Cognitive Function and Beliefs in Luck in the Consumer Context

by

Justin F. McManus

A thesis submitted in partial fulfillment
of the requirements for the degree of

Master of Science

in

Marketing and Consumer Studies

University of Guelph
Guelph, Ontario, Canada

© Justin F. McManus, 2014

ABSTRACT

COGNITIVE FUNCTION AND BELIEFS IN LUCK IN THE CONSUMER CONTEXT

Justin F. McManus
University of Guelph, 2014

Advisor: Dr. Theodore J. Noseworthy

Dual-process attribution theories suggest that attributional reasoning involves automatic judgments that are adjusted by a controlled correction process. However, this corrective process is vulnerable to failure because human cognitive capacity is of a limited pool of resources. Three experiments test whether there is a corrective process for people who hold beliefs in luck, and if so, whether cognitive constraints inhibit this process. Results suggest inhibited executive function impedes the usual correction of beliefs in luck, which facilitates future expectations of success. As such, factors within our environment that tax cognitive resources may enable people to act on beliefs in luck. This finding holds important theoretical and practical implications for gambling because these factors could range from the mindset created by financial distress or the ambient casino environment.

In loving memory of

Pauline Alma Ferguson, December 23rd 1929 - July 19th 2003

Acknowledgements

I would like to acknowledge and express my gratitude to a few people who greatly assisted me during my time in Guelph. First, I want to thank my advisor, Dr. Theodore Noseworthy, for training me to recognize the creative nuances of experimental design and for his mentorship, which has been parallel to none and has had a huge impact on my development as a young researcher. The mentality and drive instilled by Theo elevates the work of others.

Second, I wish to thank my committee members Dr. Peter Darke and Dr. Sally Gainsbury for sharing their knowledge, insight, and patience, particularly with the organization of this thesis. Both Peter and Sally have provided lasting advice and unrivaled guidance that has fostered my growth, which I will cherish moving forward in research. In these thanks, I also wish to extend my appreciation to Dr. Vinay Kanetkar for being involved in reviewing my thesis and overseeing it to completion.

I am incredibly grateful to my parents Antony, Louise, and Debbie for inspiring my work ethic and for their unwavering encouragement, love, and support – without whom, I would be unable to pursue my goals in research. I also wish to thank my partner, Amanda, for entertaining more practice talks than most and for bringing a contagious sense of humour to any setbacks.

Thanks are also in order to my mentor at Carleton University, Dr. Michael Wohl, and close friends Dr. Jamey Lister and, soon to be Dr., Travis Sztainert, who provided some stellar advice during some difficult situations.

To my NOSESIS lab mates, it has been incredibly fun and a sincere pleasure spending many late hours at work and many laughs on the basketball court. I also wish to thank the faculty members in the Department of Marketing and Consumer Studies for their assistance throughout my degree.

Lastly, I would like to thank the Ontario Problem Gambling Research Centre for funding this research in the form of a Master's Studentship Award (#3496) and a Student Research Grant.

Without these people combined, this thesis would not be what it is today and I would not have had the opportunity to study in Guelph – for this, I sincerely thank you.

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION.....	1
CHAPTER 2: LITERATURE REVIEW	4
• 2.1 Attribution Theory and Perceptions of Luck.....	7
• 2.2 Attention, Working Memory, and Cognitive Function.....	9
• 2.3 Executive Function: A singular or Subcomponent Construct?	11
• 2.4 Reviewing the Function of Selective Attention.....	13
• 2.5 Scarcity: The Earworm of Attention.....	15
• 2.6 The Attention-Luck Link.....	17
• 2.7 Financial Distress and Gambling.....	18
CHAPTER 3: OVERVIEW OF THE CURRENT RESEARCH.....	21
CHAPTER 4: STUDY 1.....	23
• 4.1 Hypotheses.....	23
• 4.2 Data Analyses.....	24
• 4.3 Methods.....	26
○ 4.3.1 Participants and Design.....	26
○ 4.3.2 Procedure.....	27
○ 4.3.3 Measures.....	28
○ 4.4 Results.....	30
▪ 4.3.1 Pretest of Luck-related Words.....	30
▪ 4.3.2 Digit Span Performance.....	31
▪ 4.3.3 Automatic Inferences of Luck.....	31
▪ 4.3.4 Attributional Reasoning.....	32
○ 4.5 Discussion.....	34
CHAPTER 5: STUDY 2.....	38
• 5.1 Hypotheses.....	40
• 5.2 Methods.....	41
○ 5.2.1 Participants and Design.....	41

○ 5.2.1 Procedures.....	41
○ 5.2.3 Measures.....	45
○ 5.3 Results.....	46
▪ 5.3.1 Lottery Outcome Manipulation Check.....	46
▪ 5.3.2 Digit Span Performance.....	47
▪ 5.3.3 Amount Bet on Roulette.....	47
○ 5.4 Discussion.....	49
CHAPTER 6: STUDY 3.....	53
• 6.1 Hypotheses.....	54
• 6.2 Methods.....	54
○ 6.2.1 Participants and Design.....	54
○ 6.2.2 Procedures.....	55
○ 6.2.3 Measures.....	57
○ 6.3 Results	59
▪ 6.3.1 Lottery Outcome Manipulation Check.....	59
▪ 6.3.2 Digit Span Performance.....	59
▪ 6.3.3 Slot Machine Persistence.....	59
○ 6.4 Discussion	60
CHAPTER 7: GENERAL DISCUSSION.....	62
• 7.1 Limitations & Future Directions.....	65
• 7.2 Theoretical Contributions.....	67
• 7.3 Managerial Implications.....	69
• 7.4 Conclusions.....	71
REFERENCES	84
Appendix A: Attribution Models.....	87
Appendix B: Manipulation Checks Studies 1 & 2).....	86
Appendix C: Tests of Normality (Q-Q Plots & Histograms).....	87
Appendix D: Two-way Interaction Plots (study 1).....	94

Appendix E: Moderated Moderation Models.....	95
Appendix F: Tables.....	99
Appendix G: Three-way interaction plots (studies 2 & 3).....	102
Appendix H: Experimental Stimuli.....	105
Appendix I: Experimental Script.....	111
Appendix J: Word-fragment Completion Task.....	112
Appendix K: Research Ethics Board Certificate.....	113
Appendix L: Survey Instruments.....	114

LISTS OF TABLES

Table 1. Study 2 Moderated Moderation Results (Win vs. Control)

Table 2. Study 2 Moderated Moderation Results (Loss vs. Control)

Table 3. Study 3. Moderated Moderation Results

LISTS OF FIGURES

- Figure 1.** Weiner's 1985 attributional theory of achievement motivation and emotion.
- Figure 2.** Automatic inference and controlled correction processes of current attribution models
- Figure 3.** Study 2 lucky manipulation check.
- Figure 4.** Study 3 lucky manipulation check.
- Figure 5.** Histogram of word-fragment completion scores in study 1.
- Figure 6.** Q-Q plot of word-fragment completion scores in study 1.
- Figure 7.** Histogram of personal control scores in study 1.
- Figure 8.** Q-Q plot of personal control scores in study 1.
- Figure 9.** Histogram of locus of causality scores in study 1.
- Figure 10.** Q-Q plot of locus of causality scores in study 1.
- Figure 11.** Histogram of external control scores in study 1.
- Figure 12.** Q-Q plot of external control scores in study 1.
- Figure 13.** Histogram of stability scores in study 1.
- Figure 14.** Q-Q plot of stability scores in study 1.
- Figure 15.** Histogram of the amount bet on roulette in study 2.
- Figure 16.** Q-Q plot of the amount bet on roulette in study 2.
- Figure 17.** Histogram of slot machine persistence in study 3.
- Figure 18.** Q-Q plot of slot machine persistence in study 3.
- Figure 19.** An interaction plot between cognitive resources and the card draw outcome on the word-fragment completion task.
- Figure 20.** An interaction plot between cognitive resources and the card draw outcome on attributions of personal control.

Figure 21. A statistical model of multiplicative moderation recreated from Hayes (2012) Process documentation.

Figure 22. A conceptual moderated moderation model displaying a significant 3-way interaction between lottery outcome (coded: win = 1, control = 0), trait beliefs in luck (mean centered; tested at M , $\pm 1SD$), and cognitive resources (coded: load, control) on the amount bet on roulette.

Figure 23. A conceptual moderated moderation model displaying a significant 3-way interaction between lottery outcome (coded: loss = 1, control = 0), trait beliefs in luck (mean centered; tested at M , $\pm 1SD$), and cognitive resources (coded: load, control) on the amount bet on roulette.

Figure 24. A conceptual moderated moderation model displaying a significant 3-way interaction between lottery outcome (coded: win = 1, loss = 0), trait beliefs in luck (mean centered; tested at M , $\pm 1SD$), and cognitive resources (coded: load = 1, control = 0) on slot machine persistence .

Figure 25. An interaction plot between lottery outcome (win, control) and trait beliefs in luck (low, moderate, high) on the model-predicted expected values of the amount bet on roulette under cognitive load (above).

Figure 26. An interaction plot between lottery outcome (win, control) and trait beliefs in luck (low, moderate, high) on the model-predicted expected values of the amount bet on roulette under cognitive control.

Figure 27. An interaction plot between lottery outcome (loss, control) and trait beliefs in luck (low, moderate, high) on the model-predicted expected values of the amount bet on roulette under cognitive load (above).

Figure 28. An interaction plot between lottery outcome (loss, control) and trait beliefs in luck (low, moderate, high) on the model-predicted expected values of the amount bet on roulette under cognitive control.

Figure 29. An interaction plot between lottery outcome (win, loss) and trait beliefs in luck (low, moderate, high) on the model-predicted expected values of slot machine persistence under cognitive load.

Figure 30. An interaction plot between lottery outcome (win, loss) and trait beliefs in luck (low, moderate, high) on the model-predicted expected values of slot machine persistence under cognitive control.

CHAPTER 1: INTRODUCTION

It is human nature to be curious, inquisitive, and eager to understand experiences of personal relevance. People often try to understand why a certain event comes to fruition by examining and ascribing different causal elements to its outcome (Weiner et al., 1972). This attribution process helps discern potential factors that cause success and failure. For example, such a process might arise after being fired from a job. The former employee might contemplate whether this failure was caused by a lack of effort, an irrational boss, or just bad luck. Attributing the cause of a puzzling or fortuitous event helps explain and reconcile elements of chance to bring perceived control and optimism (Rothbaum, Weisz, & Snyder, 1982). These attributions help people make sense of past outcomes and predict future outcomes (Weiner, 1972). In one way, this is how people learn, adapt, and come to endorse certain expectations (Weiner, 1985). Although beneficial, attributional reasoning takes effort – people must engage in an evaluation of different causal elements such as the difficulty of the task and one's ability, effort, and luck (Weiner et al. 1972; also known as an inference process, see Trope, 1986). However, cognitive capacity is of a limited pool of resources (Luck & Vogel, 1997) and in the world of cell phones, nagging emails, and bill payments, people often have multiple demands placed on their attention. One such example is when cognitive resources are overtaken by financial distress.

According to Shah and colleagues, financial scarcity can impact how we process information, most notably where people focus their attention (Shah, Mullainathan, & Shafir, 2012). Hence, when money is limited, pending expenses are met with a pressing urgency. In order to solve the dilemma of meeting the debt, people engage in deeper levels of processing (Shah et al., 2012). As a result, problem-solving ability pertaining to the task at hand is hindered due to the cognitive load exerted by financial distress. Clearly, in such cases, this distress places

ongoing demands on one's attention. These cognitive burdens, be it engendered by debt or other demands, impact executive function in a manner consistent with Lavie and De Fockert's (2005) attentional capture. Specifically, these demands act as a distraction by stealing attentional resources away from the current activity, impeding executive function (Mani et al., 2013). What happens though, when people do not have the cognitive resources to engage in a thorough evaluation of attributions after experiencing a random event?

The goal of this thesis is to identify whether cognitive resources and beliefs in luck impact future expectations of success after experiencing a random positive event. Specifically, cognitive load directly inhibits people from engaging in deeper-level evaluations and makes people extremely sensitive to the activation of attributional cues after experiencing a random event. It is offered herein that when cognitive resources are scant and people are cued with a random positive event, they are much likelier to evaluate the outcome as controllable and attribute its success to personal luck. This is based on the contention that when attention is limited, the attribution of luck is used as an automatic judgment, similar to the differences in cognitive processing that exacerbate the use of stereotypes (Devine, 1989; Gilbert & Hixon, 1991). Even though heuristics can be used during instances of both low and high processing demand, cognitive load likely inhibits one's ability to correct the inference of luck.

In a typical consumer context, such as a contest promotion, misattributing causality to luck may not be detrimental; however, in the context of gambling, this process may instigate irrational beliefs implicated in exceeding monetary limits and excessive spending (i.e., persistence) among both recreational (Stewart & Wohl, 2013) and problem gamblers (Ladouceur & Sevigny, 2005).

This thesis outlines three studies that used a between-subjects design and discusses their contributions and limitations. Chapter 2 provides a comprehensive literature review of traditional attribution theory and perceptions of luck, theories of dual-process attribution, executive function, and the impact of resource scarcity on executive function. Chapter 3 links the conceptual development as an overview of the current research. Chapter 4 provides evidence that cognitive resources are important for the attribution process and specifically that different levels of selective attention facilitate automatic judgments of luck and controllability (study 1). Chapter 5 identifies that when people are exposed to a lucky event, those who believe in luck tend to bet more money during a gambling task when they are under cognitive load (study 2). Chapter 6 provides a conceptual replication in showing that when people experience a lucky event, those who believe in luck persist longer in the face of continued loss on a slot machine when executive function is inhibited (study 3). Results suggest cognitive resources facilitate the correction of irrational beliefs whereas inhibited executive function exacerbated future expectations in risk taking. Chapter 7 discusses the limitations and managerial, clinical, and policy implications for marketing tactics that cue the feeling of luck among consumers with inhibited executive resources. The noteworthy theoretical contribution of this thesis suggests that many people believe in luck but under normal circumstances (i.e., not under cognitive load) mentally correct or adjust these beliefs to avoid biasing future behaviour; however, when executive function is inhibited, people tend to fall victim to beliefs in luck.

CHAPTER 2: LITERATURE REVIEW

Attribution theory has a relatively long history, spanning over the past 50 years and is an appropriate and applicable theory for consumer behaviour. Attributional reasoning influences both the rationalization of an outcome or social judgment and the processes navigating future decisions (Weiner, 2000). Attributions are implicated in the evaluation of oneself (e.g., emotions, achievement motivation) and the personality dispositions of others – whether the smile of a sales clerk is genuine and whether the work ethic of a struggling sports icon is lazy. Research investigating the interpretation of events originated with Heider (1958) and the theory suggests that outcomes could be impacted by factors both within the person and the environment. This interpretation developed into an internal-external locus (Rotter, 1966) – the idea that some elements were controlled by oneself (internal) and others were controlled by one's environment (external). For example, a person might fail a math test because they did not study or because the teacher gave a test that was too difficult. Both attributions lead to the same outcome – a failure – but have very different reasons and implications for future behaviour. Another meaningful factor that comes into play is whether an attribution is stable and long-term. Weiner and colleagues (1971) introduced the concept of stability to attribution theory – some attributions are stable, lasting, and enduring, while others are unstable, fickle, and variable. One might imagine in the case of failing a math test, a person might attribute the failure to a low ability for math (i.e., internal and stable). That is, the person perceives the cause of this failure to be caused by a stable, dispositional aptitude. In contrast, another student could interpret the same math test failure as a lack of effort and not studying long enough (i.e., internal and unstable). In the context of gambling, a winning roll of the dice from the hand of someone who believes in luck may result in greater expectations for future gambles than someone who doesn't believe in luck. This

is because people who believe in luck tend to think of their luck as a personal quality (Wohl & Enzle, 2002).

As mentioned earlier, causal attributions are important for guiding future behaviour and motivation (Weiner, 1985). It is not surprising that the last example, the attribution of low effort might cause a student to work harder in preparation for the next test if they want to avoid the aversive feeling of failure. That said, it is completely possible a math test failure is not aversive. Such a situation would not motivate someone to exert more effort than before (Weiner, 1985).

Weiner's Attribution Theory is directly related to the appraisal of attaining success or failure (Weiner et al. 1972; Weiner, 1985). Making causal attributions involves many antecedents and consequences. Attributions can be categorized and combined in two ways: their causal ascriptions and causal dimensions. Causal ascriptions are factors such as the difficulty of the task and one's strategy, ability, effort, and luck (Weiner et al. 1972; Weiner, 1985). In the achievement domain, the most common attributions are ability (i.e., aptitude) and effort (Weiner, 1985). Causal dimensions help define these ascriptions by narrowing their focus. The causal dimensions described by Weiner (1985) include whether an event is perceived to be (1) internal to oneself or external to the environment, (2) enduring over time or liable to change, (3) global across many situations or specific to a certain instance, and (4) under one's control or not (See Figure 1, Appendix A for full model; Weiner, 1985).

Knowing the reason for why an event occurred, such as failing a test or losing a game, is an adaptive feature. For example, imagine being a competitive runner. If losing a race is perceived to be due to feeling under the weather from sickness the loss may not be as impactful. This is because the loss can be reconciled and rationalized as not being under personal control, allowing a person to relinquish responsibility for the outcome (Weiner, 1985). In this scenario,

the prospect of future success remains. However, if losing a big race is attributed to low ability, this failure may not be dismissed as readily because future hope is minimized (Weiner, 1985). Those wishing to catalyze a different outcome post-failure will likely avoid the steps attributed to that failure (Weiner, 1985). A caveat to this is when a person feels hopeless by attributing enduring low ability across many domains with little expectancy for future success – a concept described by learned helplessness (Klein, Fencil-Morse, & Seligman, 1976).

