.

[The written instructions for *Past-Close* condition are presented on the following pages. Any deviations of *Past-Distant* conditions from *Past-Close* condition are shown in square brackets.]

Introduction: Your task is to imagine that you did seven activities yesterday [last year], and to describe these activities. Of course, there are no right or wrong answers. People simply differ in their descriptions of different behaviours, and we are interested in your personal descriptions.

1. Please imagine that yesterday [last year] you read a science fiction book, and describe this activity.

2. Please imagine that yesterday [last year] you moved into a new apartment, and describe this activity.

3. Please imagine that yesterday [last year] you spent a weekend with your family, and describe this activity.

4. Please imagine that yesterday [last year] you took an exam, and describe this activity.

5. Please imagine that yesterday [last year] you had a party at your apartment, and describe this activity.

6. Please imagine that yesterday [last year] you wrote a letter to your family, and describe this activity.

7. Please imagine that yesterday [last year] you watched TV, and describe this activity.

Forced-choice questionnaire used in experiment 5. Text in square brackets [] was the time indicator added for different conditions in Study.

Instruction: Any behaviour can be identified in many ways. For example, one person might describe a behaviour as “typing a paper,” while another might describe the behaviour as “pushing keys.” Yet another person might describe the behaviour as “expressing thoughts.” We are interested in your personal preferences for how a number of different behaviours should be described. On the following pages you will find several different behaviours listed. After each behaviour will be two choices of different ways in which the behaviour might be identified. Here is an example:

Attending class

_a. sitting in a chair

_b. looking at the board

Your task is to choose the identification, a or b, that best describes the behaviour for you. Simply place a check mark in the space beside the identification statement that you pick. Please mark only one alternative for each pair. Of course, there are no right or wrong answers. People simply differ in their preferences for the different behaviour descriptions, and we are interested in your personal preferences. Be sure to mark your choice for each behaviour. Remember, choose the description that you personally believe is more appropriate in each pair.

1. Making a list [tomorrow/yesterday/next year/last year]

A. Getting organized B. Writing things down

2. Reading [tomorrow/yesterday/next year/last year]

A. Following lines of print B. Gaining knowledge

3. Washing clothes [tomorrow/yesterday/next year/last year]

A. Removing odours from clothes B. Putting clothes into the machine

4. Measuring a room for carpeting [tomorrow/yesterday/next year/last year]
 - A. Getting ready to remodel
 - B. Using a tape measure
5. Cleaning the house [tomorrow/yesterday/next year/last year]
 - A. Showing one's cleanliness
 - B. Vacuuming the floor
6. Painting the room [tomorrow/yesterday/next year/last year]
 - A. Applying brush strokes
 - B. Making the room look fresh
7. Paying the rent [tomorrow/yesterday/next year/last year]
 - A. Maintaining a place to live
 - B. Writing a check
8. Caring for houseplants [tomorrow/yesterday/next year/last year]
 - A. Watering plants
 - B. Making the room look nice
9. Locking a door [tomorrow/yesterday/next year/last year]
 - A. Putting a key in the lock
 - B. Securing the house
10. Filling out a personality test [tomorrow/yesterday/next year/last year]
 - A. Answering questions
 - B. Revealing what you're like
11. Toothbrushing [tomorrow/yesterday/next year/last year]
 - A. Preventing tooth decay
 - B. Moving a brush around one's mouth
12. Taking a test [tomorrow/yesterday/next year/last year]
 - A. Answering questions
 - B. Showing one's knowledge
13. Greeting someone [tomorrow/yesterday/next year/last year]
 - A. Saying hello
 - B. Showing friendliness
14. Resisting temptation [tomorrow/yesterday/next year/last year]
 - A. Saying "no"
 - B. Showing moral courage
15. Eating [tomorrow/yesterday/next year/last year]
 - A. Getting nutrition
 - B. Chewing and swallowing
16. Traveling by car [tomorrow/yesterday/next year/last year]

A. Following a map B. Seeing countryside

17. Having cavity filled [tomorrow/yesterday/next year/last year]

A. Protecting your teeth B. Going to the dentist

18. Talking to a child [tomorrow/yesterday/next year/last year]

A. Teaching a child something B. Using simple words

19. Pushing a doorbell [tomorrow/yesterday/next year/last year]

A. Moving a finger B. Seeing if someone's home

Appendix F: Scrambled Word Task and Questionnaire Used in Experiment 6

[The written instructions for *reality* condition are presented on the following pages. Any deviations of *hypothetical* condition from *reality* condition are shown in square brackets. The scrambled word tasks in four studies were same. Participants in the *hypothetical* condition did not need to do the second scrambled word task.]

You're going to participate in an experiment on the psychology of thought. We ask you to read and follow the instructions carefully. First, you have to play a game. Its rules are explained in detail below.

“SCRAMBLED-WORD GAME”

Your task is to find a 6-letter word in each of the 12 grids presented on the next page. This word must be readable by moving from one letter to another.

The game's rules are as follows:

- In each grid you need to find a 6-letter word (belonging to the English language).