Current attribution theories, given rise by Winter and Uleman (1984), Quattrone (1982), and Tversky and Kahneman's (1974), take a dual-process approach to attributional reasoning (see Figure 2, Appendix A; Gilbert, Pelham, & Krull, 1988; Liberman, Gaunt, Gilbert, & Trope, 2002; Trope, 1986). In Trope's (1986) *Identification-Inference Model*, attributions are formed by two processes: (a) the identification and categorization of information regarding the person, situation, or behaviour, and (b) the inference – a controlled process to determine the dispositional or situational cause. This second stage is dependent on cognitive and motivational resources (Liberman et al., 2002). "Systematic (diagnostic) evaluation compares the consistency of the behavior with a favored hypothetical cause to the consistency of the behavior with other possible causes, whereas heuristic (pseudodiagnostic) evaluation is based on the consistency of the behavior with the favored hypothetical cause and disregards alternative causes" (Liberman et al. 2002, p. 202, from Trope & Liberman, 1993). Importantly, heuristic evaluations produce a correspondence bias – the over attribution of a dispositional cause (Trope & Liberman, 1993).

In the application of Tversky and Kahneman's (1974) anchoring and adjustment of this initial identification of information, Quattrone (1982) showed how people begin attributional reasoning by drawing an assumption (used as a working hypothesis) and then adjust them by using the situational cues (Liberman et al. 2002). Gilbert and colleagues (1988) further

developed dual-process attribution in their *Characterization-Correction Model* by incorporating these two stages discussed by Quattrone (1982) into the second *inference* stage of Trope's (1986) model (see Figure 2). The first sub-stage of which was argued to be relatively automatic whereas the latter sub-stage is more controlled. "People automatically identify actions [*categorization*], automatically draw dispositional inferences from those actions [*characterization*], and then consciously correct these inferences with information about situational constraints [*correction*]," (Liberman et al. 2002, p. 203). As such, when people are unable to dedicate attentional resources to attributional reasoning, the third *correction* process is vulnerable to failure (Gilbert et al., 1988).

The appraisal process involved in determining the cause of events is important because it allows one to effectively navigate and manage both oneself and one's environment. If an event is successful, the attributions thought to cause the outcome will be recreated (Weiner, 1985) and it is suggested that self-attributions follow a similar process as those involved in the social judgments of others (Trope, 1986). It is offered that the self-attribution of luck is also open to this dual-process correction bias.

2.1 Attribution Theory and Perceptions of Luck

According to traditional Attribution Theory, luck should not be perceived to impact one's future success. Weiner and colleagues (1972) suggest that luck is external, unstable, and unpredictable in nature. As such, from the standpoint of rationality, luck should have no perceivable bearing on future outcomes. Nevertheless, research shows that beliefs of luck impact legal decisions (Kessler, 1994), the perception of entrepreneurial success (Loderer, Peyer, & Liechti, 2010), the reason for discovering a loved one (Ben-Zeev, 2009), and the decision to gamble (Wohl & Enzle, 2002, 2003; Wohl, 2008). Luck itself can be thought of as experiencing

an improbable event, such as winning the lottery. It is important to note that feeling lucky after such instances is not irrational. Beliefs of luck are irrational when they are applied to future unrelated situations. Beliefs in luck has been defined as “the view that luck is a somewhat stable characteristic that consistently favors some people but not others and is especially likely to favor oneself,” (Darke & Freedman, 1997a). As such, endorsing such beliefs can be thought of as irrational.

It is apparent that some people endorse luck as a personal quality or attribute that can be deployed as an advantage during external, uncontrollable events (Darke & Freedman, 1997a; Wohl, Stewart, Young, 2011). Darke and Freedman (1997b) demonstrate how irrational beliefs of luck are bolstered by past success where luck was attributed to be a causal factor. Viewing luck as stable and with an internal locus of control leads to heightened perceived control (Darke & Freedman, 1997a). As a result, those who endorse personal luck believe that luck is a facet of their disposition, which can have a deterministic impact on future outcomes (Wohl, Stewart, & Young, 2011). Not surprisingly, this feeling is related to increased confidence and risk-taking during chance situations (Darke & Freedman, 1997b).

Although many factors, such as emotion, personal choice, optimism, perceived control, and neuroticism, have been related to the perceptions of luck (Darke & Freedman, 1997; Jiang, Cho, & Adaval, 2009; Thompson & Prendergast, 2013; Wohl & Enzle, 2002, 2003) a recent study suggests that cognitive functioning may play an important role for endorsing luck-related beliefs (Maltby, Day, Pinto, Hogan, & Wood, 2013). Across multiple studies, Maltby and colleagues (2013) show that, when controlling for other variables known to impact luck (i.e., irrational beliefs, optimism, self-efficacy, and personality), lower levels of executive functioning are predictive of the belief that one is unlucky – a phenomenon coined the *dysexecutive luck*

hypothesis. One explanation for this relationship is that cognitive function moderates the appraisal of luck. In the case of those with dysexecutive syndrome (e.g., brain damage), some people are likely motivated to attribute failures in their environment to bad luck as opposed to self-incompetence as a result of the long-term condition. However, in the case of people who otherwise have healthy everyday functioning, cognitive load or impairment placed on information processing may impede one's identification of causal attributions by disrupting the final correction stage (Gilbert et al., 1988). In other words, cognitive functioning may influence one's appraisal abilities and bias people to attribute outcomes to luck.

The appraisal and evaluation of causal factors takes effort as people process and consider different available options. Indeed, when making causal attributions, people often “pay selective attention to the most conspicuous, accessible, and easily processed information in the focus of their attention” (Forgas, 1998, p. 319). The cognitive system required to make these evaluations is known as executive function, which is an umbrella term that refers to human decision making and the capacity for higher-order cognitive abilities: inhibition of automatic responses, planning, monitoring and regulating performance, attention control, cognitive flexibility, and goal attainment (McCabe et al. 2010).

2.2 Attention, Working Memory, and Cognitive Function

Through advancements in cognitive psychology and, specifically, the development of Baddeley's (1986, 2000) conceptualization of working memory, executive function has been studied as an important aspect of maintaining normative, everyday functioning. The multiple component model of working memory addresses how people store and manipulate information (Baddeley, 1986). Working memory applies to many areas of functioning including daily mundane routines, novel thinking, reasoning, and complex problem solving – the latter of which,

occupy a larger proportion of mental resources. The capacity of working memory has been related to higher-order cognitive abilities like episodic memory (McCabe, Smith, & Parks, 2007), reasoning (Barrouillet & Lecas, 1999), and fluid intelligence (Colom, Rebollo, Palacios, Juan-Espinosa, & Kyllonen, 2004).

The central executive can be thought of as the command center of working memory (Henry, 2011) and subsequently, directs the attention for executive function and higher-order cognition (McCabe et al., 2010). The core role of the central executive is to switch, divide, and focus attention across the various facets of working memory (Baddeley, 2007). Furthermore, the central executive is considered to function in a manner described by the Supervisory Attentional System (SAS; Norman & Shallice, 1986). Originally, it was thought the SAS was activated during novel thought, reasoning, and planning because new tasks are more demanding and require more attentional resources than well-learned tasks. However, the SAS is responsible for both engaging in novel (Shallice, 1988) and routine tasks (Schwartz, 1995).

Executive function is primarily related to the anatomical area of the frontal lobe, specifically the prefrontal cortex (Duncan & Owen, 2000), which is the most forward point of the human brain. Frontal lobe functioning is often synonymous with executive functioning (Carlson, 2005) and is associated with other important daily functions such as impulse control, emotion regulation, and social functioning (Gray, Chabris, & Braver, 2003). A plethora of research demonstrates a relationship between frontal lobe damage and deficits in executive function (Bivona et al. 2008; Bodenbun & Dopsloff, 2008; Hunt, Turner, Polatajko, Bottari, & Dawson, 2013; Shallice & Burgess, 1993).

Some theories discuss executive function through their operating neural mechanisms. Duncan and Owen (2000) theorize that multiple executive functions are reliant on the lateral

prefrontal cortex, suggesting a singular control center. However, Petrides (2005) argues different, distinct, areas of the lateral prefrontal cortex drive specific executive functions. Specifically, that the inferior lateral prefrontal cortex operates working memory while the mid-dorso-lateral prefrontal cortex exercises executive-control on the information in working memory.

2.3 Executive Function: A Singular or Subcomponent Construct?

Not surprisingly, executive function enables people to successfully engage in a wide range of independent and calculated actions. A longstanding question that has interesting theoretical implications is whether the system responsible for human attention is composed of a singular pool or resources or subcomponents with separate pools for different stimuli (e.g., visual versus auditory). Recent research has attempted to merge psychological and neurobiological models to better understand whether executive processing is a singular or multifaceted construct. For example, one perspective suggests that executive function is a monolithic construct like fluid intelligence or processing speed, which is understood as working memory (Salthouse & Davis, 2006). Recent findings suggest that a central component of resources, demonstrated by manipulating working memory load, is dominantly responsible for attention. This is illustrated when participants are put under high load conditions through a visual-verbal task they are less likely to attend to auditory stimuli (SanMiguel, Corral, & Escera, 2008). If attention were truly allocated across two different visual-auditory subsystems, participants would be able to attend to both stimuli with relative ease. In another example, increased auditory working memory load reduces brain activity in the regions of visual processing (Klemen, Büchel, Bühler, Menz, & Rose, 2010) and anatomical areas associated with working memory direct selective attention to process sensory information (Gazzaley & Nobre, 2012). Furthermore, individual differences in

high capacity working memory predict performance on selective attention tasks (Kane et al., 2004). All to suggest that selective attention associated with executive function is controlled by a singular pool of resources (Sorqvist, Stenfelt, & Ronnberg, 2012).

Another perspective however, suggests executive functioning consist of separate subcomponents, which can be demonstrated by shifting tasks and inhibiting behaviours (Fisk & Sharp, 2004; Friedman et al., 2006). Some operations of these subcomponents can be explained in a three-component model of executive function (Friedman et al., 2008; Miyake et al., 2000). The first component, *updating*, describes the ability of adding and removing information from working memory that is no longer important. The second component, *shifting*, can be thought of switching between different tasks, mental states, or ways of responding. The third component, *inhibition*, is important for task specific information, when avoiding automatic responses (in order to tailor responses appropriate to certain situations). In the *Dysexecutive Luck Hypothesis*, Maltby and colleagues (2013) suggest that beliefs of unluckiness are related to many subcomponents. Beliefs of unluckiness were found to be related to self-reported symptoms of dysexecutive function, lower scores during a shifting task (i.e., the number-letter task; Rodgers & Monsell, 1995), worse performance during an inhibition task (i.e., Stroop task; Stroop, 1935), and worse performance during a decision making task (i.e., Iowa Gambling Task; Bechara, Damasio, Damasio, & Anderson, 1994). Given that prior research suggest that shifting and inhibition are simpler working memory processes, the executive function of updating was not tested in the dysexecutive luck hypothesis (Maltby et al., 2013). However, the executive function of updating, the “ability to change existing and irrelevant information in working memory by monitoring and coding newer and relevant information” (Maltby et al., 2013, pp. 139) might be especially relevant for perceptions of luck especially when confronted with luck-related cues.

Furthermore, research that has attempted to show distinct and specific brain activation among these different tasks suggest that executive function is not a monolithic construct (Godefroy, Cabaret, Petit-Chenal, Pruvo, & Rousseaux, 1999; Shallice, 1988).

Increasing research findings suggest that executive function is not exclusively a unified or diverse construct. Recent neuropsychological research, more aligned with the subcomponent perspective, indicates both a common regional activation and distinct area activation during different executive functions (Collette et al., 2005; Banich, 2009; Nee et al., 2012; Miyake et al., 2000). A recent meta-analysis of 36 experiments on working memory and executive function suggests that two frontal areas are used during executive tasks (Nee et al., 2012). Different frontal regions were recruited to attend to spatial and non-spatial content, respectively. These new results suggest there is no one “central executive” that serves to delineate executive function; however, both regions were involved in selection and attending to relevant context specific stimuli. Nee and colleagues (2012) explain that maintenance and executive control simply boil down to the selection of appropriate stimuli. “Selection serves to maintain information, protect it from irrelevant information, and update new information. Hence, much of the work of working memory can be accomplished through a simple selection mechanism. A biased competition model of selection can then simultaneously explain storage and executive aspects of working memory,” (Nee et al. 2012, pp. 278). As such, inhibiting the universal attentional element, such as a digit-span task expressed through working memory, impacts multiple aspects of executive function and therefore may impact casual attributions of luck.

2.4 Reviewing the Function of Selective Attention

The traditional experimental paradigm of selective attention involves participants attending to one source of information while simultaneously ignoring another (Healy & Proctor,

2003). Within a “shadowing” experiment, participants are presented with two different messages while wearing headphones – one message for each ear. During these types of experiments, participants are asked to “shadow” or verbally repeat the message they hear from one ear only. Not surprisingly, people typically have lower awareness of the messages from the “non-shadowed” ear as a result of the little attention it is allocated. However, there is an exception and this is when the unattended message has information of personal relevance such as one’s name or an emotionally-charged word (Mack & Rock, 1998). In these cases, participants typically switch to the unattended source, which suggests that information can penetrate selective attention. Numerous experimental paradigms such as the attentional blink (Dux & Marois, 2009), inattention blindness (Mack & Rock, 1998), and change blindness (Jensen, Yao, Street, & Simons, 2011) indicate that selective attention is extremely important for acquiring and processing information. For example, when participants are shown multiple target stimuli in rapid serial visual presentation, they fail to notice the second target if it is presented within 200-500ms (Dux & Marois, 2009). Similarly, when participants complete multiple trials of an initial task, such as a visual search task, and then are exposed to the same trial with a new stimulus within the task they often fail to recognize the new stimulus (Mack & Rock, 1998). Finally, when two identical stimuli differ by only one element, attention is often not drawn to this change and it goes unnoticed (Jensen et al., 2011). These results suggest that attention is a key factor for recognition and thoughtful evaluation of salient information.

The human cognitive system, specifically working memory, is a finite resource that is subject to depletion (Lavie & De Fockert, 2005; Luck & Vogel, 1997) expressed by cognitive load, which is the mental demand imposed on the cognitive system when performing tasks (Paas & Van Merriënboer, 1994; Sweller et al., 1998). For the purpose of this thesis, in line with Lavie

and colleagues, cognitive load will refer to an occupied or exhausted state of working memory and is synonymous with depleted attentional resources (Lavie, Hirst, De Fockert, & Viding, 2004; Lavie & De Fockert, 2005). Consequentially, cognitive load can pose a significant barrier for problem solving and learning (Sweller, 1988).

Importantly, cognitive load can impact executive function through selective attention. During instances of cognitive load, task performance suffers as a result of disturbances on selective attention. Attentional capture, described by Lavie & De Fockert (2004) is dependent on the capacity of working memory and whether it is in a state of cognitive load (Lavie & De Fockert, 2005). This reduced level of working memory, lowers one's ability to focus attention on the current task and therefore, irrelevant information may intrude. This intrusion, for example, could be in the form of an attributional cue that activates the concept of luck. Indeed, when cognitive load is manipulated, attentional capture is impacted by a single irrelevant distractor (Lavie & De Fockert, 2003). Furthermore, this salient information is not only found in the environment, but also in the form of internal cues such as self-awareness. Research suggests that deficits in executive function displayed by traumatic brain injury are positively related to decreased self-awareness (Bivona et al. 2008). Such disturbances on executive function, namely attention, could impact attributional reasoning.

As discussed, cognitive load is not just a laboratory-based phenomenon – the suppression of working memory is widely seen in the real world. One example is when people experience resource scarcity.

2.5 Scarcity: The Earworm of Attention

Shah and colleagues (2012) argue that cognitive load in the real world is not unique to financial scarcity but applies to the broader concept of resource scarcity. For example, people

who are busy and have time scarcity pay more attention to deadlines (Karau & Kelly, 1992). Similarly, people who experience a scarcity of food or water pay greater attention to food and drink cues (Aarts, Diikjsterhuis, De Vries, 2001; Radel & Clement-Guilotin, 2012). Compared to relative controls, thirsty participants were more sensitive to drink-related cues within their environment and responded faster to drinking-related words during a lexical decision task (Aarts, Diikjsterhuis, De Vries, 2001). This suggests that when resources are scarce, acquiring them is top of mind, which acts as a distraction, stealing one's attentional capture away from current tasks. This distraction depletes the attentional resources required for optimal executive function (Mani et al., 2013). In a field study of Indian sugarcane farmers, Mani and colleagues (2013) demonstrate that financial distress impedes cognitive function. Specifically, sugarcane is harvested once a year and therefore, farmers experience instances of extreme wealth immediately after the harvest and instances of poverty in the weeks prior to the harvest. This type of bipolar change in wealth provides a rare opportunity to study the impact of income on cognitive function using a within-subjects design. Importantly, it was found that farmers had diminished cognitive capacity pre-harvest compared to during and immediately after the harvest when they came across a windfall gain (Mani et al., 2013). These results were not explained by stress, nutrition or work effort.