Once you find it, write it down in the space provided next to the grid.

- In each grid you should only look for a 6-letter word (there may also be 2, 3, 4 or 5 letter words).
- The first letter of the word can be any of the 8 letters present in the grid.
- The letters can be linked:

- vertically

E.g.:

P	L	Z	P
E	O	Z	U

- horizontally

E.g.:

P	L	Z	P
E	O	Z	U

•diagonally

E.g.:

P	L	Z	P
E	O	Z	U

- You can link only adjoining letters.

E.g.:

P	L	Z	P
E	O	Z	U

YES

E.g.:

P	L	Z	P
E	O	Z	U

NO

- Each letter in the grid can only be used once to form the word.

- You don't have to solve the grids in the given order.

- You have 2 minutes and 15 seconds to complete this task.

Example of a solved grid:

U	T	U	A
A	L	C	D

Answer: Actual

Example of an unsolved grid; try to find the word! The solution is on the next page...

R	E	U	A
B	A	V	D

R	E	U	A
B	A	V	D

Answer: Adverb

Now, if everything is clear, you can begin the game. Otherwise you can ask for further explanation. When you're ready, tell the experimenter who will start the timer and turn the page. Then you can start the game.

The scrambled-word quizzes are presented below:

R	R	B	A
B	A	O	S

Answer:

F	R	D	R
A	F	O	A

Answer:

F	B	R	R
E	A	E	A

Answer:

V	H	R	B
E	A	E	A

Answer:

V	G	R	B
E	D	I	A

Answer:

V	E	R	B
E	R	A	C

Answer:

L	N	D	E
E	C	A	C

Answer:

C	D	O	L
R	A	L	B

Answer:

F	D	A	L
O	U	B	E

Answer:

C	D	A	W
B	R	E	R

Answer:

L	F	A	B
U	R	E	P

Answer:

C	L	W	D
F	E	L	O

Answer:

You have just played the “Scrambled-word game”. In a few moments you will play the game with new words again. Before starting the next game, we ask you to fill in the following questionnaire [**You have just played the ‘Scrambled-word game’. The game is over, and there will be no more scrambled-word puzzles in this study. However, please imagine that in a few moments you will play the game with new words again. We now ask you to fill in the following questionnaire**].

1. What is your gender?

A. Female; B. Male; C. I prefer to describe my gender in another way; D. Prefer

not to say

2. How old are you?

3. Are you a Psychology Undergraduate student?

A. Yes; B. Other (please specify)

4. What is your first language?

A. English; B. Other (please specify)

5. Please indicate the ethnic background that best describes you

A. Indian; B. Chinese; C. Other Asian; D. Black African; E. Black Caribbean; F.

Other Black; G. White Irish; H. White British; I. Other White; J. Mixed Race; K. Other

(please specify)

6. A few minutes ago, you played “Scrambled-word quizzes” :

How do you assess your performance?

Please, rate your performance playing the scrambled-word game on the following 7-point scale, where -3 corresponds to “poor performance” and 3 corresponds to “perfect performance” (intermediate values correspond to intermediate judgments). Circle the number that best represents your rating.

-3	-2	-1	0	1	2	3
Poor performance			Neither bad nor good performance			Perfect performance

If you solved all 12 grids in the given time, please return the questionnaire to the experimenter. Otherwise, before starting the new game, please complete the following sentence [**Otherwise, imagining that you were about to start a new game, please complete the following sentence**]:

“Things will be better for me in the next game if... [**Things would be better for me in the next game if...**]”

Write at least one way in which you would complete this sentence.

1)

.....

2)

.....

3)

.....

7. What result do you think you will get in the next game [What result do you think you would get in the next game]?

Please give your rating using the following 7-point scale, where -3 corresponds to “certainly worse” and 3 corresponds to “certainly better” (intermediate values correspond to intermediate judgments). Circle the number that best represents your judgment.

-3	-2	-1	0	1	2	3
Certainly worse			Neither worse nor better			Certainly better

Thank you for completing the questionnaire. Now, you will play the game again, but with different grids and solutions. The rules are the same. You have 2 minutes 15 seconds to solve as many grinds as you can. When you’re ready, tell the experimenter who will start the timer, and turn the page. Then you can start the game.

C	L	M	E
F	E	A	L

Answer:

I	E	N	E
F	N	A	C

Answer:

O	R	N	B
A	F	B	I

Answer:

O	L	N	N
D	G	D	E

Answer:

O	O	G	N
E	R	N	I

Answer:

O	I	E	T
N	R	N	E

Answer:

O	T	V	B
E	I	I	N

Answer:

O	N	V	K
E	Y	D	I

Answer:

O	N	L	V
C	H	U	A

Answer:

D	M	I	N
A	R	E	R

Answer:

R	A	E	M
C	E	B	M

Answer:

E	I	R	R
A	M	O	R

Answer:

Appendix G: Questionnaire Used in Experiment 7

[The written instructions for *future* condition are presented on the following pages. Any deviations of *past* condition from *future* condition are shown in square brackets.]