In past, research has argued that when cognitive resources are strained, people suffer a deficit in their ability to control impulses (Ledgerwood et al., 2012; McCabe, Roediger, McDaniel, Balota, & Hambrick, 2010). Hence, people enduring cognitive load exhibit decreased inhibition and are unable to restrain impulses. Under this traditional line of thought, it would be expected that within the current research, cognitive load would be the sole contributor to increased gambling. Although a long line of research supports impulse-control failure during

cognitive load (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Vohs & Heatherton, 2000), recent research examining selective attention suggests otherwise (Dillen, Papies, & Hofmann, 2013). Contrary to the common belief that low cognitive resources may be an antecedent factor to disinhibition, Dillen and colleagues (2013) argue that cognitive load inhibits one's ability to focus attention on rewarding stimuli and therefore, promotes self-regulation. As such, the current research suggests that it is a combination of experiencing a perceived low probability event and depleted attentional resources that contribute to attributions of luck that promote increased gambling.

2.6 The Attention-Luck Link

Attribution theorists suggests the attribution process begins with the identification of the most readily available or salient attributions (Gilbert et al. 1988; Trope, 1986; Weiner, 1985). It is argued that when attentional resources are strained attributional evaluations stop at the most salient attribution, specifically because they are unable to correct initial automatic judgments (Gilbert et al. 1988). That is, attributional reasoning requires cognitive resources and when these resources are unavailable people may employ heuristics. As a result, people under cognitive load may be unable to guard against beliefs of luck. During heuristic processing, people bank on the most accessible information or related cues (Chaiken, 1980). Heuristic processing offers utility insofar as an adaptive and economic method for dealing with everyday demands – people use heuristics to minimize cognitive effort (Chaiken, 1980). Automatic biases and heuristic judgments are especially prevalent in the realm of consumer behaviour (Noseworthy & Good, 2011). If people processed all information systematically, everyday trivialities like grocery shopping would become burdensome and overwhelming.

To further this explanation, we look towards a commonality within the literature on stereotypes. When a stereotype is activated, participants under cognitive load are unable to search and bring about the incongruent or counter-stereotypical information (Gilbert & Hixon, 1991; Macrae, Hewstone, & Griffiths, 1993). As such, stereotypes are used as a heuristic for efficiency. Similarly, when an attribution is cued, people under cognitive load are unable to harness the resources to process a systematic evaluation to bring about a counter causal attribution. In this case, high processing load may facilitate luck as a heuristic.

People consciously employ tactics based on superstitious beliefs, such as avoiding the construction of a 13th floor or sidestepping the path of a black cat. However, superstitious beliefs also work nonconsciously, like when people pay more for lucky priced products (Jiang, Cho, & Adaval, 2006; Kramer & Block, 2007). These nonconscious actions of superstition are thought to work in a similar manner to stereotypes (Kramer & Block, 2007). Moreover, the salience of superstitious beliefs weakens their effect on consumer behaviour (Kramer & Block, 2007). In some cases, when participants are aware of the relation between a superstitious prime and an evaluative judgment, the effects of superstitious beliefs can reverse, suggesting that a correction (or over correction) process occurs. As such, beliefs in luck may work along a similar principle where people consciously correct them. Consequently, people who lack the cognitive resources to do so may not have the ability to correct or guard against beliefs of luck when cued.

A plethora of luck cues exist within the consumer environment such as those surrounding consumer risk. Such cues are ubiquitous within the gambling context. Given prior research, it is not surprising there is an overwhelming relationship between financial distress and those who gamble.

2.7 Financial Distress and Gambling

Lottery advertising has been most effective among those with lower levels of income (Lee & Chang, 2008). Several studies demonstrate a relationship between a consumer's financial position and their likelihood to gamble. Low-income individuals purchase lottery tickets more often (Barnes, Welte, Tidwell, & Hoffman, 2011), spend and lose a greater proportion of their income on lottery tickets (Livernois, 1987; Lang & Omori, 2009), and spend less on non-gambling expenditures (e.g., food or other bills) after the introduction of state lotteries (Barnes et al., 2011; Kearney, 2005). Gambling is more typically attractive to low-income consumers over high-income consumers (Welte et al., 2002). For example, households earning less than \$10 000 annually were found to spend a notable 3% of their income on state lotteries alone (Clotfelter, Cook, Edell, & Moore, 1999). Moreover, some lottery markets are composed of up to 60% of low-income consumers (Ariyabuddiphongs, 2006).

It is not only one's actual financial state that affects the consumer's propensity to purchase lottery tickets, but a consumer's perceived financial state (Haisley, Mostafa, Loewenstein, 2008). This increased propensity to gamble is seen amongst people who feel poor as well as people who feel that they have less than similar others compared to those not experiencing feelings of deprivation (Callen, Shead, & Olsen, 2008). Indeed, even the process of feeling poor may impact where one focuses attention and therefore compromise cognitive processing (Mani et al., 2013).

This attentional bias is also apparent during reward-related stimuli involved in gambling (Cox et al., 2006; van Holst et al., 2010) and addictive behaviour especially during instances of craving (Goldstein & Volkow, 2002; Garavan et al., 2000; Wang et al., 2007). That is, when people go without having access to what they crave, they display biased attentional focus. Furthermore, disadvantageous financial decisions and gambling-related problems (including

disordered gambling) are reliably related to deficits in executive functioning (Ledgerwood et al., 2012; van Holst et al., 2010). These deficits may bias attributional responses and expose people to an increased likelihood of acting on beliefs of luck. This is problematic since beliefs in luck can bias the evaluation of success during chance-based situations (Darke & Freedman, 1997a, b; Wohl, 2008).

Taken together, this research indicates that consumers under financial distress likely experience cognitive load, which may impede executive function. It is argued that cognitive load inhibits the correction process involved in beliefs of luck, which facilitates people to gamble. This is not because they experience deficits in impulse control, but because they are unable to adjust automatic judgments of luck. In this same light, people enduring financial difficulties may lack the attentional resources for an effortful attribution process, and may be more likely to gamble in response to cues of luck. Although the current thesis does not manipulate financial distress, cognitive load was manipulated in order to mimic the processing capabilities that scarcity creates.

CHAPTER 3: OVERVIEW OF THE CURRENT RESEARCH

There are many reasons and motivations of why people gamble (Lister, Wohl, & Davis, 2014; Stewart & Zack, 2008). Simply suggesting that everyone who gambles do so to win money is overly simplistic – some people do not expect to win but simply play because it brings positive emotion (i.e., mood maintenance) or alleviates negative emotion (i.e., mood repair). In contrast other people gamble because it is a social activity and is such interactions bring positive reinforcement (Stewart & Zack, 2008). However, within these motivations may also exist beliefs in luck, controllability, or other irrational beliefs that lead to gambling persistence (Jefferson & Nicki, 2003).

Lotteries are often colloquially referred to as a “poverty trap” or a “stupidity tax,” suggesting that people who play the lottery are either trying to buy their way out of a marginalized situation or are simply unaware of the minimal chances of winning. The current research takes a different stance: simply having less attentional resources, such as the cognitive burden earmarked by financial distress, biases the correction process in attributional reasoning leaving people sensitive to cues of luck. This is based on recent findings that indicate financial scarcity weighs heavy and impedes executive function (Mani et al., 2013; Shah et al., 2012). Indeed, financial distress impacts how we process information by where we direct our attention and by how much attention we can devote to tasks at hand. For example, while the brainstorming gears are turning for a solution to an impending balloon payment due by weeks end, one’s attention to other events is compromised, effectively disabling an attributional correction process. This research doesn’t manipulate people’s finances; but proposes to manipulate cognitive load as a proxy to mimic the processing capabilities that scarcity creates.

Throughout the following experiments, a low-probability outcome will be manipulated by using a draw from deck of cards (study 1), a ping-pong lottery draw (study 2), and a dice rolling game (study 3). Cognitive function was manipulated using a traditional digit-span task (Conway, Kane, Bunting, Hambrick, Wilhelm, & Engle, 2005; Gilbert & Osborne, 1989; Gilbert, Giesler, & Morris, 1995; Sternberg, 1966). It is argued that this command on cognitive resources steals attention away from the task at hand similar to that of the effects of poverty on cognitive resources. This demand increases bias in judgments pertaining to luck by inhibiting a correction process, thereby making people sensitive to beliefs in luck.

The purpose of this research is to test if depleted attentional resources facilitate sensitivity to cues of luck. This is based on the contention that causal attributions take careful evaluation of many factors. However, when other demands are placed on cognitive resources, people suffer deficits in problem solving (Sweller, 1988). This impediment on cognition is what may undermine thoughtful and thorough evaluation and correction. Subsequently, causal factors that are cued during instances of low attentional resources may become salient and influence attributional reasoning. For example, when people win at a seemingly random game of chance, they may attribute this win to luck, which may skew future expectations.

CHAPTER 4: STUDY 1

The goal of study 1 was to first show that when people experience a low-probability outcome and are under cognitive load, they experience biased attributional reasoning. Participants were exposed to a manipulation of cognitive load and a seemingly random positive event. Two dependent measures were taken: (a) An adapted word-fragment completion task (Anderson, Carnagey, & Eubanks, 2003), and (b) a measure of causal attributions. The word-fragment completion task was used to demonstrate that when people were under cognitive load, they were sensitive to automatic judgments related to luck. Word-fragment completion tasks are typically used for identifying implicit processing. The original word-fragment completion task from which this was adapted from was used to investigate exposure to violent media; however, instead of having aggressive-related words peppered throughout the task, words that were related to luck took their place. A pretest was conducted using Amazon's Mechanical Turk to identify and validate words that are most commonly associated with luck (e.g., lucky *seven*). The idea being, that after being exposed to a lucky event, those under cognitive load would complete significantly more luck-related word-fragments compared to those in either condition alone. In addition, it was thought that those same participants would feel an elevated sense of personal control, stability, and internal locus (McAuley, Duncan, & Russell, 1992).

4.1 Hypotheses

H₁: When people win (versus lose) at a game of chance the concept of luck will be far more accessible when cognitive resources are limited compared to when they are fully available.

H₂: When people win (versus lose) at a game of chance they will have greater attributions of personal control when cognitive resources are limited compared to when they are fully available.

H₃: When people win (versus lose) at a game of chance they will attribute the cause to have greater stability when cognitive resources are limited compared to when they are fully available.

H₄: When people win (versus lose) at a game of chance they will have lower attributions of external control when cognitive resources are limited compared to when they are fully available.

H₅: When people win (versus lose) at a game of chance they will attribute a greater internal locus of causality when cognitive resources are limited compared to when they are fully available.

4.2 Data Analyses

G*Power version 3.1 was used for an a priori power analysis. Statistical power (i.e., $1-\beta$) is defined as the “long-term probability, given the population effect size, alpha level, and population size, of rejecting the null hypothesis. When effect size is not equal to zero (i.e., null is false), failure to reject is also an error” (i.e., type two error; Cohen, 1992). An a priori power analysis accounts for (a) sample size, (b) significance criteria (alpha level), (c) population effect

size in order to determine sample size. In the current thesis, it was aimed to attain 80% statistical power. A $p < .05$ criterion for significance was used throughout analyses.

Data analyses for the current research were conducted using the Statistical Package for the Social Sciences (SPSS) version 20. When comparing several means for differences between groups, such as those in a between-subjects design, a factorial Analysis of Variance (ANOVA) was employed. The critical assumptions of ANOVA include homogeneity of variance, normality, and independence.

The assumption of independence means that experimental errors must be independent – random assignment of subjects into treatment groups will counter this. The assumption of independence is tested using Levene's test equality of error variances. Although ANOVA is sensitive when groups are not equal if homogeneity is not met (i.e., Levene's test is significant), if analyses have equal groups, it is robust with respect to error rate. That is, even if Levene's test is not passed (i.e., when some heterogeneity of variance exists) it should not compromise the interpretation of the results.

One benefit of ANOVA is that the F -statistic is quite robust against Type I error while experiencing violations of skewness, kurtosis, and non-normality (especially for two-tailed tests and when groups are equal). Interestingly, leptokurtic distributions inflate power, consequently resulting in null effects seeming significant. Leptokurtic distributions (i.e., positive kurtosis) are too peaked whereas platykurtic distributions (i.e., negative kurtosis) are too flat. The opposite is true for distributions that are platykurtic. The Shapiro-Wilk test was used when testing normality. This test identifies whether the data is significantly different from a normally distributed distribution.

Tests of moderation throughout this thesis were completed by using the Process Macro for SPSS (Hayes, 2012). Studies 2 and 3 employ *Model 3* of this macro; a technique used for determining the conditional effects of a two-way interaction, where the effect of an independent variable (X) on a dependent variable (Y) is contingent on the multiplicative effect of moderator (M) and moderator (W), otherwise known as *moderated moderation* or a *three-way interaction*.

4.3 Methods

4.3.1 Participants and design

An a priori sample size calculation using G*Power 3.1 revealed that in order to obtain a medium effect (Cohen's $f = .25$) and adequate statistical power (80%), study 1 required 128 participants. Certification of ethical acceptability of research involving human participants was obtained on October 17th 2013 from the University of Guelph Research Ethics Board (General; see Appendix K). Participants were 128 students (48 females, 37.2%) who were enrolled in an introductory marketing class at the University of Guelph. Participants ranged from 18 to 29 ($M = 19.53$, $SD = 1.88$) years of age and were predominantly of Caucasian ethnicity (79.1%).

Participants were invited to a computer lab to partake in an experiment to investigate consumer thoughts and feelings in exchange for 1% course credit and the chance to win five dollars. This description was used to avoid experimental demand characteristics. Upon arrival, participants were randomly assigned to a 2 (cognitive load: high load vs. control) $\times$ 2 (outcome: win vs. lose) between-subjects design using a question randomizing function in Qualtrics (the online survey management system). Participants were run simultaneously in small groups ranging from five to ten participants per session.

The Department of Marketing and Consumer Studies at the University of Guelph had a recruitment pool of approximately 1200 students. All participants for this thesis were recruited

through the SONA system, which is an online experiment management system. Prior to signing up, participants logged onto SONA to browse the available research studies to register for a time slot. On SONA, there was a clear exclusion criterion to identify someone who was receiving treatment for gambling related problems or was actively attempting to quit gambling.

4.3.2 Procedures

Upon entering the lab, participants were asked to turn off any cellular devices and to refrain from chatting amongst themselves during the study. Participants were then told that they had a chance to win \$5 by drawing a card from a deck of cards and that some cards were winning cards while other cards were losing cards (Appendix I for experimenter script). A deck of cards was spread out on a table face-up for participants to choose from (see Appendix H for stimuli). Participants were instructed to have a seat at a nearby computer and enter their card number on the screen in front of them (where the experiment was being administered). Importantly, participants were spread out throughout the lab to prevent distraction. The computer indicated whether the card they chose was a winner or not. Before entering the card number however, half of the participants were directed to a digit-span task to induce cognitive load (Conway et al., 2005).

This task was introduced to participants as an adaptive intelligence test in order to motivate participants to try to remember the number as best as they could for the remainder of the experiment. Consistent with Gilbert and Hixon (1991), participants in the high cognitive load condition were given 20 seconds to remember an eight-digit number whereas participants in the control condition (low cognitive load) were shown a screen that thanked them for coming to do the study and that would automatically move forward when the survey was fully loaded. Following this task, participants entered their card number into the computer to find out whether

they won five dollars. After discovering whether they won or lost, all participants were directed to the main survey tasks (i.e., word-fragment completion and attributions questionnaire), the cognitive load recall item (for those in the cognitive load condition), and a demographics questionnaire. In order to protect against hypothesis guessing and awareness of experimental deception, participants completed the funnel questionnaire to assess if they detected the deception (Bargh & Chartrand, 2000). Upon completing the study, all participants were debriefed, granted course credit, and given five dollars.

4.3.3 Measures

Automatic inferences of luck. The word-fragment completion task consisted of 20 different word fragments. A word fragment is a word that has some letters removed such that participants can fill in letters to complete the word. These fragments can be completed with words that are typically associated with luck (as defined by the pretest) or with words that are not associated with luck. For example, __ T T E R Y can be completed as *lottery* or as *battery*. It is thought that when luck is top of mind, participants will complete the most luck-related words. Specifically, participants will be given 15 seconds to complete as many words as possible. Consistent with Anderson et al. (2003), half of these word fragments can be completed with words typically related to luck. Participants will then complete a demographics questionnaire and receive debriefing.

Attributional reasoning. The Revised Causal Dimensions Scale (McAuley, Duncan, & Russell, 1992) is a 12-item scale designed to measure causal attributions and has four subscales: locus of causality, external control, stability, and personal control. The locus of causality dimension pertains to whether the causal outcome is internal or external to oneself. The dimension of stability describes whether the cause is likely to change or remain stable over time.

The control dimension measures the extent to which a person has control over the outcome.

Although these dimensions seem conceptually similar, they are theoretically separate. For example, fatigue may be an internal cause but is largely uncontrollable whereas effort is also an internal cause but is controllable. Items from each subscale were combined and used to assess attributional reasoning of the card draw outcome. Participants responded to one question “is the cause(s) something:” on various causal-differential items that range from 1 (*manageable by you; you can regulate; over which you have power*) to 9 (*not manageable by you; you cannot regulate; over which you have no power*). These subscales ranged from poor to good reliability: stability ($\alpha = .48$), locus of causality ($\alpha = .69$), external control ($\alpha = .74$), and personal control ($\alpha = .82$). Lower total scores on each subscale reflect an elevated attribution of internal locus, stability, and personal controllability.

Dysexecutive function¹ (control variable). The Dysexecutive Function Questionnaire (self-rating; Wilson et al. 2006) is a 20-item scale designed for participants to rate their own level of cognitive function based on the common behavioural symptoms of executive dysfunction. This trait-level measure of self-reported executive function was included to assess long-term cognitive dysfunction on perceptions of luck. This scale was originally created to measure the dysfunction associated with frontal lobe damage. A factor analysis by Mooney and colleagues (2006) suggests this scale measures four aspects to cognitive dysfunction: inhibition, intention, social regulation, and abstract problem solving. Participants respond to items like “I have difficulty thinking ahead or planning for the future” and “I have difficulty showing emotion” on a five-point Likert type scale ranging from 1 (*Never*) to 5 (*Very Often*). Total scores

¹ Dysexecutive function was not a significant covariate in any model tested.

indicate greater levels of executive dysfunction. The dysexecutive function questionnaire demonstrated good internal consistency ($\alpha = .84$).

Demographics. This questionnaire was designed to identify participants gender, age, and ethnicity.

Funnel Debriefing. The funnel debriefing method (Bargh & Chartrand, 2000) is a four-item questionnaire that funnels participants toward understanding the true purpose and nature of the study. Over four questions, participants are asked to describe the study in their own words. When participants immediately identify their awareness of experimental manipulation or deception within the first two items, it suggests their data might be compromised with hypothesis guessing².

4.4 Results

4.4.1 Pretest of Luck-related Words

A pretest was completed using 88 participants (33 males, 34 females, 1 other; $M_{\text{age}} = 31.5$, $SD = 10.5$) from the United States using Amazon's Mechanical Turk (MTurk) to identify words related to luck (i.e., concepts related to being lucky such as the lucky number *seven* or being unlucky such as walking under a *ladder*). MTurk is a website that allows people to complete surveys and tasks for monetary compensation. Importantly, previous research has found that results gathered using MTurk are similar to results using traditional lab-based data collection (Buhrmester, Kwang, & Gosling, 2011), including many traditional psychological effects (Crump, McDonnell, & Gureckis, 2013).

After identifying words related to the concept of luck, a second pretest examined whether these words significantly differed from the control words to be included in the word-fragment

² No participant discussed the concept of luck (or any questions related to the experimental manipulations) within the first two items.

completion task. Specifically, 68 participants (34 females; $M_{\text{age}} = 30$, $SD = 8.7$) on MTurk were randomly assigned to read a list of either 10 luck-related words or 10 control words. Participants rated each word as fast as they could on the extent to the word was related to the concept of luck (either lucky or unlucky) on a scale from 1 (*not at all*) to 9 (*extremely*; see Appendix J). No luck-related word had a mean score lower than 5. Participants who viewed the luck-related words reported significantly higher scores ($M = 6.3$, $SD = 1.3$) than those who viewed the control words ($M = 2.01$, $SD = 1.3$), $t(63) = -13.2$, $p < .001$.

4.4.2 Digit Span Performance

Every participant randomly assigned to the cognitive load manipulation was able to recall most or all of the numbers. Forty-four participants (66%) recalled the eight-digit number perfectly while 23 (34%) made up to four mistakes during recall. Consistent with Dillen and colleagues, all participants in the cognitive load conditions were included in the following analyses (Dillen, Papies, & Hofmann, 2013). Participants who were unable to perfectly remember the number may have been under the highest cognitive load, predicted by individual differences in working memory capacity (Conway et al., 2005).

4.4.3 Automatic Inferences of Luck

Total scores were created for the word-fragment completion task by summing the amount of completed luck-related words. Levene's Test of Equality of Error Variances suggests that the assumption of the homogeneity of variance was met, $F(3, 123) = .42$, $p = .74$. When testing normality, the significant Shapiro-Wilk test suggests that the data is significantly different from a normally distributed distribution, $W(127) = .92$, $p < .05$. Furthermore, given that the points on the Q-Q plot deviate off the line, this graphical figure also suggests the data is not normally distributed (see Figures 5 & 6, Appendix C).

A 2×2 factorial ANOVA was conducted to determine the effects of outcome (win vs. loss) and cognitive load (high load vs. control) on luck-related word-fragment completion scores. The main effects of outcome, $F(1, 126) = .24, p = .62, \eta^2 = .002$, and cognitive load, $F(1, 126) = 1.37, p < .24, \eta^2 = .01$, were non-significant. There was a marginally significant outcome $\times$ cognitive load interaction, $F(1, 126) = 4.03, p = .05, \eta^2 = .031$, (see Figure 19, Appendix D). Simple effects revealed the nature of this interaction was driven by cognitive load. Specifically, those in the cognitive load condition who experienced a loss completed more luck-related words ($M = 2.92, SD = 1.86$) than participants in the control condition who experienced a loss ($M = 1.91, SD = 1.72$) or participants in both win conditions (i.e., load [$M = 2.45, SD = .1.63$] and control [$M = 2.7, SD = 1.81$]), $F(1, 126) = 1.34, p = .03, \eta^2 = .04$.

4.4.4 Attributional Reasoning

Attributions of personal control. Levene's Test of Equality of Error Variances suggests that the assumption of the homogeneity of variance was met, $F(3, 123) = .61, p = .61$. When testing normality, the significant Shapiro-Wilk test suggests that the data is significantly different from a normally distributed distribution, $W(127) = .93, p < .05$. Furthermore, given that the points on the Q-Q plot deviate off the line, this graphical figure also suggests the data is not normally distributed. (see Figures 7 & 8, Appendix C)

A 2×2 factorial ANOVA was conducted to determine the effects of outcome (win vs. loss) and cognitive load (high load vs. control) on attributions of personal control. The main effects of outcome, $F(1, 126) = 1.33, p = .25, \eta^2 = .011$, and cognitive load, $F(1, 126) = 2.42, p = .12, \eta^2 = .02$, were non-significant. The outcome $\times$ cognitive load interaction was also non-significant, $F(1, 126) = 1.46, p = .23, \eta^2 = .012$, (see Figure 20, Appendix D). Simple effects revealed a significant difference in attributions of personal control between those in the cognitive

load condition who experienced a win ($M = 4.96$, $SD = 2.24$) and those in the control condition who experienced a win ($M = 6.14$, $SD = 2.46$), $F(1, 126) = 4.05$, $p = .04$, $\eta^2 = .03$.

Locus of causality. Levene's Test of Equality of Error Variances suggests that the assumption of the homogeneity of variance was met, $F(3, 120) = .98$, $p = .40$. When testing normality, the significant Shapiro-Wilk test suggests that the data is significantly different from a normally distributed distribution, $W(127) = .97$, $p < .05$. Furthermore, given that the points on the Q-Q plot deviate off the line, this graphical figure also suggests the data is not normally distributed (see Figures 9 & 10, Appendix C).

A 2×2 factorial ANOVA was conducted to determine the effects of outcome (win vs. loss) and cognitive load (high load vs. control) on locus of causality. The main effects of outcome, $F(1, 123) = .001$, $p = .97$, $\eta^2 = .00$, and cognitive load, $F(1, 123) = .91$, $p = .34$, $\eta^2 = .008$, were non-significant. The outcome $\times$ cognitive load interaction was also non-significant³, $F(1, 123) = .45$, $p = .50$, $\eta^2 = .004$.

External control. Levene's Test of Equality of Error Variances failed, suggesting that the assumption of the homogeneity of variance was met, $F(3, 123) = .84$, $p = .47$. When testing normality, the significant Shapiro-Wilk test suggests that the data is significantly different from a normally distributed distribution, $W(127) = .96$, $p < .05$. Furthermore, given that the points on the Q-Q plot deviate off the line, this graphical figure also suggests the data is not normally distributed. (see Figures 11 & 12, Appendix C)

A 2×2 factorial ANOVA was conducted to determine the effects of outcome (win vs. loss) and cognitive load (high load vs. control) on external control. The main effects of outcome, $F(1,$

³ Controlling for word-fragment completions did not alter the results for any attributional reasoning subscale.

125) = .006, $p = .94$, $\eta^2 = .00$, and cognitive load, $F(1, 125) = 1.19$, $p = .28$, $\eta^2 = .01$, were non-significant. The outcome $\times$ cognitive load interaction was also non-significant, $F(1, 125) = .09$, $p = .76$, $\eta^2 = .001$.

Stability. Although marginally significant, Levene's Test of Equality of Error Variances suggests that the assumption of the homogeneity of variance was met, $F(3, 123) = 2.2$, $p = .08$. When testing normality, the significant Shapiro-Wilk test suggests that the data is significantly different from a normally distributed distribution, $W(127) = .97$, $p < .05$. Furthermore, given that the points on the Q-Q plot deviate off the line, this graphical figure also suggests the data is not normally distributed (see Figures 13 & 14, Appendix C)

A 2×2 factorial ANOVA was conducted to determine the effects of outcome (win vs. loss) and cognitive load (high load vs. control) on stability. The main effects of outcome, $F(1, 126) = 1.04$, $p = .31$, $\eta^2 = .008$, and cognitive load, $F(1, 126) = .001$, $p = .99$, $\eta^2 = .00$ were non-significant. The outcome $\times$ cognitive load interaction was also non-significant, $F(1, 126) = .77$, $p = .38$, $\eta^2 = .006$.

4.5 Discussion

In the current study, those in the cognitive load condition who experienced a loss completed the most luck-related words, suggesting that luck-related concepts were top of mind. Although cognitive load impacted luck-related concepts, it only did so in the loss condition. One explanation for this is that since the words were composed of both luck-related and bad-luck-related words, the loss may have been the most sensitive to automatic judgments. In addition, both outcome conditions (i.e., win and loss) cued luck-related concepts. This is potentially the case because everyone who participated was involved in this draw – either participants won (potentially cuing good luck) or lost (potentially cuing bad luck). As a result, words related to

both good luck and bad luck may have been activated. As such, a limitation of study 1 is the lack of a true control condition (e.g., no cognitive load, no draw). Such a condition may simply provide monetary compensation for completing the study as opposed to a draw.

Study 1 also found that a positive outcome and cognitive resources influenced personal control. Interestingly, cognitive load did not significantly impact locus of causality, stability, or external control. This suggests that the relationship between inhibited executive function and luck may not be caused by biased attributional reasoning. However, this may have been a result of low scale reliability or scale item ambiguity. For example, asking whether the card draw outcome was stable could be interpreted two ways: whether the process of winning or losing was stable (i.e., *I consistently win or lose draws*) or whether this particular draw was stable (i.e., *I consistently win or lose this draw*). The latter of which is nonsensical given the draw was a singular point in time. This ambiguity may have resulted in inconsistent interpretations and reports during these subscales. It is argued that the personal control items however, make more sense in relation to the outcome of the draw because the lack of ambiguity. That is, these items can only have one interpretation, which is whether one had personal control over the outcome of the draw.

The goal of study 1 was to disturb the correction process of attributional reasoning by manipulating cognitive load. Prior work suggests that disturbances in cognitive resources may impact attributional reasoning. Gilbert and colleagues (1988) argue that attributional reasoning occurs in a dual-process fashion – the second stage has two subcomponents defined by a characterization and correction. Specifically, if one's initial inference is appraised as incorrect (i.e., not justified by the situation) a correction will occur. In terms of traditional attributional reasoning, an example of this correction would be wrongly attributing an actor's sad face to

dispositional sadness without incorporating situational cues. If for instance, the actor was attending a funeral, the attribution of dispositional sadness is likely incorrect and a correction process would occur where the onlooker factors this information into their attributional equation. It is the correction process that is most vulnerable to the exhaustion of cognitive resources. As such, study 2 will measure beliefs in luck to examine this correction. Specifically, if people lack cognitive resources this correction should not occur and people may be more likely to act on these beliefs. One likely scenario pertaining to the current research is when someone experiences a random positive event. If the correction process fails, a person might more readily attribute this positive experience to themselves as having increased personal control.

The impact of a positive outcome and cognitive load on personal control suggest a correction process may be impaired. If a correction process does occur, it may be attempting to correct beliefs in luck. Trait beliefs in luck bias the perceived control of future hypothetical situations, which lead to a greater expectancy of success than chance alone would allow (Darke & Freedman, 1997b).

Experiencing a positive outcome may exacerbate these beliefs and cognitive load likely prevents people from correcting their automatic inclination to expect success during chance events. If financial distress causes cognitive load (Mani et al., 2013; Shah et al., 2012), these results may suggest that people enduring financial distress may fall victim to biased attribution reasoning when cued with a positive outcome. This is based on the work by Mani and colleagues (2013) that financial distress would also impede the attributional correction process. This becomes problematic when making future judgments especially if there is risk involved because people could potentially misattribute the positive outcome to having increased personal control.

If these feelings are used to assess future risk, even unrelated experiences could be viewed as controllable. It is important to investigate whether beliefs in luck transfer to unrelated events while under cognitive load.

In order to address these limitations, study 2 built in a true control condition (i.e., no cognitive load, no lottery outcome), took a manipulation check of the luck cue (i.e., the lottery outcome), measured trait beliefs in luck, and allowed people to act in an unrelated chance-based situation.

CHAPTER 5: STUDY 2

The goal of study 2 is to uncover the relationship between random positive events, trait beliefs in luck, and cognitive resources. Study 1 revealed that limited cognitive resources may bias the interpretation of past random events. It is argued that there is an attributional correction process that occurs to prevent people from acting on these automatic judgments in the future. However, this correction process likely only occurs among people who endorse high trait beliefs in luck. Beliefs in good luck tend to predict when people endorse luck as a personal and stable factor in future judgments (Darke & Freedman, 1997a). In contrast, this correction likely does not occur among people who do not believe in luck. This is not to say that nonbelievers think of themselves as unlucky, they simply just do not believe in luck (Thompson & Prendergast, 2013). Therefore, the amount of cognitive resources should not implicate future judgments of luck for nonbelievers.

It is argued that because the correction requires processing resources, it may be impeded by cognitive load. For example, after a person perceives an outcome (known as identification, Trope, 1986; or categorization, Gilbert et al., 1988), they try to understand its cause – why did this happen? It is when people attempt to make future judgments that they are exposed to biased perceptions of luck. This *why*, also termed the identification (Trope, 1986) or characterization (Gilbert et al., 1988) is thought to be relatively automatic. Therefore, if people endorse trait beliefs in luck, they may automatically infer that previous chance wins are implicated in future positive outcomes. Under circumstances of full cognitive resources, it is this automatic judgment that would be corrected. Such trait beliefs may lead one to believe that random positive outcomes were not chance-based at all. According to Gilbert and colleagues (1988), this automatic inference is followed by an adjustment. This adjustment, or correction process, overrides initial

incorrect assumptions. It is this process that may prevent people from irrationally applying their beliefs in luck to unrelated chance-based events. However, if this process is impeded by cognitive load for example, those who endorse a trait belief in luck may engage in risks that they would otherwise avoid. An implicit assumption within this argument is that people who endorse high trait beliefs in luck are aware that these beliefs are somewhat irrational and that they want or at least try to correct them. In essence, they are cautious of acting on their beliefs in luck because are aware these beliefs are irrational.

Those who endorse trait luck experience a random positive event, they may be overly optimistic about future success when cognitive resources are limited. This is based on the contention that when those who endorse trait luck experience a random positive event, they attempt to correct their irrational beliefs in luck before applying them to unrelated future behaviours but are subsequently unable to do so when enduring cognitive load. This is because they simply do not have the resources to do so.

What about people who do not believe in luck? It is possible that people who do not believe in luck will consciously overcorrect as illustrated by the gambler's fallacy. People who do not believe in luck may fall victim to believing that probability will subscribe to a self-correcting process anchored by an equilibrium. That is, people will believe that after many flips of a coin landing on heads, subsequent flips are more likely to be tails. The gambler's fallacy is thought to be driven by the representative heuristic (Tversky & Kahneman, 1974) where people identify how likely an outcome is to occur by applying personal experience, which is biased by the law of small numbers (i.e., the belief that small samples are representative of the larger population). This is illustrated by the famous example "a coin has no memory" (Tversky & Kahneman, 1974, p. 1130), explaining that each flip of a coin is independent from the previous

flip. This rule applies to all forms of gambling that are solely based on probabilistic outcomes, such as slot machine outcomes, roulette spins, and dice rolls.

The current laboratory experiment will employ the use of a small ping-pong lottery outcome to manipulate the random positive event and a digit-span task to manipulate cognitive load. In order to test their effects on future behaviour, participants will be given the opportunity to place a wager in a chance-based task with real money. Despite all participants being paid the same amount, special care was taken to ensure that people believed they were risking their own remuneration for the study.

Study 2 will extend the findings of study 1 by showing that participants who endorse trait luck when cued with a lucky event will be willing to risk more money in a gambling task. It is thought that cognitive resources will moderate this interaction. Under cognitive load, people who believe in luck should respond to win by betting more. In contrast, people under cognitive load who don't believe in luck should respond to a win by betting less. In essence, the interaction between the initial win (versus control) and beliefs in good luck is the same interaction discussed by Darke and Freedman (1997b). The opposite effect (i.e., an overcorrection) is explained by the gamblers fallacy. That is, people under cognitive load who do not believe in luck will demonstrate an overcorrection and people who believe in luck will demonstrate an under-correction. The cognitive control condition will eliminate this interaction because

5.1 Hypothesis

H₆: There will be a three-way interaction between the lottery outcome, beliefs in luck, and cognitive load, such that individuals who win \$10 at a game of chance (as opposed to individuals who are compensated \$10) and endorse trait beliefs in luck will bet

significantly more while under cognitive load than when not under cognitive load. This will not occur for those who do not endorse trait beliefs in luck. (see Figure 21 for statistical model, Appendix E).

5.2 Methods

5.2.1 Participants and Design

Participants were 100 members of the Guelph community (52 males, 47 females, 1 other) who ranged from 18 to 54 ($M = 25.79$, $SD = 8.35$) years of age and were predominantly of Caucasian ethnicity (72%). Advertisements were posted online (e.g., Kijiji.ca), on campus, and at local restaurants/stores downtown Guelph to prompt participants to visit the SONA website and sign-up. Participants were invited to a computer lab to partake in an experiment to investigate consumer thoughts and decision making in exchange for the chance to win money. In reality, all participants were paid \$20 upon completion of the study. Again, this description was used to avoid experimental demand characteristics.