You have just played the ‘Scrambled-word game’. The game is over, and there will be no more scrambled-word puzzles in this study. However, please imagine that in a few moments you will play the game with new words again. We now ask you to fill in the following questionnaire. [**You have just played the ‘Scrambled-word game’. The game is over, and there will be no more scrambled-word puzzles in this study. We now ask you to fill in the following questionnaire.**]

1. What is your gender?

A. Female; B. Male; C. I prefer to describe my gender in another way; D. Prefer not to say

2. How old are you?

3. Are you a Psychology Undergraduate student?

A. Yes; B. Other (please specify)

4. What is your first language?

A. English; B. Other (please specify)

5. Please indicate the ethnic background that best describes you

A. Indian; B. Chinese; C. Other Asian; D. Black African; E. Black Caribbean; F. Other Black; G. White Irish; H. White British; I. Other White; J. Mixed Race; K. Other (please specify)

6. A few minutes ago, you played “Scramble-word quizzes” :

How do you assess your performance?

Please, rate your performance playing the scrambled-word game on the following 7-point scale, where -3 corresponds to “poor performance” and 3 corresponds to “perfect

performance” (intermediate values correspond to intermediate judgments). Circle the number that best represents your rating.

-3	-2	-1	0	1	2	3
Poor performance			Neither bad nor good performance			Perfect performance

If you solved all 12 grids in the given time, please return the questionnaire to the experimenter. Otherwise, imagining that you were about to start a new game, please complete the following sentence:

“Things would be better for me in the next game if...” [**“Things would have been better for me if...”**]

Write at least one way in which you would complete this sentence.

1)

.....

.....

2)

.....

.....

3)

.....

.....

7. What result do you think you would get in the next game?

Please give your rating using the following 7-point scale, where -3 corresponds to “certainly worse” and 3 corresponds to “certainly better” (intermediate values correspond to intermediate judgments). Circle the number that best represents your judgment.

-3	-2	-1	0	1	2	3
Certainly worse			Neither worse nor better			Certainly better

Thank you for completing the questionnaire.

Appendix H: Questionnaire Used in Experiment 8

[The written instructions for *far* condition are presented on the following pages. Any deviations of *close* condition from *far* condition are shown in square brackets.]

You have just played the ‘Scrambled-word game’. The game is over, and there will be no more scrambled-word puzzles in this study. However, please imagine that in a year you will play the game with new words again. [**However, please imagine that in a few moments you will play the game with new words again.**] We now ask you to fill in the following questionnaire.

1. What is your gender?

A. Female; B. Male; C. I prefer to describe my gender in another way; D. Prefer not to say

2. How old are you?

3. Are you a Psychology Undergraduate student?

A. Yes; B. Other (please specify)

4. What is your first language?

A. English; B. Other (please specify)

5. Please indicate the ethnic background that best describes you

A. Indian; B. Chinese; C. Other Asian; D. Black African; E. Black Caribbean; F. Other Black; G. White Irish; H. White British; I. Other White; J. Mixed Race; K. Other (please specify)

6. A few minutes ago, you played “Scramble-word quizzes” :

How do you assess your performance?

Please, rate your performance playing the scrambled-word game on the following 7-point scale, where -3 corresponds to “poor performance” and 3 corresponds to “perfect performance” (intermediate values correspond to intermediate judgments). Circle the number

that best represents your rating.

-3	-2	-1	0	1	2	3
Poor performance			Neither bad nor good performance			Perfect performance

If you solved all 12 grids in the given time, please return the questionnaire to the experimenter. Otherwise, imagining that in a year you will play the game with new words again, please complete the following sentence [**Otherwise, imagining that you were about to start a new game, please complete the following sentence**]:

“Things would be better for me in the next game if...”

Write at least one way in which you would complete this sentence.

1)

.....
.....

2)

.....
.....

3)

.....
.....

7. What result do you think you would get in the next game?

Please give your rating using the following 7-point scale, where -3 corresponds to “certainly worse” and 3 corresponds to “certainly better” (intermediate values correspond to intermediate judgments). Circle the number that best represents your judgment.

-3	-2	-1	0	1	2	3
Certainly worse			Neither worse nor better			Certainly better

Thank you for completing the questionnaire.

Appendix I: Questionnaire Used in Experiment 9

Parcel story used in Experiment 9. Text in square brackets [] was added for the versions of the story.

Alison's parents asked her to be home in time for an important delivery after work. On her way, Alison stopped off for a coffee for half an hour [was delayed for half an hour by the traffic light being broken]. Alison arrived home just before the delivery was due only to discover that it arrived 5 minutes early and she missed it.

Ella's parents also asked her to be home in time for an important delivery after work. On her way, Ella was delayed for half an hour by the traffic light being broken [stopped off for a coffee for half an hour]. Ella arrived home just before the delivery was due only to discover that it arrived 5 minutes early and she missed it.

Counterfactual thinking question: Although you cannot tell for sure from the reading materials, who spends more time thinking about how things could have been different?