Upon arrival, participants were randomly assigned to a 2 (cognitive load: high load vs. control) $\times$ 3 (lottery outcome: win vs. lose vs. control) between-subjects design. A question randomizing function in Qualtrics determined the condition of the cognitive load whereas a random number generator determined the condition of the lottery outcome condition. The lottery outcome manipulation used a different task than the one found in study 1 to avoid a mono-operationalization bias (e.g., simply finding an effect do to a specific artifact of a manipulation). Participants were run individually.

5.2.2 Procedures

Upon entering the lab, participants were asked to turn off or put any cellular devices on silent. Participants were thanked for making the trip into the university and given an informed consent. Participants who were randomly assigned to the outcome control condition were told that they would be completing the study in exchange for \$10 and therefore were not exposed to the lottery draw. Participants in the win and loss conditions were told that in exchange for their participation they would have the chance to win money during the session. It was at this time they were introduced to the ping-pong lottery task (See Appendix H for stimuli; importantly, the bucket of lottery balls were hidden participants in the control condition arrived to avoid any visual cues of luck).

Participants in both win and loss conditions were told that in the lottery bucket there were 50 marked ping-pong balls ranging from 1-50 and that they would be picking a ball for the chance to win money. It was important to have the participants pick their own ball not only to provide the illusion that it was random but also because prior work has demonstrated that people feel luckier when participants choose their own lottery ticket as opposed to an experimenter doing this for them (Wohl & Enzle, 2002). In addition, this bucket was completely clear so every ball and its number were visible.

Those in the win condition were instructed that they could win \$10 during the lottery task. It was explained that they would choose a ball from the lottery bucket and at some point during the questionnaire the computer would randomly generate five winning numbers and that if their ball was within these five numbers, they won the \$10. They were also told that if they did not win, they did not receive any money.

Participants in the loss condition were told slightly different instructions. Upon arrival, participants in the loss condition were told that they would be receiving \$20 for participating in

the study and that they would be partaking in the ping-pong lottery for the chance to win an extra \$10. However, it was explained that if the computer drew the number two, they would actually lose \$10 and would thus only receive \$10 at the end of the study.

Participants in both lottery conditions were also asked to inform the experimenter when the lottery outcome occurred so it could be recorded. In order to truly control the outcome of the ping-pong lottery, these outcomes were fixed. Specifically, the experimenter observed what ball the participant chose and entered it into Qualtrics. Care was taken to ensure the participant did not see the computer screen when this was happening. If the participant did see the screen (which only happened once) the title of the page was labeled *Participant ID*. A function called *display logic* within Qualtrics was used to bring the participant's number forward during the draw. The winning (or losing) number occurred in the same place of the same sequence of five drawn numbers. In addition, all participants were exposed to the lottery outcome at the same point in the questionnaire, which occurred directly after randomly assigning participants to a cognitive load condition.

Before discovering the outcome of the lottery, half of the participants randomly assigned to a digit-span task to induce cognitive load (Conway et al., 2005). This task was introduced to participants as an adaptive intelligence test in order to motivate participants to try to remember the number as best as they could for the remainder of the experiment. Consistent with Gilbert and Hixon (1991), participants in the high cognitive load condition were given 20 seconds to remember an eight-digit number whereas participants in the control condition (low cognitive load) were shown a screen that thanked them for coming to do the study and that would automatically move forward when the survey was fully loaded.

Following this task, participants were informed that the draw was about to take place. In order to bolster the manipulation of the lottery, an active spinning GIF file was used to simulate a slight delay when the numbers were being draw (Appendix H). This was to provide the feeling of a random number generation. Following the outcome of the lottery task, participants were stopped from continuing the questionnaire and directed to the *decision making* portion of the study. This was in fact a gambling task and acted as the core dependent measure of the study. At this point in the study, participants in each condition had \$10. This helped to ensure that only relative wins and losses differed across lottery conditions. Procedures were replicated from Wohl, Branscombe, and Lister (2013; see study 2) to complete this gambling task. Participants were brought to a roulette table (see Appendix H) located in a separate portion of the lab. Participants were told that the money they had so far from the study (i.e., their newly earned, won, or remaining \$10) could be used to play a simplified game of roulette. Participants were also told they could feel free to bet as little or as much as they like or even refrain from playing at all. In the latter option, participants were told if they chose to forego playing the game that they would get to keep the entire \$10. Participants were given 10 poker chips and it was then explained that each chip represented \$1 and that they could place a wager in \$1 increments on a single spin. The game was simplified such that participants only had two options for their wager. In front of the roulette wheel was a *red* and *black* square patch for the participant to place their wager. Participants were only able to bet on a single colour and were told that if the ball landed on the green “0” or “00” they would get to spin again. All participants were instructed that the payout for this game was 2:1, such that they would receive \$4 for a \$2 wager. Specifically, participants were told “if the ball lands on the color you wagered on, your bet will double but if not, you will lose your money” (Wohl et al. 2013, p. 4). Directly after participants made their

decision on how much money to wager and on what colour, they were directed back to the computer to finish the questionnaire (i.e., a manipulation check of the lottery outcome, trait beliefs in luck, and demographics). Participants were instructed that the roulette spin would occur at the end of the survey⁴. Once participants completed the questionnaire however, they were fully debriefed, thanked, and compensated with \$20.

5.2.3 Measures

Manipulation check: lottery outcome. Participants were asked to complete the Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegan, 1994), with an embedded item assessing luck. The purpose of embedding a luck item in the PANAS is to identify how lucky participants feel without evoking demand characteristics. The PANAS is a 20-item scale used to measure the valence and content of mood. Each item of the PANAS contains single word mood descriptors (e.g., “cheerful,” “disgusted,” or “alert”) that are rated on a 1 (*very slightly or not at all*) to 5 (*extremely*) scale. The inclusion of a luck item as a single mood descriptor will make a total of 21 items (e.g., “lucky”). This single item will likely not seem obvious among the other mood descriptors⁵. In addition, the PANAS instructions can be specifically tailored for how a person feels “right now.” The PANAS has two general dimensions that reflect mood valence (i.e., positive or negative affect). Separate total scores are then created for the general dimension items.

Amount bet on roulette. The amount of money wagered during the gambling task was recorded and used as a \$0 - \$10 continuous dependent measure.

⁴ Although the roulette wheel was never spun, a handful of participants asked whether they themselves would get to spin when it came time to play. In response to this question, it was clarified that the experimenter would spin the wheel, similar to the procedures in a real casino.

⁵ No participant mentioned this luck item during the debriefing process.

Beliefs in luck. The Beliefs in Good Luck (BIGL) Scale is a 12-item scale that was designed to assess dispositional beliefs in luck (Darke and Freedman, 1997). Each item is rated on a six-point Likert type scale ranging from 1 (*Strongly Disagree*) to 6 (*Strongly Agree*) where greater scores are related to greater beliefs in luck. Participants are asked to respond to items like “Luck works in my favour” and “I consider myself a lucky person.” Higher scores indicated a greater belief in good luck⁶. The BIGL scale demonstrated good internal consistency ($\alpha = .76$).

Demographics. This questionnaire was designed to identify participants gender, age, ethnicity, gambling games of choice, and exposure to gambling-related media.

Funnel debriefing. The funnel debriefing method (Bargh & Chartrand, 2000) is a four-item questionnaire that funnels participants toward understanding the true purpose and nature of the study. Over four questions, participants are asked to describe the study in their own words. When participants immediately identify their awareness of experimental manipulation or deception within the first two items, it suggests their data might be compromised with hypothesis guessing⁷.

5.3 Results

5.3.1 Lottery Outcome Manipulation Check.

To confirm the ping-pong lottery outcome successfully acted as a luck cue, the luck item embedded in the PANAS⁸ was subjected to a two-way ANOVA, which revealed only a

⁶ There were no experimental effects detected on trait luck scores.

⁷ No participant asked whether the ping-pong lottery was predetermined within the first two items.

⁸ Positive and negative affect were not significant covariates of the following moderated moderation analyses. Including them did not change the nature of the 3-way interaction for the

significant main effect of the outcome condition, $F(1, 87) = 4.63, p = .01, \eta^2 = .10$ (see Figure 4, Appendix B). Specifically, the two winning outcome conditions (i.e., load [$M = 3, SD = .31$] and control [$M = 3.1, SD = .29$]) felt significantly luckier than participants in the losing outcome conditions (i.e., load [$M = 2.2, SD = .28$] and control [$M = 2.2, SD = .28$]). All other effects were non-significant ($F < .1$).

5.3.2 Digit Span Performance

Every participant randomly assigned to the cognitive load manipulation was able to recall most or all of the numbers⁹. 42 participants (82.4%) recalled the eight-digit number perfectly while 9 (17.6%) made up to four mistakes during recall. As in study 1, all participants in the cognitive load conditions were included in the following analyses for the reason that imperfect recall may indicate highest cognitive load (Conway et al., 2005; Dillen, et al., 2013). Although it is possible that some people who made a mistake during recall simply didn't try (thus had remaining cognitive resources), this explanation was undermined by an open ended item that asked participants of their subjective effort while remembering the number. All participants reported doing their best while remembering the number.

5.3.3 Amount Bet on Roulette

When testing normality, the significant Shapiro-Wilk test suggests that the data is significantly different from a normally distributed distribution, $W(127) = .90, p < .05$.

win vs. control analysis. However, when positive and negative affect were included in the loss vs. control analysis, the 3-way interaction become marginally significant ($p = .06$).

⁹ Results did not vary when deselecting participants who recall the digit span number perfectly for the losing vs. control model. Effects in the win vs. control model become non-significant. This is likely because those who made mistakes during the digit span task were at their max cognitive capacity reflected by individual differences in working memory capacity (Kane et al, 2004). In addition, this may have unbalanced the conditions.

Furthermore, given that the points on the Q-Q plot deviate off the line, this graphical figure also suggests the data is not normally distributed (see Figure 15 and 16).

Hypothesis 6 suggests there will be a significant 3-way interaction between lottery outcome (win vs. loss vs. control), trait beliefs in luck (high vs. low), and cognitive load (high load vs. control) on the amount bet on roulette. Specifically, it was hypothesized that the nature of this interaction would be driven by those who experienced a winning lottery outcome, endorse trait beliefs in luck, and had their cognitive resources exhausted. A custom modeled 3-way ANOVA (i.e., the interaction terms were built using the continuous trait beliefs in luck measure as a covariate) revealed a significant lottery outcome $\times$ trait beliefs in luck $\times$ cognitive load interaction on the amount bet on roulette, $F(2, 86) = 3.82, p = .02, \eta^2 = .08$. In order to fully probe these effects, the following analyses compared the win and loss conditions against the control group in separate moderated moderation models (i.e., win vs. control; loss vs. control).

Winning Lottery Outcome vs. Control. Scores for the amount bet on roulette were subjected to a moderated moderation analysis (Hayes 2012; Model 3). Results suggest that there was a significant lottery outcome $\times$ trait beliefs in luck $\times$ cognitive load interaction on the amount bet on roulette ($B = 5.48, t = 2.96, p = .004, d = .75$; see Figure 22, Appendix E). Trait beliefs in luck were mean centered. Conditional effects of the winning lottery outcome on the amount bet on roulette was tested at three levels of trait beliefs in luck (i.e., the mean, 0; one standard deviation above the mean, .59; and one standard deviation below the mean, -.59), which were then tested at two levels of cognitive load (i.e., high load; control). The conditional effect of the lottery outcome $\times$ trait beliefs in luck interaction was significant during the presence of cognitive load ($B = 4.13, t = 3.21, p = .002, d = .81$; see Table 1, Appendix F). Specifically, the conditional effect of the winning lottery outcome on the expected value of the amount bet on

roulette was elevated ($M = 5.01$) during high levels ($+1SD$) of trait beliefs in luck compared to low levels ($-1SD$) of trait beliefs in luck ($M = 2.07$), $B = 2.38$, $t = 2.01$, $p < .05$, $d = .54$; see Figures 25 and 26 in Appendix G.

Losing Lottery Outcome vs. Control. Scores for the amount bet on roulette were subjected to a moderated moderation analysis (Model 3; Hayes, 2012). Results suggest that there was a significant lottery outcome $\times$ trait beliefs in luck $\times$ cognitive load interaction on the amount bet on roulette ($B = 4.52$, $t = 2.07$, $p < .05$, $d = .55$; see Figure 23, Appendix E). Trait beliefs in luck were mean centered. Conditional effects of the losing lottery outcome on the amount bet on roulette was tested at three levels of trait beliefs in luck (i.e., the mean, 0; one standard deviation above the mean, .67; and one standard deviation below the mean, -.67), which were then tested at two levels of cognitive load (i.e., high load; control). The conditional effect of the lottery outcome $\times$ trait beliefs in luck interaction were significant during the presence of the cognitive control condition ($B = -3.17$, $t = -1.96$, $p = .05$, $d = .50$ see Table 2, Appendix F). Specifically, the conditional effect of the losing lottery outcome on the expected value of the amount bet on roulette was elevated ($M = 5.25$) during low levels ($-1SD$) of trait beliefs in luck compared to high levels ($+1SD$) of trait beliefs in luck ($M = 2.85$), $B = 3.28$, $t = 1.94$, $p = .05$, $d = .51$; see Figures 27 and 28 in Appendix G.

5.4 Discussion

The results of study 2 extend the findings of study 1. Not only do exhausted cognitive resources impair attributions of personal control for lottery wins in the past (study 1), this attentional depletion can also impair the correction process involved in decisions about future chance outcomes. Specifically, study 2 suggests that exhausted cognitive resources moderates the correction of beliefs in luck and biases future decisions. This is demonstrated by showing the

classic Darke and Freedman (1997b) luck effect in the cognitive load condition, suggesting that the effect of a lottery win is largely automatic, insofar that participants respond as if they are about to experience a *lucky streak*. That is, people's response to this outcome is moderated by trait beliefs in luck, which is moderated by cognitive resources. The correction process (demonstrated by the cognitive control condition) in the current study likely occurs because it is in the context of gambling. The purpose of study 2 was to investigate whether the correction process was occurring among people who varied in trait beliefs in luck and cognitive resources. It was hypothesized that the amount of money people chose to bet during roulette would differ by the lottery outcome and trait beliefs in luck and that this relationship would be contingent on cognitive resources.

Specifically, it was predicted that those exposed to a winning lottery outcome, who endorsed trait beliefs in luck, and had their cognitive resources exhausted would display elevated wagers on the amount bet on roulette. This was based on the contention that people who believe they are lucky would be sensitive to receiving a chance-based win. Furthermore, cognitive load would inhibit the correction process involved in attributional reasoning and therefore people who endorsed high trait luck would be unable to adjust these beliefs when deciding to gamble.

Given that both a winning lottery outcome and a losing lottery outcome could cue luck among people who endorse high trait beliefs of luck, these conditions were compared in separate models against the control outcome condition. Specifically, participants under cognitive load who won the lottery wagered more in roulette when they endorsed elevated trait beliefs in luck than when they did not believe in luck. These results support hypothesis 6. It is argued that cognitive correction (or the lack thereof) explains the effects of load, in the sense that cognitive load should interfere with any conscious correction process. When people are unable to correct

beliefs in luck and when they are exposed to a seemingly random positive event, they tend to approach a subsequent unrelated event (i.e., the roulette game) with increased risk. Because this corrective or adjustment process is impeded, people automatically transfer their expectations for future success. This is the irrational influence of believing in luck. Conversely, cognitive resources washed the *lucky streak* effect among participants with high beliefs in trait luck.

In addition, a second model was run to assess the effects of moderated moderation during the presence of a loss. It was found that participants who endorsed elevated beliefs in luck did not display elevated wagers while under cognitive load. In this sense, a belief in good luck buffered against the negative effects of a losing lottery outcome in that they did not display elevated wagers. In addition, it was found that under conditions of a losing lottery outcome (vs. control) and low beliefs of trait luck, people in the cognitive control condition were significantly related to elevated wagers in roulette. These effects are likely occurring because people tend to naturally believe random outcomes are beholden to an equilibrium (Keren & Lewis, 1994). For example, in terms of roulette, after many spins resulting in a *red* outcome many people erroneously believe that the probability increases for a *black* outcome on the next spin (Keren & Lewis, 1994). This is especially true for people who do not believe in luck (Darke & Freedman, 1997). Kahneman and colleagues (1982, p. 7) refer to this process as a “self-correcting process in which a deviation in one direction induces a deviation in the opposite direction to restore the equilibrium.” If this is a self-correcting process, it would be expected that people would bet more during the roulette task after experiencing a losing outcome under the conditions of low trait luck and available cognitive resources. This is because this equilibrium-correction would require cognitive resources. However, these results should be interpreted with caution. If these effects are caused by the gambler’s fallacy, the inverse relationship should be found after experiencing a

win (or at least the inverse direction). That is, if participants in the cognitive control displayed elevated wagers after experiencing a loss, they should display lowered wagers after experiencing a win. That said, the interaction between the lottery outcome and trait beliefs in luck after during the presence of a win was not significant in the cognitive control condition and therefore it is difficult to interpret this inverse relationship.

One limitation of the current study is the nature of the gambling dependent measure. Although this measure provides a good representation of expectations for future success and risk, it does not represent the main characteristic of disordered gambling – persistence in the face of loss. In order to test whether the effects of cognitive resources on the interaction between lottery outcomes and trait beliefs in luck lead to increased gambling persistence, study 3 will employ the use of a slot machine as the main dependent measure.

CHAPTER 6: STUDY 3

Although gambling is a harmless form of recreation for most, a minority of people develop serious problems (Shaffer, Hall, Vander Bilt, 1999; Volberg, 1994), characterized by elevated craving (Young and Wohl, 2009), erroneous cognitions (Jefferson & Nicki, 2003; Steenberg, Meyers, May, & Whelan, 2002), chasing to win back money (Lesieur, 1984), and persistence in the face of mounting loss (Laduceur & Sevigny, 2005).

Despite that only 15% of slot players develop serious problems, they are vastly over represented in slot revenue by contributing up to 60% of total slot earnings (Williams & Wood, 2003). One manifestation of slot machine play, central to developing problems, is persistence (Young & Wohl, 2009). Although some slot players are cognizant of the problems their behaviour creates, they are nonetheless unwilling or unable to stop playing in a given session.

Why might people persist while gambling? The proportional impact of risk factors contributing to the pathways of problem gambling remain relatively unknown (see Pathways Model; Blaszczynski & Nower, 2002); however, it is thought that some gamblers develop problems as a result of irrational beliefs (Jefferson & Nicki, 2003)

Study 3 had multiple purposes. First, to replicate whether depletion of attentional resources can impede the correction of trait beliefs in luck; and second to investigate whether participants with limited cognitive resources that were cued with luck would exhibit gambling persistence. A resistance to gambling cessation is the core behavioural feature of problem gambling. Gambling persistence can be measured by how long a person chooses to gamble in the face of continued and repeated loss. Perceptions of personal luck are related to increased gambling (Wohl et al., 2011), however it is unknown if momentary luck cued during instances of cognitive load contribute to gambling persistence.

Study 3 aimed to extend the findings of study 2 by showing that participants cued with a chance win who endorse beliefs in good luck will display greater gambling persistence when under cognitive load.

6.1 Hypothesis

H₇: There will be a three-way interaction between the lottery outcome, beliefs in luck, and cognitive load, such that individuals who a win at a game of chance (as opposed to a loss) and endorse trait beliefs in luck will display elevated gambling persistence while under cognitive load than when not under cognitive load. This will not occur for those who do not endorse trait beliefs in luck.

6.2 Methods

6.2.1 Participants and Design

Participants were 126 members of the Guelph community (81 female, 64.3%). Participants ranged from 18 to 63 ($M = 26.61$, $SD = 9.93$) years of age and were predominantly of Caucasian ethnicity (73%). Participants were also predominantly non-problem gamblers¹⁰ (95.9%). Advertisements were posted online (e.g., Kijiji.ca), on campus, and at local restaurants/stores downtown Guelph to prompt participants to visit the SONA website and sign-up. Participants were invited to a computer lab to partake in an experiment to investigate the enjoyment of games in exchange for the chance to win money. In reality, all participants were paid \$10 upon completion of the study. Again, this description was used to avoid experimental

¹⁰ Analyses did not differ when removing those with problem gambling.

demand characteristics. Upon arrival, participants were randomly assigned to a 2 (cognitive load: high load vs. control) $\times$ 2 (outcome: win vs. lose) between-subjects design. Participants were run individually.

6.2.2 Procedures

Upon entering the lab, participants were asked to turn off or put any cellular devices on silent. Participants were thanked for making the trip into the university, were brought into a cubical in the lab, and given an informed consent. Participants were told that in exchange for their participation they would have the chance to win money during the session. It was explained that they would be playing two games during the session for the chance to win money. The first game was a dice game and the second game was a computerized slot machine.

Participants in the win condition were instructed that the lab would be providing them with \$5 to play on the slot machine later in the study, but first they would be playing the dice game. It was at this time they were introduced to the dice game task. Participants were told if they won the dice game by rolling a *two*, *seven*, or *ten* then they would be given another \$5 for a total of \$10 to play on the slot machine. This guise of multiple winning numbers was necessary to bolster that the outcome was in the realm of chance – simply telling participants there was a single winning number may have induced hypothesis guess when they won. Participants were then instructed that if they lost the dice game, they would only receive \$5 to play slots. Unknown to the participant, the dice were weighted such that nearly every roll would land on a *seven* (see Appendix H). This was caused by a small weight loaded on one side of each die. Importantly, participants only rolled the dice once and never saw that the dice would only roll sevens. Three winning outcomes were chosen in order to guard against this procedure being obviously fixed

and to guard against demand characteristics. Participants rolled the dice instead of the experimenter in order to bolster the feeling of luck (Wohl & Enzle, 2002).

Participants in the loss condition were given different instructions. Specifically, those participants were instructed that the lab would be providing them with \$15 to play on the slot machine later in the study, but first they would be playing the dice game. Participants were told if they could win the dice game by rolling any number other than a *two*, *seven*, or *ten*. It was explained that if they won, they would be given another \$5 for a total of \$20 to play on the slot machine but if they lost they would only have \$10 to play slots.

Just before rolling the dice, half of the participants were randomly assigned to a digit-span task to induce cognitive load (Conway et al., 2005). This task was introduced to participants as an adaptive intelligence test in order to motivate participants to try to remember the number as best as they could for the remainder of the experiment. Consistent with Gilbert and Hixon (1991), participants in the high cognitive load condition were given 20 seconds to remember an eight-digit whereas participants in the control condition (low cognitive load) were asked to wait a moment as the experimenter went to get the dice for the game.

Following the dice game, the experimenter turned on the computer monitor in front of them, which revealed the computerized slot machine. All participants started the slot machine portion with \$10. Persistence on this task acted as the main dependent measure. It was explained that in front of them was a touch screen monitor and that in order to play the slot machine they could just touch the *spin* button. It was then explained to participants that they could play for as little or as long as they wanted and that any money in the credit hopper was theirs to keep, including any winnings they get. That is, that they could cash out at anytime but that the money they were playing with was the money they were receiving as compensation for completing the

study. Also unknown to the participants, each reel outcome on the slot machine had been pre-scripted and programmed such that each person had the identical experience. Specifically, these outcomes were designed as a persistence trial and thus every spin was coded to reveal a losing outcome. The amount of credits that participants were able to bet per spin was also held constant and thus was the same for each participant. This was completed using AllJ Slots 2.2 custom slot machine software. Directly after participants finished gambling, they were directed to another computer to finish the questionnaire (i.e., a manipulation check of the lottery outcome, trait beliefs in luck, and demographics). Once participants completed the questionnaire, they were fully debriefed, thanked, and compensated with \$10 (regardless of how much they spent gambling).

6.2.3 Measures

Manipulation check: lottery outcome. Participants will be asked to complete the Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegan, 1994), with an embedded item assessing luck. The purpose of embedding a luck item in the PANAS is to identify how lucky participants feel without evoking demand characteristics. The PANAS is a 20-item scale used to measure the valence and content of mood. Each item of the PANAS contains single word mood descriptors (e.g., “cheerful,” “disgusted,” or “alert”) that are rated on a 1 (*very slightly or not at all*) to 5 (*extremely*) scale. The inclusion of a luck item as a single mood descriptor will make a total of 21 items (e.g., “lucky”). This single item will likely not seem obvious among the other mood descriptors. In addition, the PANAS instructions can be specifically tailored for how a person feels “right now.” The PANAS has two general dimensions that reflect mood valence (i.e., positive or negative affect). Separate total scores are then created for the general dimension items.

Gambling persistence. Gambling persistence was measured by total spins of continuous loss until the participant voluntarily stopped. AllJ slots custom slot machine software allowed participants a realistic virtual/online slot machine experience while allowing the experimenter to program the outcomes. Slot machine outcomes were programmed by coding each reel outcome for 67 separate spins. (see Appendix H for a screenshot of the slot machine program).

Beliefs in luck. The Beliefs in Good Luck (BIGL) Scale is a 12-item scale that was designed to assess dispositional beliefs in luck (Darke and Freedman, 1997). Each item is rated on a six-point Likert type scale ranging from 1 (*Strongly Disagree*) to 6 (*Strongly Agree*) where greater scores are related to greater beliefs in luck. Participants are asked to respond to items like “Luck works in my favour” and “I consider myself a lucky person.” Higher scores indicated elevated beliefs in good luck¹¹. The BIGL scale demonstrated good internal consistency ($\alpha = .74$).

Problem gambling severity index. The Problem Gambling Severity Index (Ferris & Wynne, 2001) is a nine-item measure that was designed to measure the extent to which gambling behavior causes negative consequences for the gamblers, their social network, and/or their community. Participants are asked to indicate how frequently they engage in a certain gambling behavior ranging from 1 (*never*) to 4 (*always*); participants could also indicate if they were unsure of their frequency (option 5). Items include such questions as “Have you bet more than you could really afford to lose?” The result of this questionnaire categorizes respondents into one of four groups: non-problem gambling, low risk, moderate risk, and problem gambling.

¹¹ There was no interaction effect between the lottery outcome and cognitive load on BIGL scores. However, participants who were in the lottery win conditions (load [$M = 3.64$, $SD = .56$] and control [$M = 3.30$, $SD = .53$]) reported elevated BIGL scores than participants in the loss conditions (load [$M = 3.35$, $SD = .74$] and control [$M = 3.29$, $SD = .53$]).

Demographics. This questionnaire was designed to identify participants gender, age, ethnicity, gambling games of choice, and exposure to gambling-related media.

6.3 Results

6.3.1 Lottery Outcome Manipulation Check.

To confirm the dice game outcome successfully acted as a luck cue, the luck item embedded in the PANAS was subjected to a two-way ANOVA, which revealed only a significant main effect of the outcome condition, $F(1, 117) = 27.29, p < .001, \eta^2 = .18$ (see Figure 4, Appendix B). Specifically, the two winning outcome conditions (i.e., load [$M = 2.53, SD = 1.29$] and control [$M = 2.68, SD = 1.31$]) felt significantly luckier than participants in the losing outcome conditions (i.e., load [$M = 1.65, SD = 1.07$] and control [$M = 1.32, SD = .72$]). All other effects were non-significant ($F < 1$).

6.3.2 Digit Span Performance

Every participant (except one) randomly assigned to the cognitive load manipulation was able to recall most or all of the numbers¹². 62 participants (91.2%) recalled the eight-digit number perfectly while 5 (7.4%) made up to four mistakes during recall.

6.3.3 Slot Machine Persistence

When testing normality, the significant Shapiro-Wilk test suggests that the data is significantly different from a normally distributed distribution, $W(71) = .91, p < .05$. Furthermore, given that the points on the Q-Q plot deviate off the line, this graphical figure also suggests the data is not normally distributed (see Figures 17 and 18).

¹² Results did not change when deselecting the participants who didn't recall the digit perfectly.

Hypothesis 7 suggests there will be a significant 3-way interaction between lottery outcome (win vs. loss vs. control), trait beliefs in luck (high vs. low), and cognitive load (high load vs. control) on slot machine persistence. Specifically, it was hypothesized that the nature of this interaction would be driven by those who experienced a winning lottery outcome, endorse trait beliefs in luck, and had their cognitive resources exhausted. As such, scores for slot machine persistence were subjected to a moderated moderation analysis (Hayes, 2012; Model 3). Results suggested directional effects of the lottery outcome $\times$ trait beliefs in luck $\times$ cognitive load interaction ($B = 19.12$, $t = 1.56$, $p = .12$, $d = .29$; see Figure 24¹³, Appendix E).

Trait beliefs in luck were mean centered. Specifically, conditional effects of the winning lottery outcome on slot machine persistence was tested at three levels of trait beliefs in luck (i.e., the mean, 0; one standard deviation above the mean, .61; and one standard deviation below the mean, -.61), which were then tested at two levels of cognitive load (i.e., high load; control). The conditional effect of the lottery outcome $\times$ trait beliefs in luck interaction were significant during the presence of cognitive load ($B = 19.0$, $t = 2.61$, $p = .01$, $d = .48$; see Table 3, Appendix F). Specifically, the conditional effect of the winning lottery outcome on the expected value of slot machine persistence was elevated ($M = 38.4$) during high levels (+1SD) of trait beliefs in luck compared to low levels (-1SD) of trait beliefs in luck ($M = 23.1$), $B = 14.21$, $t = 2.31$, $p = .02$, $d = .43$; see Figures 29 and 30 in Appendix G.

6.4 Discussion

The results of study 3 replicate the findings of study 2, demonstrating a consistent moderating effect of cognitive load on the interaction between a positive outcome and trait beliefs in luck. This suggests that the effect of positive outcomes are relatively automatic for

¹³ Problem gambling was not a significant covariate.

people who endorse trait beliefs in luck (i.e., replicating the original Darke & Freedman, 1997b luck effect). These results suggest that hypothesis 7 was supported – cognitive busyness exacerbates the effects of an initial win on gambling persistence for those who believed in luck. In addition, participants who endorsed high trait beliefs in luck and experienced a winning dice outcome tended to show directional evidence of a correction in the cognitive control condition.

Previous research indicates a relationship between perceptions of luck and the willingness to risk money in a gamble (Wohl & Enzle, 2002, 2003). In addition, those with disordered gambling tend to hold higher beliefs of luck (Wohl et al., 2011). Current dual-process attribution theories suggest that disturbances to cognitive resources can impair the correction of automatic attributional inferences. The goal of study 3 was to replicate the results found in study 2 and to test if these effects extended to elevated gambling persistence. These results suggest that hypothesis 7 was supported – limited cognitive resources exacerbate beliefs in luck, which facilitated gambling persistence. This study indicates that cognitive resources impact whether people act on beliefs in luck, which lead to maladaptive, persistent, gambling. It is argued that cognitive load impairs the process of correction – a process that adjusts people's initial assumptions when understanding events within their environment. Without the correction of automatic inferences, the impairments on processing ability effectively bias attributional inferences. The results from study 3 suggest that under certain circumstances, cognitive load not only facilitates the engagement in future risk but also promotes its persistence.

CHAPTER 7: GENERAL DISCUSSION

Attributions have a substantial impact within consumer decision making processes (Weiner, 2000). For example, the fungibility of money in a purchasing context is effected by attributions regarding its physical appearance (Di Muro & Noseworthy, 2013); misattributions of arousal concerning schema congruity of new products can influence consumer preference (Noseworthy, Di Muro, & Murray, 2014); and attributions of brand power are inferred from label positioning on a product's packaging (Sundar & Noseworthy, 2014).

In terms of understanding ones' own environment, attributing the cause of past successes can help people attain future success and avoid failure (Weiner, 1985). Likewise, understanding past failures can help people cope and reconcile losses (Rothbaum, Weisz, & Snyder, 1982). Although understanding why events occur is an important and adaptive feature of human nature, making causal attributions takes mental effort (Gilbert et al., 1988; Trope, 1986). Current dual process models of attribution argue that attributional reasoning occurs over two main stages. The latter of the two has two subcomponents involving the characterization and adjustment of automatic categorizations. This final process is sensitive to one's current available cognitive resources. This is based on the argument that in order to mentally correct one's initial thought, it takes effort. Someone engaged in attributional reasoning must have the cognitive resources to make this mental adjustment.

Given prior work has demonstrated a relationship between the concept of luck and executive dysfunction (Maltby et al., 2013), the current research examined whether inhibited cognitive function would impact attributional reasoning involved in understanding and reacting to lucky events. Specifically, whether impeding attentional resources would bias attributional reasoning and facilitate people to act on beliefs in luck during future chance-based decisions.

This is based on the premise that the attribution process begins with the identification of the most readily available or salient attributions (Gilbert et al., 1988; Trope, 1986; Weiner, 1985). In addition, a recent review of attribution and executive function indicates that patients with frontal lobe dysfunction exhibit difficulty with causal attributions (Hunt et al., 2013). As such, when attention is limited, people may have a harder time disambiguating the cause of events when cued with luck, allowing beliefs in luck to guide future behaviour. The current thesis suggests that during instances of low cognitive resources, these cues may result in people unable to guard against their natural beliefs in luck.

Results from study 1 indicate that when people lack sufficient cognitive resources for thorough attributional reasoning, cues of luck become salient, biasing one's perception of personal control. In this case, because attention is impaired, luck likely became the forefront of one's focus. This was interpreted that cognitive load had an effect on the automatic categorization surrounding luck. In addition, when people are cued with luck under cognitive load, it was found that people believed they exerted an increased sense of personal control over the event whereby their luck originated (i.e., the cue of luck). This is because people did not have the cognitive resources for the correction process involved in interpreting random chance. As such, people were likely unable to bring about the alternate attribution associated with randomness or probability. However, study 1 did not account for people's natural trait beliefs in luck.

Study 2 investigated how beliefs in luck during limited attention impacts the perception of success in future behaviours by measuring the propensity to wager on a game of roulette. Importantly, participants were under the guise that they were betting their actual compensation for participating in the study. This experimental task was a relatively accurate measure of risk

especially given that the sample was composed of community members who expended their own energy and resources traveling into the university to participate in the study. Specifically, the results of study 2 indicate that when people endorse elevated trait beliefs in luck, exhausted cognitive resources impair the correction of such beliefs after experiencing a random positive event. Consequently, it is argued beliefs in luck impact the perception of success in a future event. The interaction between the winning lottery outcome and trait beliefs in luck while under cognitive load is a replication of Darke and Freedman (1997), demonstrating an automatic component to the effect of a winning lottery outcome. This is because people with limited cognitive resources will not think about a counter-example, such as randomness, to explain their success and subsequently bet more. As expected, the presence of a corrective process was evident within the cognitive control condition, where the discrepancy between winning and control outcomes were diminished.

In addition, study 2 revealed that when people endorse low beliefs in luck and experienced a loss during the presence of cognitive resources, they were willing to risk more money. This was interpreted as a self-correcting process based on an irrational understanding of probability being beholden to a state of equilibrium. Therefore, people with available cognitive resources that do not believe in luck may simply misinterpret random chance and overcorrect for the perceived effects of luck. This overcorrection could be interpreted as a gambler's fallacy effect. In terms of gambling, this is potentially a fallacy that perpetuates the attempt to win back or chase losses.