Lying question: Although you cannot tell for sure from the reading materials, who would be more likely to lie to their parents about why they were late?

Appendix I: Questionnaire Used in Experiment 10

Parcel story used in Experiment 10. Text in square brackets [] was added for the versions of the story.

Alison's parents asked her to be home in time for an important delivery after work. On her way, Alison stopped off for a coffee for half an hour. She was also delayed for half an hour by the traffic light being broken. [Alison was delayed for half an hour by the traffic light being broken. She also stopped off for a coffee for half an hour.] Alison arrived home just before the delivery was due only to discover that it arrived 5 minutes early and she missed it.

Counterfactual thinking condition: Alison thinks about how things could have been different. What do you think she is more likely to think about:

- A. "Things could have been better if I didn't stop for coffee."
- B. "Things could have been better if the traffic light wasn't broken."

Lying condition: Alison lies to her parents about why she arrived home when she did.

What do you think she is more likely to lie about:

- A. The traffic light being broken
- B. Stopping for coffee

References

- Addis, D. R., Wong, A. T., & Schacter, D. L. (2008). Age-related changes in the episodic simulation of future events. *Psychological science, 19*(1), 33-41. Doi: 10.1111/j.1467-9280.2008.02043.x
- Addis, D. R., Wong, A. T., & Schacter, D. L. (2007). Remembering the past and imagining the future: common and distinct neural substrates during event construction and elaboration. *Neuropsychologia, 45*(7), 1363-1377. Doi: 10.1016/j.neuropsychologia.2006.10.016
- Anderson, R. J., & Dewhurst, S. A. (2009). Remembering the past and imagining the future: Differences in event specificity of spontaneously generated thought. *Memory, 17*(4), 367-373. Doi: 10.1080/09658210902751669
- Au, T. K. F. (1983). Chinese and English counterfactuals: the Sapir-Whorf hypothesis revisited. *Cognition, 15*(1-3), 155-187. Doi: 10.1016/0010-0277(83)90038-0
- Au, T. K. (1984). Counterfactuals: in reply to Alfred Bloom.
- Beck, S. R., & Riggs, K. J. (2014). Developing thoughts about what might have been. *Child development perspectives, 8*(3), 175-179. Doi: 10.1111/cdep.12082
- Beck, S. R., Weisberg, D. P., Burns, P., & Riggs, K. J. (2014). Conditional reasoning and emotional experience: a review of the development of counterfactual thinking. *Studia Logica, 102*(4), 673-689. Doi: 10.1007/s11225-013-9508-1
- Bloom, A. H. (1984). Caution—the words you use may affect what you say: A response to Au. *Cognition, 17*(3), 275-287. Doi: 10.1016/0010-0277(84)90011-8
- Bostyn, D. H., Sevenhant, S., & Roets, A. (2018). Of Mice, Men, and Trolleys: Hypothetical Judgment Versus Real-Life Behavior in Trolley-Style Moral Dilemmas. *Psychological science, 0956797617752640*. Doi: 10.1177/0956797617752640
- Botzung, A., Denkova, E., & Manning, L. (2008). Experiencing past and future personal

- events: Functional neuroimaging evidence on the neural bases of mental time travel. *Brain and cognition*, 66(2), 202-212. Doi: 10.1016/j.bandc.2007.07.011
- Brandstätter, V., Lengfelder, A., & Gollwitzer, P. M. (2001). Implementation intentions and efficient action initiation. *Journal of personality and social psychology*, 81(5), 946. Doi: 10.1037/0022-3514.81.5.946
- Briazu, R. A., Walsh, C. R., Deeprose, C., & Ganis, G. (2017). Undoing the past in order to lie in the present: Counterfactual thinking and deceptive communication. *Cognition*, 161, 66-73. Doi: 10.1016/j.cognition.2017.01.003
- Busby, J. G., & Suddendorf, T. (2010). Young children's ability to distinguish past and future changes in physical and mental states. *British Journal of Developmental Psychology*, 28(4), 853-870. Doi: 10.1348/026151009X482930
- Byrne, R. M. (1997). Cognitive processes in counterfactual thinking about what might have been. Doi: 10.1016/S0079-7421(08)60501-0
- Byrne, R. M. (2016). Counterfactual thought. *Annual review of psychology*, 67, 135-157. Doi: 10.1146/annurev-psych-122414-033249
- Byrne, R. M. (2002). Mental models and counterfactual thoughts about what might have been. *Trends in cognitive sciences*, 6(10), 426-431. Doi: 10.1016/S1364-6613(02)01974-5
- Cabeza, R. (2008). Role of parietal regions in episodic memory retrieval: the dual attentional processes hypothesis. *Neuropsychologia*, 46(7), 1813-1827. Doi: 10.1016/j.neuropsychologia.2008.03.019
- Camerer, C., & Mobbs, D. (2017). Differences in behavior and brain activity during hypothetical and real choices. *Trends in cognitive sciences*, 21(1), 46-56. Doi: 10.1016/j.tics.2016.11.001