Although these effects are related to participants displaying an increased amount on a single, one-time, bet, beliefs of luck under cognitive load were also related to behavioural persistence. This is a key distinction because behavioural persistence is the characteristic feature

of gambling-related problems. Furthermore, study 3 presents the notion that when cognition function is impaired, at least temporarily, people who believe in luck exposed to a random positive event tend to persist when faced with situations where luck may impact the outcome. This is important because people take risks everyday and make seemingly calculated decisions based on past success or failure. The results of study 3 replicate the findings in study 2 (and Darke & Freedman, 1997b), suggesting that cognitive load facilitated participants exposed to a random positive event (i.e., a winning roll of a dice) who endorse high trait beliefs of luck to persist on a slot machine. This is of high theoretical interest because this gambling persistence task was unrelated to the dice task. Under the assumption of logical causal reasoning, believing that prior success in chance events will impact future events is irrational.

7.1 Limitations & Future Directions

There are several caveats of the current research. First and foremost, this thesis combines attribution theory and research on cognitive processing in order to make the argument that financial distress impacts the way in which people process information and that this depleted attention creates cognitive load impeding the correction of automatic categorization; however, financial threat is not manipulated. This is a limitation because financial scarcity may not impact information processing in the same way a digit-span task does.

Mani and colleagues (2013) show across multiple lab studies and field experiments that when poor participants (i.e., participants on the low end of a median split variable created by household annual income divided by the square root of the size of their household; Buhmann, Rainwater, & Schmaus, 1988) are given either a difficult financial problem vs. an easy financial problem (e.g., an immediate car repair of either \$1,500 or \$150, respectively), those participants in the difficult condition show significantly worse performance on traditional non-verbal

intelligence tasks (i.e., Raven's Progressive Matrices and a spatial compatibility task to measure cognitive control). Future research may investigate the impact of such manipulations on cognitive performance and attributional reasoning of random positive events. In addition there is an implicit assumption throughout this thesis that participants who believe in luck are aware that they are irrational and have a desire to correct these beliefs. Future research should test if people who endorse elevated beliefs in luck strive to correct them in certain instances.

Another interpretation of the relationship between financial distress and beliefs in luck is motivational. That is, having less money simply increases the motivation to rely on luck. Although this likely occurs, this is a different process than discussed the current thesis. In their dual-process model for causal attributions, Gilbert and colleagues (1988) argue that the correction process will occur if people are motivated to correct and if people have the resources to correct. As such, if people are motivated not to correct, in theory, this correction may not happen. However, there is a difference between motivation and processing ability. For example, people may be motivated to make a correction, but if they don't have the cognitive resources to do so, they will be unable to adjust.

Another limitation of the current research pertains to the correction process itself. Since there was no measure of an *adjustment* or a *correction*, the current thesis was unable to prove the cognitive process by current statistical mediation standards. Future research may consider measuring this mechanism directly.

In addition, there are some limitations involving the experimental manipulations. Although a digit-span task has been the main method of inducing cognitive load (Conway et al., 2005), the current research could benefit from a different technique to rule out a mono-operationalization bias. There is also a limitation regarding the *losing* lottery conditions.

Conceptually, is this a true *loss* condition or simply a *win-less* condition? Participants may not have viewed the initial seed money as their money at the beginning of the study. Therefore, despite procedural efforts to sell the idea that participants did lose money during the lottery tasks, this must be acknowledged as a limitation. This limitation could potentially be ruled out by future field research where participants use their own money in a natural gambling environment.

Although the results throughout these experiments are consistent and support current dual-process attribution and the current understanding of beliefs in luck, another limitation comes at the toll of external validity. It is very possible that some people are aware of their beliefs in luck and therefore avoid situations where they would feel lucky. For example, perhaps people who believe in luck avoid entering contests or gambling entirely. Embedded in this thesis is an implicit assumption that people who believe in luck want to correct. A future pretest might examine whether people are aware that acting on beliefs in luck can be irrational.

Future research may consider investigating the effect of cognitive load on attributional reasoning among a vulnerable population such as problem gamblers. In the current thesis, people who experienced a winning outcome coupled with high trait beliefs in luck under cognitive load lacked an attributional correction and exhibited increased gambling. With this in mind, these results may inform other areas of consumer behaviour. For example, outside of the context of gambling, these findings may hold implications for retail environments. Retailers often employ the use of contests to sway consumer decision making. Future research may consider investigating such promotional activities that could be viewed as a random positive event on the sales floor.

7.2 Theoretical Contributions

As noted by Shah and colleagues (2012), financial scarcity is one source of this biased attention. Indeed, impending financial distress can prove to be cognitively burdensome and steal attention away from a task at hand. This is especially troubling given the association between geographical regions of low socio-economic status and elevated rates of gambling (Barnes et al. 2011). Even when people feel their financial future is bleak, they tend to gamble more than those without these feelings of concern. Similar to payday loan services that promise a quick fix to the concerns of today, gambling may also be appraised in a similar light. If successful, gambling offers the opportunity to alleviate financial woes. Unfortunately, to the detriment of some, people who feel lucky tend to believe they can control the outcome of random events, which is associated with an increased gambling (Wohl, Stewart, & Young, 2011).

Although Maltby and colleagues (2013) found that dysexecutive function was related to perceptions of bad luck, cognitive function was not manipulated. That is, only trait based measures of executive function were related to beliefs in bad luck. It is very possible that people with enduring cognitive deficits over time attribute more outcomes as bad luck as a self-protection mechanism. However, when cognitive function is only temporarily impaired, such as during instances of limited attention, people may not view attributions with this negative bias. The current research makes a theoretical contribution in showing that cognitive load facilitates the effect of winning situational cues among those who believe in luck, effectively biasing future behaviour. As such, one's ability to attend to contextual or environmental stimuli when under cognitive load greatly impacts how people make causal attributions.

Overall, the results in this thesis indicate that during instances of cognitive load, people suffer a deficit in guarding against irrational beliefs that can have negative behavioural

consequences involving risk and gambling – the increased persistence during future chance events.

Furthermore, these findings provide some evidence for the relationship between low socio-economic status and gambling, especially given prior work relating financial distress with cognitive load (Mani et al., 2013; Shah et al., 2012). If financial concerns impede cognitive processing, people enduring financial distress, at times, may suffer a deficit in the ability to correct irrational beliefs after experiencing a random positive outcome.

These implications are contrary to the typical explanation that the relationship between gambling and poverty could be related to education (Bernheim, Garrett, & Maki, 2001; Livernois, 1987; Lang & Omori, 2009). Whether cognitive load is produced artificially in the lab with a digit span task or naturally in the real world with financial distress, this thesis suggest that impairments to information processing can allow beliefs in luck, which are related to the willingness to wager more while gambling (Wohl et al., 2011), gambling persistence (Wohl, Gainsbury, Stewart, & Sztainert, 2013), and disordered gambling (Jefferson & Nicki, 2003), to take hold. Furthermore, this thesis conceptually supports current dual-processing theories of attributional reasoning (Gilbert et al., 1988) and the current understanding of beliefs in luck (Darke & Freedman, 1997b)

7.3 Managerial Implications

The current thesis may hold implications for chance-based marketing promotions. In this case, advertisements promoting contests, draws, sweepstakes, and gambling are especially applicable. People with limited cognitive resources who feel lucky may be susceptible to claims of luck throughout media. One explanation is that people are unable to guard against attributions of luck. As such, people feeling lucky may attribute more control over advertised activities

promoting luck. Furthermore, this elevated attribution of luck may bias controllability and may pose a significant risk factor for persisting during a game of chance. Persistence in the face of loss and continued engagement in chance-based tasks despite adverse consequences is the defining behaviour exhibited by problem gamblers. In terms of clinical applications, the current research suggests that beliefs in luck is a factor endorsed by many, not just those with disordered gambling (Wohl, Young, & Hart, 2007), and therefore, might be an area of focus for prevention initiatives aimed to promote responsible play (Wohl et al., in press) and treatment seeking (Sztainert, Wohl, McManus, & Stead, 2013).

Furthermore, casino environments can facilitate persistence through ambient sounds and stimuli (Noseworthy & Finlay, 2009). Cognitive load can be induced when there are multiple demands on one's attention. Such demands can arise from the array of sights, sounds, and smells from a casino floor. Research also suggests that a combination of flashing lights and sounds, all competing for one's attention, hold the potential to cause cognitive load (Gopher & Donchin, 1986). Contextual cues are important in consumer behaviour and can often be ignored (Noseworthy, Wang, & Islam, 2012). As such, it is important to consider the results of the current study in the broader context of the casino environment and consumer behaviour. This idea is particularly troubling given that some slot machines are designed with a stopping mechanism (i.e., a button that allows players to stop the reels). These mechanisms have been implicated with perceptions of control and persistence (Ladouceur & Sevigny, 2005). When players accumulate multiple small wins, as slot machines allow for with variable ratio reinforcement schedules, these mechanisms could act as a cue for luck. If a small win is experienced through the use of such stopping mechanisms, people may be more likely to attribute this win as controllable and could fuel persistence. Although many people are aware that slot machines are driven by a random

number generator, these nuances within game design likely cause people to endorse luck and have perceived control over its outcome. During these instances, people may not have the cognitive resources to guard against the feeling of luck. This may contribute to the reason that people exhibit telescoping – a term that refers to the rapid onset of gambling-related problems on slot machines. Indeed, slot machines are labeled the most addictive form of gambling.

7.4 Conclusions

This thesis examined the relationship between the outcome of random events, beliefs in luck, and cognitive function. All three laboratory experiments employed the use of a between-subjects design and manipulated independent variables. Study 1 demonstrated that when people experience a random positive event and are under the constraints of cognitive load, they exhibit biased attributional reasoning. Specifically, cognitive load biases people to view random positive outcomes as controllable. These results suggest that cognitive load biases attributional reasoning. The goal of study 2 was to assess whether people would act on this biased reasoning by approaching a separate chance-based activity with increased risk. Results garnered in study 2 indicated that exposing people who believe in luck to a random positive outcome under the conditions of cognitive load promoted risk in a gambling task. In addition, when people that had available cognitive resources demonstrated a correction when approaching the gambling task. Interestingly, study 2 also showed that people who did not believe in luck exposed to a losing outcome with available cognitive resources tended to risk more in a gambling task. This effect represents a gambler's fallacy effect, where people overcorrect for the potential impact of perceived outcomes. Together, these results suggested that cognitive load inhibited a correction process that biased participants to approach unrelated chance-based tasks with increased risk. Study three examined this relationship using a measure of gambling persistence. Specifically,

study 3 provided a conceptual replication of study 2 showing that believing in luck when exposed to a positive event under the constraints of cognitive load was related to increased slot machine persistence. Together, these results suggest that cognitive resources impair attributional correction, leading towards a maladaptive propensity towards risk.

REFERENCES

- Aarts, H., Dijksterhuis, A., & De Vries, P. (2001). On the psychology of drinking: Being thirsty and perceptually ready. *British Journal of Psychology*, 92, 631-642.
- Anderson, C.A., Carnagey, N.L., & Eubanks, J. (2003). Exposure to violent media: The effects of songs with violent lyrics on aggressive thoughts and feelings. *Journal of Personality and Social Psychology*, 84, 960- 971.
- Ariyabuddipongs, V. (2011). Lottery gambling: A review. *Journal of Gambling Studies*, 27, 15- 33.
- Baddeley, A.D. (1986). *Working memory*. Oxford: Oxford University Press.
- Baddeley, A.D. (2000). The episodic buffer: a new component of working memory? Trends in *Cognitive Sciences*, 4 , 417–423.
- Baddeley, A. (2007). *Working memory, thought, and action* . Oxford: Oxford University Press.
- Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist*, 44,1175–1184.
- Banich, M. T. (2009). Executive function: The search for an integrated account. *Current Directions in Psychological Science*, 18, 89–94.
- Bargh, J. A., & Chartrand, T. L. (2000). The mind in the middle: A practical guide to priming and automaticity research. In H. T. Reis & C. M. Judd (Eds.), *Handbook of research methods in social and personality psychology* (pp. 253–285). New York: Cambridge University Press.
- Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. (1998). Ego Depletion: Is the Active Self a Limited Resource? *Journal of Personality and Social Psychology*, 74(5), 1252-1265.
- Barnes, G. M., Welte, J. W., Tidwell, M. O., & Hoffman, J. H. (2011). Gambling on the Lottery: Sociodemographic Correlates Across the Lifespan. *Journal of Gambling Studies*, 27, 575-586.
- Barrouillet, P., & Lecas, J. (1999). Mental models in conditional reasoning and working memory. *Thinking & Reasoning*, 5, 289–302.
- Bechara, A., Damásio, A. R., Damásio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition*, 50, 7–15.

- Ben-Zeév, A. (2009). Are You Lucky to Have Me Darling? “Our love reverses nature’s laws.” *Psychology Today*.
- Bernheim, B. D., Garrett, D. M., Maki, D. J. (2001). Education and saving: the long-term effects of high school financial curriculum mandates. *Journal of Public Economics* 80, 435.
- Blaszczynski, A. & Nower, L. (2002). A pathways model of problem and pathological gambling. *Addiction*, 97, 487-499.
- Bodenburg, S. & Dopsloff, N. (2008). The Dysexecutive Questionnaire Advanced Item and Test Score Characteristics, 4-Factor Solution, and Severity Classification. *The Journal of Nervous and Mental Disease*, 196(1), 75-78.
- Callen, M. J., Shead, N. W., & Olson, J. M. (in press). Personal Relative Deprivation, Delay Discounting, and Gambling. *Journal of Personality and Social Psychology*.
- Carlson, S. M. (2005). Developmentally sensitive measures of executive function in preschool children. *Developmental Neuropsychology*, 28, 595–616.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112(1), 155-159
- Clotfelter, C. T., Cook, P. J., Edell, J. A., & Moore, M. (1999). State lotteries at the turn of the century: Report to the national gambling impact study commission.
- Chaiken, S. (1980). Heuristic versus systematic information processing and the use of course versus message cues in persuasion. *Journal of Personality and Social Psychology*, 39(5), 752-766.
- Colom, R., Rebollo, I., Palacios, A., Juan-Espinosa, M., & Kyllonen, P. C. (2004). Working memory is (almost) perfectly predicted by g. *Intelligence*, 32, 277–296.
- Collette, F., Van der Linden, M., Laureys, S., Delfiore, G., Degueldre, C., Luxen, A., & Salmon, E. (2005). Exploring the unity and diversity of the neural substrates of executive function. *Human Brain Mapping*, 25, 409–423
- Conway, M. A. & Pletdell-Pearce, C. W. (2000). The construction of autobiographical memories in the self-memory system. *Psychological Review*, 107(2), 261-288.
- Conway, A. R. A., Kane, M. J., Bunting, M. F., Hambrick, Z. D., Wilhelm, O., & Engle, R. W. (2005). Working memory span tasks: A methodological review and users guide. *Psychonomic Bulletin & Review*, 12(5), 769-786.
- Cook, M., McHenry, R., & Leigh, V. (1998). Personality and the national lottery. *Personality and Individual Differences*, 25, 49–55.
- Cox, W.M., Fadardi, J.S., Pothos, E.M., 2006. The addiction-Stroop test: theoretical

- Crump, M. J. C., McDonell, J. V., & Gureckis, T. M. (2013). Evaluating Amazon's Mechanical Turk as a tool for Experimental Behavioural Research. *PLOS One*, 8(3), 1-18.
- Darke, P. R., & Freedman, J. L. (1997a). The belief in good luck scale. *Journal of Research in Personality*, 31, 486–511.
- Darke, P. R., & Freedman, J. L. (1997b). Lucky events and beliefs in luck: Paradoxical effects on confidence and risk-taking. *Personality and Social Psychology Bulletin*, 23, 378–388.
- Devine, P. G. (1989). Stereotypes and prejudice: Their automatic and controlled components. *Journal of Personality and Social Psychology*, 56, 5-18.
- Di Muro, F. & Noseworthy, T. J. (2012). Money Isn't Everything, but It Helps If It Doesn't Look Used: How the Physical Appearance of Money Influences Spending. *Journal of Consumer Research*, 39, 1330-1342.
- Dror, I. E., Busemeyer, J. R., & Basola, B. (1999). Decision making under time pressure: An independent test of sequential sampling models. *Memory & Cognition*, 27(4), 713-725.
- Duncan, J., & Owen, A.M. (2000). Common regions of the human frontal lobe recruited by diverse cognitive demands. *Trends in Neurosciences*, 23, 475–483.
- Dux, P.E. and Marois, R. (2009) The attentional blink: A review of data and theory. *Attention, Perception Psychophysics*, 71, 1683–1700
- Frederickson, B. L., & Kahneman, D. (1993). Duration neglect in retrospective evaluations of affective episodes. *Journal of Personality and Social Psychology*, 65, 45–55.
- Gazzaley, A., & Nobre, A. C. (2012). Top-down modulation: Bridging selective attention and working memory. *Trends in Cognitive Sciences*, 16, 129–135.
- Garavan, H., Ross, T. J., Li, S., & Stein, E. A. (2000). A parametric manipulation of executive functioning. *Cerebral Cortex*, 10, 585-592.
- Gilbert, D. T. & Hixon, J. G. (1991). The trouble of thinking: Activation and application of stereotypic beliefs. *Journal of Personality and Social Psychology*, 60(4), 509-517.
- Gilbert, D. T., Pelham, B. W., & Krull, D. S. (1988). On cognitive busyness: When person perceivers meet persons perceived. *Journal of Personality and Social Psychology*, 54, 733-740.
- Gilbert, D. T., Giesler, R. B., & Morris, K. A. (1995). When comparisons arise. *Journal of Personality and Social Psychology*, 69(2) 227-236.
- Gilbert, D. T. & Osborne, R. E. (1989). Thinking backward: Some curable and incurable