- Caruso, E. M., Gilbert, D. T., & Wilson, T. D. (2008). A wrinkle in time: Asymmetric valuation of past and future events. *Psychological Science, 19*(8), 796-801. Doi: 10.1111/j.1467-9280.2008.02159.x
- Caruso, E. M., Van Boven, L., Chin, M., & Ward, A. (2013). The temporal Doppler effect: When the future feels closer than the past. *Psychological science, 24*(4), 530-536. Doi: 10.1177/0956797612458804
- Ciaramelli, E., Grady, C. L., & Moscovitch, M. (2008). Top-down and bottom-up attention to memory: a hypothesis (AtoM) on the role of the posterior parietal cortex in memory retrieval. *Neuropsychologia, 46*(7), 1828-1851. Doi: 10.1016/j.neuropsychologia.2008.03.022
- D'Argembeau, A., & Van der Linden, M. (2006). Individual differences in the phenomenology of mental time travel: The effect of vivid visual imagery and emotion regulation strategies. *Consciousness and cognition, 15*(2), 342-350. Doi: 10.1016/j.concog.2005.09.001
- Davis, C. G., Lehman, D. R., Wortman, C. B., Silver, R. C., & Thompson, S. C. (1995). The undoing of traumatic life events. *Personality and Social Psychology Bulletin, 21*(2), 109-124. Doi: 10.1177/0146167295212002
- Debey, E., De Houwer, J., & Verschuere, B. (2014). Lying relies on the truth. *Cognition, 132*(3), 324-334. Doi: 10.1016/j.cognition.2014.04.009
- Decety, J., & Ingvar, D. H. (1990). Brain structures participating in mental simulation of motor behavior: A neuropsychological interpretation. *Acta Psychologica, 73*(1), 13-34. Doi: 10.1016/0001-6918(90)90056-L
- De Vega, M., Urrutia, M., & Rizzo, B. (2007). Canceling updating in the comprehension of counterfactuals embedded in narratives. *Memory & Cognition, 35*(6), 1410-1421. Doi: 10.3758/BF03193611

- De Vega, M., & Urrutia, M. (2012). Discourse updating after reading a counterfactual event. *Psicologica: International Journal of Methodology and Experimental Psychology*, 33(2), 157-173.
- Epstude, K., & Roese, N. J. (2008). The functional theory of counterfactual thinking. *Personality and Social Psychology Review*, 12(2), 168-192. Doi: 10.1177/1088868308316091
- Epstude, K., Scholl, A., & Roese, N. J. (2016). Prefactual thoughts: Mental simulations about what might happen. *Review of General Psychology*, 20(1), 48. Doi: 10.1037/gpr0000064
- FeldmanHall, O., Mobbs, D., Evans, D., Hiscox, L., Navrady, L., & Dalgleish, T. (2012). What we say and what we do: the relationship between real and hypothetical moral choices. *Cognition*, 123(3), 434-441. Doi: 10.1016/j.cognition.2012.02.001
- Feng, G., & Yi, L. (2006). What if Chinese had linguistic markers for counterfactual conditionals? Language and thought revisited. In *Proceedings of the Annual Meeting of the Cognitive Science Society* (Vol. 28, No. 28).
- Ferguson, H. J. (2012). Eye movements reveal rapid concurrent access to factual and counterfactual interpretations of the world. *The Quarterly Journal of Experimental Psychology*, 65(5), 939-961. Doi: 10.1080/17470218.2011.637632
- Ferguson, H. J., & Jayes, L. T. (2018). Plausibility and perspective influence the processing of counterfactual narratives. *Discourse Processes*, 55(2), 166-186. Doi: 10.1080/0163853X.2017.1330032
- Ferguson, H. J., & Sanford, A. J. (2008). Anomalies in real and counterfactual worlds: An eye-movement investigation. *Journal of Memory and Language*, 58(3), 609-626. Doi: 10.1016/j.jml.2007.06.007
- Ferguson, H. J., Sanford, A. J., & Leuthold, H. (2008). Eye-movements and ERPs reveal the

- time course of processing negation and remitting counterfactual worlds. *Brain research*, 1236, 113-125. Doi: 10.1016/j.brainres.2008.07.099
- Ferrante, D., Giroto, V., Stragà, M., & Walsh, C. (2013). Improving the past and the future: A temporal asymmetry in hypothetical thinking. *Journal of Experimental Psychology: General*, 142(1), 23. Doi: 10.1037/a0027947
- Galotti, K. M. (1989). Approaches to studying formal and everyday reasoning. *Psychological bulletin*, 105(3), 331. Doi: 10.1037/0033-2909.105.3.331
- Galotti, K. M., Ciner, E., Altenbaumer, H. E., Geerts, H. J., Rupp, A., & Woulfe, J. (2006). Decision-making styles in a real-life decision: Choosing a college major. *Personality and Individual Differences*, 41(4), 629-639. Doi: 10.1016/j.paid.2006.03.003
- Gavanski, I., & Wells, G. L. (1989). Counterfactual processing of normal and exceptional events. *Journal of Experimental Social Psychology*, 25(4), 314-325. Doi: 10.1016/0022-1031(89)90025-5
- Gentner, D., & Yeh, D. (2005). Reasoning counterfactually in Chinese: Picking up the pieces. In *Proceedings of the Annual Meeting of the Cognitive Science Society* (Vol. 27, No. 27).
- Gilbert, D. T., Morewedge, C. K., Risen, J. L., & Wilson, T. D. (2004). Looking forward to looking backward: The misprediction of regret. *Psychological Science*, 15(5), 346-350. Doi: 10.1111/j.0956-7976.2004.00681.x
- Giroto, V., Ferrante, D., Pighin, S., & Gonzalez, M. (2007). Postdecisional counterfactual thinking by actors and readers. *Psychological Science*, 18(6), 510-515. Doi: 10.1111/j.1467-9280.2007.01931.x
- Giroto, V., Legrenzi, P., & Rizzo, A. (1991). Event controllability in counterfactual thinking. *Acta Psychologica*, 78(1-3), 111-133. Doi: 10.1016/0001-6918(91)90007-M

- Hammell, C., & Chan, A. Y. (2016). Improving physical task performance with counterfactual and prefactual thinking. *PloS one*, *11*(12), e0168181. Doi: 10.1371/journal.pone.0168181
- Hassabis, D., Kumaran, D., & Maguire, E. A. (2007). Using imagination to understand the neural basis of episodic memory. *Journal of neuroscience*, *27*(52), 14365-14374. Doi: 10.1523/JNEUROSCI.4549-07.2007
- Hassabis, D., & Maguire, E. A. (2007). Deconstructing episodic memory with construction. *Trends in cognitive sciences*, *11*(7), 299-306. Doi: 10.1016/j.tics.2007.05.001
- Henrich, J., Heine, S.J., & Norenzayan, A. (2005). The weirdest people in the world? *Behavioral and Brain Sciences*, *33*, 61-135. doi:10.1017/S0140525X0999152X
- Jing-Schmidt, Z. (2017). What are they good for? A constructionist account of counterfactuals in ordinary Chinese. *Journal of Pragmatics*, *113*, 30-52. Doi: 10.1016/j.pragma.2017.03.004
- Johnson-Laird, P. N., & Byrne, R. M. (1991). *Deduction*. Lawrence Erlbaum Associates, Inc.
- Kahneman, D., & Miller, D. T. (1986). Norm theory: Comparing reality to its alternatives. *Psychological Review*, *93*(2), 136. Doi: 10.1037/0033-295x.93.2.136
- Kahneman, D., & Tversky, A. (1981). *The simulation heuristic* (No. TR-5). STANFORD UNIV CA DEPT OF PSYCHOLOGY
- Kahneman, D., & Tversky, A. (1982). Variants of uncertainty. *Cognition*, *11*(2), 143-157. Doi: 10.1016/0010-0277(82)90023-3
- Kivetz, Y., & Tyler, T. R. (2007). Tomorrow I'll be me: The effect of time perspective on the activation of idealistic versus pragmatic selves. *Organizational Behavior and Human Decision Processes*, *102*(2), 193-211. Doi: 10.1016/j.obhdp.2006.07.002.

- Klein, S. B., Loftus, J., & Kihlstrom, J. F. (2002). Memory and temporal experience: The effects of episodic memory loss on an amnesic patient's ability to remember the past and imagine the future. *Social Cognition, 20*(5), 353-379. Doi: 10.1521/soco.20.5.353.21125
- Kray, L. J., & Galinsky, A. D. (2003). The debiasing effect of counterfactual mind-sets: Increasing the search for disconfirmatory information in group decisions. *Organizational Behavior and Human Decision Processes, 91*(1), 69-81. Doi: 10.1016/S0749-5978(02)00534-4
- Kray, L. J., Galinsky, A. D., & Wong, E. M. (2006). Thinking within the box: The relational processing style elicited by counterfactual mind-sets. *Journal of personality and social psychology, 91*(1), 33. Doi: 10.1037/0022-3514.91.1.33
- Kray, L. J., George, L. G., Liljenquist, K. A., Galinsky, A. D., Tetlock, P. E., & Roese, N. J. (2010). From what might have been to what must have been: Counterfactual thinking creates meaning. *Journal of personality and social psychology, 98*(1), 106. Doi: 10.1037/a0017905
- Landman, J. (1987). Regret and elation following action and inaction: Affective responses to positive versus negative outcomes. *Personality and Social Psychology Bulletin, 13*(4), 524-536. Doi: 10.1177/0146167287134009
- Lelieveld, G. J., Shalvi, S., & Crone, E. A. (2016). Lies that feel honest: Dissociating between incentive and deviance processing when evaluating dishonesty. *Biological psychology, 117*, 100-107. Doi: 10.1016/j.biopsycho.2016.03.009
- Liberman, N., & Förster, J. (2008). Expectancy, value and psychological distance: A new look at goal gradients. *Social Cognition, 26*(5), 515-533. Doi: 10.1521/soco.2008.26.5.515

- Liberman, N., & Trope, Y. (1998). The role of feasibility and desirability considerations in near and distant future decisions: A test of temporal construal theory. *Journal of personality and social psychology*, 75(1), 5. Doi: 10.1037/0022-3514.75.1.5
- Liberman, N., Trope, Y., & Wakslak, C. (2007). Construal level theory and consumer behavior. *Journal of Consumer Psychology*, 17(2), 113-117. Doi: 10.1016/S1057-7408(07)70017-7
- Mandel, D. R., & Lehman, D. R. (1996). Counterfactual thinking and ascriptions of cause and preventability. *Journal of personality and social psychology*, 71(3), 450. Doi: 10.1037/0022-3514.71.3.450
- 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. Doi: 10.1177/0146167295216005
- 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. Doi: 10.1006/jesp.1993.1005
- 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. Doi: 10.1016/j.jesp.2007.01.001
- McCrea, S. M. (2008). Self-handicapping, excuse making, and counterfactual thinking: consequences for self-esteem and future motivation. *Journal of personality and social psychology*, 95(2), 274. Doi: 10.1037/0022-3514.95.2.274
- McCrea, S. M., Liberman, N., Trope, Y., & Sherman, S. J. (2008). Construal level and procrastination. *Psychological Science*, 19(12), 1308-1314. Doi: 10.1111/j.1467-9280.2008.02240.x

- Medvec, V. H., Madey, S. F., & Gilovich, T. (1995). When less is more: counterfactual thinking and satisfaction among Olympic medalists. *Journal of personality and social psychology*, 69(4), 603. Doi: 10.1037/0022-3514.69.4.603
- Mercier, H., Rolison, J. J., Stragà, M., Ferrante, D., Walsh, C. R., & Giroto, V. (2017). Questioning the preparatory function of counterfactual thinking. *Memory & cognition*, 45(2), 261-269. Doi: 10.3758/s13421-016-0660-5
- Meyers-Levy, 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. Doi: 10.1086/209312
- Naito, M., & Suzuki, T. (2011). "When did I learn and when shall I act?": The developmental relationship between episodic future thinking and memory. *Journal of experimental child psychology*, 109(4), 397-411. Doi: 10.1016/j.jecp.2011.03.005
- Nasco, S. A., & Marsh, K. L. (1999). Gaining control through counterfactual thinking. *Personality and Social Psychology Bulletin*, 25(5), 557-569. Doi: 10.1177/0146167299025005002
- Niedenthal, P. M., Tangney, J. P., & Gavanski, I. (1994). "If only I weren't" versus "If only I hadn't": Distinguishing shame and guilt in counterfactual thinking. *Journal of personality and social psychology*, 67(4), 585. Doi: 10.1037/0022-3514.67.4.585
- Northoff, G., & Bermpohl, F. (2004). Cortical midline structures and the self. *Trends in cognitive sciences*, 8(3), 102-107. Doi: 10.1016/j.tics.2004.01.004
- Peetz, J., Wilson, A. E., & Strahan, E. J. (2009). So far away: The role of subjective temporal distance to future goals in motivation and behavior. *Social Cognition*, 27(4), 475-495. Doi: 10.1521/soco.2009.27.4.475

- Pighin, S., Byrne, R. M., Ferrante, D., Gonzalez, M., & Girotto, V. (2011). Counterfactual thoughts about experienced, observed, and narrated events. *Thinking & Reasoning, 17*(2), 197-211. Doi: 10.1080/13546783.2011.561598
- Raposo, A., Han, S., & Dobbins, I. G. (2009). Ventrolateral prefrontal cortex and self-initiated semantic elaboration during memory retrieval. *Neuropsychologia, 47*(11), 2261-2271. Doi: 10.1016/j.neuropsychologia.2008.10.024
- Rinaldi, L., Locati, F., Parolin, L., & Girelli, L. (2017). Distancing the present self from the past and the future: Psychological distance in anxiety and depression. Doi: 10.1080/17470218.2016.1271443
- Robinson, E. J., Pendle, J. E. C., Rowley, M. G., Beck, S. R., & McColgan, K. L. T. (2009). Guessing imagined and live chance events: Adults behave like children with live events. *British Journal of Psychology, 100*(4), 645-659. Doi: 10.1348/000712608X386810
- Roese, N. J. (1997). Counterfactual thinking. *Psychological bulletin, 121*(1), 133. Doi: 10.1037/0033-2909.121.1.133
- Roese, N. J., & Epstude, K. (2017). The functional theory of counterfactual thinking: New evidence, new challenges, new insights. In *Advances in experimental social psychology* (Vol. 56, pp. 1-79). Academic Press. Doi: 10.1016/bs.aesp.2017.02.001
- 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. Doi: 10.1006/jesp.1996.0010
- Roese, N. J., & Olson, J. M. (1993). The structure of counterfactual thought. *Personality and social psychology bulletin, 19*(3), 312-319. Doi: 10.1177/0146167293193008
- Roese, N. J., Smallman, R., & Epstude, K. (2017). Do episodic counterfactual thoughts focus on controllable action?: The role of self-initiation. *Journal of Experimental Social*

Psychology, 73, 14-23. Doi: 10.1016/j.jesp.2017.05.006

- Santamaría, C., Espino, O., & Byrne, R. M. (2005). Counterfactual and semifactual conditionals prime alternative possibilities. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 31(5), 1149. Doi: 10.1037/0278-7393.31.5.1149
- Schacter, D. L., Addis, D. R., & Buckner, R. L. (2007). Remembering the past to imagine the future: the prospective brain. *Nature Reviews Neuroscience*, 8(9), 657. Doi: 10.1038/nrn2213
- Semin, G. R., & Smith, E. R. (1999). Revisiting the past and back to the future: Memory systems and the linguistic representation of social events. *Journal of Personality and Social Psychology*, 76(6), 877. Doi: 10.1037/0022-3514.76.6.877
- Shalvi, S., Dana, J., Handgraaf, M. J., & De Dreu, C. K. (2011). Justified ethicality: Observing desired counterfactuals modifies ethical perceptions and behavior. *Organizational Behavior and Human Decision Processes*, 115(2), 181-190. Doi: 10.1016/j.obhdp.2011.02.001
- Smallman, R., & McCulloch, K. C. (2012). Learning from yesterday's mistakes to fix tomorrow's problems: When functional counterfactual thinking and psychological distance collide. *European Journal of Social Psychology*, 42(3), 383-390. Doi: 10.1002/ejsp.1858
- Smallman, R., & Roese, N. J. (2009). Counterfactual thinking facilitates behavioral intentions. *Journal of experimental social psychology*, 45(4), 845-852. Doi: 10.1016/j.jesp.2009.03.002
- Smallman, R., & Summerville, A. (2018). Counterfactual thought in reasoning and performance. *Social and Personality Psychology Compass*, 12(4), e12376. Doi: 10.1111/spc3.12376

- Stalnaker, R. (1999). Context and content: Essays on intentionality in speech and thought. Oxford, UK. Clarendon Press. Doi:10.1093/0198237073.001.0001
- Suddendorf, T. (2010). Linking yesterday and tomorrow: Preschoolers' ability to report temporally displaced events. *British Journal of Developmental Psychology*, 28(2), 491-498. Doi: 10.1348/026151009X479169
- Taylor, S. E., & Brown, J. D. (1988). Illusion and well-being: a social psychological perspective on mental health. *Psychological bulletin*, 103(2), 193. Doi: 10.1037/0033-2909.103.2.193
- Tennen, H., Affleck, G., & Gershman, K. (1986). Self-blame among parents of infants with perinatal complications: The role of self-protective motives. *Journal of Personality and Social Psychology*, 50(4), 690. Doi: 10.1037/0022-3514.50.4.690
- Trope, Y., & Fishbach, A. (2000). Counteractive self-control in overcoming temptation. *Journal of personality and social psychology*, 79(4), 493. Doi: 10.1037/0022-3514.79.4.493
- Trope, Y., & Liberman, N. (2003). Temporal construal. *Psychological review*, 110(3), 403. Doi: 10.1037/0033-295X.110.3.403
- Trope, Y., & Liberman, N. (2010). Construal-level theory of psychological distance. *Psychological review*, 117(2), 440. Doi: 10.1037/a0018963
- Vallacher, R. R., & Wegner, D. M. (1989). Levels of personal agency: Individual variation in action identification. *Journal of Personality and Social psychology*, 57(4), 660. Doi: 10.1037/0022-3514.57.4.660
- Van Boven, L., & Ashworth, L. (2007). Looking forward, looking back: Anticipation is more evocative than retrospection. *Journal of Experimental Psychology: General*, 136(2), 289. Doi: 10.1037/0096-3445.136.2.289

- Van Boven, L., Kane, J., McGraw, A. P., & Dale, J. (2010). Feeling close: emotional intensity reduces perceived psychological distance. *Journal of personality and social psychology*, 98(6), 872. Doi: 10.1037/a0019262
- Vasconcelos e Sa, D., Barrowclough, C., Hartley, S., & Wearden, A. (2017). Self-blame attributions in relatives of people with recent-onset psychosis: Associations with relatives' distress and behavioural control. *British Journal of Clinical Psychology*, 56(2), 172-188. Doi: 10.1111/bjc.12132
- Viard, A., Chételat, G., Lebreton, K., Desgranges, B., Landeau, B., de La Sayette, V., ... & Piolino, P. (2011). Mental time travel into the past and the future in healthy aged adults: an fMRI study. *Brain and cognition*, 75(1), 1-9. Doi: 10.1016/j.bandc.2010.10.009
- Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological bulletin*, 132(2), 249. Doi: 10.1037/0033-2909.132.2.249
- Wrosch, C., & Heckhausen, J. (2002). Perceived control of life regrets: Good for young and bad for old adults. *Psychology and aging*, 17(2), 340. Doi: 10.1037/0882-7974.17.2.340