- consequences of cognitive busyness. *Journal of Personality and Social Psychology*, 57(6), 940-949.
- Godefroy, O., Cabaret, M., Petit-Chenal, V., Pruvo, J.-P., & Rousseaux, M. (1999). Control functions of the frontal lobes: Modularity of the central-supervisory system? *Cortex*, 35, 1–20.
- Gopher, D. & Donchin, E. (1986). Workload – An examination of the concept. In K.R. Boff, L. Kaufman, and J.P. Thoman (Eds.) *Handbook of Perception and Human Performance*. New York: John Wiley.
- Goldstein, R. Z. & Volkow, N. D (2002). Drug addiction and its underlying neurobiological basis: neuroimaging evidence for the involvement of the frontal cortex. *American Journal of Psychiatry*, 159(10), 1642-52.
- Gray, J. R., Chabris, C. F., & Braver, T. S. (2003). Neural mechanisms of general fluid intelligence. *Nature Neuroscience*, 6, 316–322.
- Haisley, E., Mostafa, R., & Loewenstein, G. (2008). Subjective Relative Income and Lottery Ticket Purchases. *Journal of Behavioral Decision Making*, 21, 283-295.
- Hayes, A. F. (2012). PROCESS: A versatile computational tool for observed variable mediation, moderation, and conditional process modeling [White paper]. Retrieved from <http://www.afhayes.com/public/process2012.pdf>
- Healy, A. F. & Proctor, R. W. (2003). Experimental Psychology, in Weiner I. B. (ed) *Handbook of Psychology*: Wiley & Sons, New Jersey.
- Heider, F. (1958). The psychology of interpersonal relations. New York: Wiley.
- Jefferson, S., & Nicki, R. (2003). A new instrument to measure cognitive distortions in video lottery terminal users: The Informational Biases Scale (IBS). *Journal of Gambling Studies*, 19, 387-403.
- Jensen, M.S., Yao, R., Street, W. N., & Simons, D. J. (2011) Change blindness and inattentional blindness. *WIREs Cognitive Science*. 2, 529–546
- Jiang, Y., Cho, A., & Adaval, R. (2009). The unique consequences of feeling lucky: Implications for consumer behavior. *Journal of Consumer Psychology*, 19, 171-184.
- Jiang, Y., Cho, A., Adaval, R. (2006). Priming lucky numbers: Effects on attributions and performance. *Advances in Consumer Research*, Vol. 33.
- Kane, M. J., Hambrick, D. Z., Tuholski, S. W., Wilhelm, O., Payne, T. W., & Engle, R. W. (2004). The generality of working memory capacity: A latent-variable approach to verbal and visuospatial memory span and reasoning. *Journal of Experimental Psychology: General*, 133, 189–217.

- Kahneman, D., Slovic, P., & Tversky, A. (1982). *Judgement Under uncertainty: Heuistics and Biases*. Cambridge: Cambridge University Press.
- Karau, S.J., & Kelly, J.R. (1992). The effects of time scarcity and time abundance on group performance quality and interaction process. *Journal of Experimental Social Psychology*, 28(6), 542-571.
- Kearney, M. S. (2005). State lotteries and consumer behavior. *Journal of Public Economics*, 89, 2269–2299.
- Keren, G. & Lewis, C. (1994). The two fallacies of gamblers: Type I and Type II. *Organizational Behaviour and Human Decision Processes*, 60, 75-89.
- Kessler, K. D. (1994). The role of luck in criminal law. *University of Pennsylvania Law Review*, 142, 2183–2237.
- Klein, D. C. Fencil-Morse, E., & Seligman, M. E. P. (1976). Learned Helplessness, Depression, and the Attribution of Failure. *Journal of Personality and Social Psychology*, 33(5), 508-516.
- Klemen, J., Büchel, C., Bühler, M., Menz, M. M., & Rose, M. (2010). Auditory working memory load impairs visual ventral stream processing: Toward a unified model of attentional load. *Journal of Cognitive Neuroscience*, 22, 437–446.
- Kramer, T. & Block, L. (2008). Conscious and nonconscious components of superstitious beliefs in judgment and decision making. *Journal of Consumer Research*, 34, 783-793.
- Ladouceur, R. & Sevigny, S. (2005). Structural characteristics of video lotteries: Effects of stopping device on illusion of control and gambling persistence. *Journal of Gambling Studies*, 21(2), 117-131.
- Lang, K. B., & Omori, M. (2009). Can demographic variables predict lottery and pari-mutuel losses? An empirical investigation. *Journal of Gambling Studies*, 25, 171– 183.
- Lavie, N. & DeFockert J. W. (2003). Contrasting effects of sensory limits and capacity limits in visual selective attention. *Perception & Psychophysics*, 65, 202-212
- Lavie, N. & De Fockert, J. (2005). The role of working memory in attentional capture. *Psychonomic Bulletin & Review*, 12(4), 669-674.
- Lavie, N., Hirst, A., De Fockert, J., & Viding, E. (2004). Load Theory of Selective Attention and Cognitive Control. *Journal of Experimental Psychology: General*, 133(3), 339-354.
- Lee, Y.-K., & Chang, C.-T. (2008). A social landslide: Social inequalities of lottery

- advertising in Taiwan. *Social Behavior and Personality*, 36, 1423–1438.
- Ledgerwood, D. M., Orr, E. S., Kaploun, K. A., Milosevic, A., Frisch, G. R., Rupcich, N., & Lundahl, L. H. (2012). Executive Function in Pathological Gamblers and Healthy Controls. *Journal of Gambling Studies*, 28, 89-103.
- Lesieur, H. R. (1984) *The Chase*. Cambridge, MA: Schenkman.
- Lister, J.J., Wohl, M.J.A., & Davis, C.G. (2014). The dark side of authenticity: Feeling “real” while gambling interacts with enhancement motives to predict problematic gambling behavior. *Journal of Gambling Studies*. <http://dx.doi.org/10.1007/s10899-014-9460-7>
- Livernois, J. (1987). The redistributive effect of lotteries: Evidence from Greyhound. *Public Finance Quarterly*, 15, 339–351.
- Lieberman, M. D., Guant, R., Gilbert, D. T., Trope, Y. (2002). Reflexion and reflection: A social cognitive neuroscience approach to attributional inference. *Advances in Experimental Social Psychology*, 34, 199-249.
- Loderer, G. F., Peyer, U., & Liechti, D. (2010). Luck and entrepreneurial success. Social Science Research Network
- Luck, S. J. & Vogel, E. K. (1997). The capacity of visual working memory for features and conjunctions. *Nature*, 390, 279-281.
- Maltby, J., Day, L., Pinto, D. G. Hogan, R.A., & Wood, A. M. (2013). Beliefs in being unlucky and deficits in executive functioning. *Consciousness & Cognition*, 22, 137-147.
- Mani, A., Mullainathan, S., Shafir, E., & Zhao, J. (2013). Poverty impedes cognitive function. *Science*, 341, 976-980.
- McAuley, E., Duncan, T. E., Russell, D. W. (1992). Measuring causal attributions: The revised causal dimensions scale (CDSII). *Personality and Social Psychology Bulletin*, 18(5), 566-573.
- McCabe, D. P., Smith, A. D., & Parks, C. P. (2007). Inadvertent plagiarism in young and older adults. *Memory & Cognition*, 35, 231–241.
- Mack, A., & Rock, I. (1998). *Inattention blindness*. Cambridge, MA: MIT Press.
- McCrae, C. N., Hewstone, M., Griffiths, R. J. (1993). Processing load and memory for stereotype-based information. *European Journal of Social Psychology*, 23, 77-87.
- McCabe, D. P., Roediger, H. L., McDaniel, M. A. Balota, D. A. & Hambrick, D. Z. (2010). The Relationship Between Working Memory Capacity and Executive Functioning: Evidence for a Common Executive Attention Construct. *Neuropsychology*, 24(2), 222-243.

- Mitchell, T. R., Thompson, L., Peterson, E., & Cronk, R. (1997). Temporal adjustments in the evaluation of events: The “rosy view”. *Journal of Experimental Social Psychology*, 33, 421–448.
- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. *Cognitive Psychology*, 41, 49–100.
- Nee, D. E., Brown, J. W., Askren, M. K., Berman, M. G., Demiralp, E., Krawitz, A., & Jonides, J. (2012). A meta-analysis of executive components of working memory. *Cerebral Cortex*, 23, 264–282.
- Norman, D. A. & Shallice, T. (1986). Attention to action: Willed and automatic control of behavior. In R. J. Davidson, G. E. Schwartz, & D. Shapiro (Eds.), *Consciousness and self-regulation: Advances in research and theory* (Vol. 4, pp. 1–18). New York: Plenum.
- Noseworthy, T. J. & Goode, M. R. (2011). Contrasting Rule-Based and Similarity-Based Category Learning: The Effects of Mood and Prior Knowledge on Ambiguous Categorization. *Journal of Consumer Psychology*, 21, 362–71.
- Noseworthy T.J., Finlay, K. (2009) A comparison of ambient casino sounds and music: Effects on dissociation and perceptions of elapsed time while playing slot machines. *Journal of Gambling Studies*, 25, 331–342.
- Noseworthy, T. J., Wang, J., & Islam, T. (2012). How Context Shapes Category Inferences and Attribute Preference for New Ambiguous Products. *Journal of Consumer Psychology*, 22 (October), 529–54.
- Noseworthy, T. J., Di Muro, F., & Murray, K. B. (2014). The Role of Arousal in Congruity-Based Product Evaluation, *Journal of Consumer Research* (Forthcoming).
- Paas, F., & van Merriënboer, J. J. G. (1994a). Instructional control of cognitive load in the training of complex cognitive tasks. *Educational Psychology Review*, 6, 51–71.
- Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, and Computers*, 36, 717–731.
- Radel, C. Clément-Guillotin, *Psychological Science*, 23, 232
- Shah, A. K., Mullainathan, S., & Shafir, E. (2012). Some consequences of having too little. *Science*, 682–685.

- Stewart, M. J. & Wohl, M. J. A. (in press). Pop-up messages, dissociation, and craving: How monetary limit reminders facilitate adherence in a session of slot machine gambling. *Psychology of Addictive Behavior*.
- Rodgers, R. D., & Monsell, S. (1995). The cost of a predictable switch between simple cognitive tasks. *Journal of Experimental Psychology*, 124, 207–231.
- Rothbaum, F., Weisz, J. R., & Snyder, S. S. (1982). Changing the world and changing the self: A two-process model of perceived control. *Journal of Personality and Social Psychology*, 42, 5-37.
- Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs*, 80.
- Ritchie, T. D., Skowronski, J. J., Wood, S. E., Walker, W. R., Vogl, R. J., & Gibbons, J. A. (2006). Event self-importance, event rehearsal, and the fading affect bias in autobiographical memory. *Self and Identity*, 5, 172–195.
- Salthouse, T.A., & Davis, H.P. (2006). Organization of cognitive abilities and neuropsychological variables across the lifespan. *Developmental Review*, 26, 31–54.
- SanMiguel, I., Corral, M.-J., & Escera, C. (2008). When loading working memory reduces distraction: Behavioral and electrophysiological evidence from an auditory-visual distraction paradigm. *Journal of Cognitive Neuroscience*, 20, 1131–1145.
- Schwartz, M. F. (1995). Re-examining the role of executive functions in routine action production. *Annals of the New York Academy of Sciences*, 769, 321–335.
- Shaffer, H. J., Hall, M. N., & Vander Bilt, J. (1999). Estimating the prevalence of disordered gambling behavior in the United States and Canada: A research synthesis. *American Journal of Public Health*, 89, 1369-1376.
- Shah, A. K., Mullainathan, S., & Shafir, E. (2012) Some consequences of having too little. *Science*, 338, 682-685.
- Shallice, T., & Burgess, P. (1993). Supervisory control of action and thought selection. In A. D. Baddeley & L. Weiskrantz (Eds.), *Attention: Selection, awareness, and control* (pp. 171–187). Oxford, England: Oxford University Press.
- Shallice, T. (1988). *From neuropsychology to mental structure*. New York: Cambridge University Press.
- Steenbergh, T.A., Whelan, J.P., Meyers, A.W., May, R.K., & Floyd, K. (2004). Impact of warning and brief intervention messages on knowledge of gambling risk, irrational beliefs and behaviour. *International Gambling Studies*, 4, 3-16.

- Sternberg, S. (1966, August 5). High-speed scanning in human memory. *Science*, 153, 652–654.
- Stewart, S. H. & Zack, M. (2008). Development and psychometric evaluation of a three-dimensional gambling motives questionnaire. *Addiction*, 103(3), 1110-1117.
- Stewart, M. J. & Wohl, M. J. A. (2013). Pop-up messages, dissociation, and craving: How monetary limit reminders facilitate adherence in a session of slot machine gambling. *Psychology of Addictive Behavior*, 27, 288-273.
- Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, 18, 643–662.
- Sundar, A. & Noseworthy, T. J. (2014). Place the Logo High or Low? Using Conceptual Metaphors of Power in Packaging Design. *Journal of Marketing (Forthcoming)*.
- Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 12, 257–285.
- Sweller, J., van Merriënboer, J. J. G., & Paas, F. (1998). Cognitive architecture and instructional design. *Educational Psychology Review*, 10, 251–296.
- Sztainert, T., Wohl, M. J. A., McManus, J. F., & Stead, J. D. H. (2013). On being attracted to the possibility of a win. Reward sensitivity (via gambling motives) undermines treatment seeking among pathological gamblers. *Journal of Gambling Studies*, doi: 10.1007/s10899-013-9394-5
- Thompson, E. R., & Prendergast, G. P. (2013). Belief in Luck and Luckiness: Conceptual Clarification and Measure Validation. *Personality and Individual Differences*, 54, 501-506.
- Trope, Y. (1986). Identification and inferential processes in dispositional attribution. *Psychological Review*, 93, 239-257.
- Tversky, A. & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, 185, 1124-1131.
- Van Dillen, L. F., Papies, E. K., & Hofmann, W. (2013). Turning a Blind Eye to Temptation: How Cognitive Load Can Facilitate Self-Regulation. *Journal of Personality and Social Psychology*, 104(3), 427-443.
- Van Holst, R. J., van den Brink, W., Veltman, D. J., & Goudriaan, A. E. (2010). Why gamblers fail to win: A review of cognitive and neuroimaging findings in pathological gambling. *Neuroscience and Biobehavioral Reviews*, 34, 87-107.

- Vohs, K. D. & Heatherton, T. F. (2000). Self-regulatory failure: A resource-depletion approach. *Psychological Science*, 11(3), 249-254.
- Volberg RA. (1994). The Prevalence and Demographics of Pathological Gamblers: Implications for Public Health. *American Journal of Public Health*, 84(2), 237-241.
- Watson, D., Clark, L. A., & Tellegan, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063-1070.
- Wang, Z., Faith, M., Patterson, F., Tang, K., Kerrin, K., Wileyto, E.P., Detre, J.A., Lerman, C., 2007. Neural substrates of abstinence-induced cigarette cravings in chronic smokers. *Journal of Neuroscience*, 27, 14035–14040.
- Weiner, B., Frieze, I., Kukla, A., Reed, L., Rest, S., & Rosenbaum, R. M. (1972). Perceiving the causes of success and failure. In E. E. Jones, D. E. Kanouse, H. H. Kelley, R. E. Nisbett, S. Valins, & B. Weiner (Eds.), *Attribution: Perceiving the causes of behavior* (pp. 95–120). New York: General Learning Press.
- Weiner, B., Frieze, I. H., Kukla, A., Reed, L., Rest, S., & Rosenbaum, R. M. (1971). *Perceiving the causes of success and failure*. Morristown, NJ: General Learning Press.
- Weiner, B. (2000) Attributional thoughts about consumer behaviour. *Journal of Consumer Research*, 27, 382-387.
- Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review*, 92, 548-573.
- Welte, J. W., Barnes, G. M., Wiczorek, W. F., Tidwell, M.-C., & Parker, J. (2002). Gambling participation in the U.S.—Results from a National Survey. *Journal of Gambling Studies*, 18, 313–337.
- White, R. W. (1959). Motivation reconsidered: The concept of competence. *Psychological Review*, 66, 297-333.
- Williams, R.J., & Wood, R. (2003). The demographics of Ontario gaming revenue. Retrieved June 6, 2009 from gamblingresearch.org.
- Wohl, M. J. A. (2008). Belief in a lucky self: The role of personal luck in the facilitation and maintenance of gambling behavior. *Psychologie Francaise*, 53, 7-23.
- Wohl, M. J. A., Branscombe, N. R. & Lister, J. J. (2013). When the Going Gets Tough: Economic Threat Increases Financial Risk Taking in Games of Chance. *Social Psychological & Personality Science*,

- Wohl, M. J. A., Gainsbury, S., Stewart, M. J., & Szteinert, T. (*in press*). Facilitating responsible gambling: The relative effectiveness of education-based animation and monetary limit setting pop-up messages among electronic gaming machine players. *Journal of Gambling Studies*.
- Wohl, M. J. A., & Enzle, M. E. (2002). The deployment of personal luck: Illusory control in games of pure chance. *Personality and Social Psychology Bulletin*, 28, 1388–1397.
- Wohl, M. J. A., & Enzle, M. E. (2003). The effects of near wins and near losses on self-perceived personal luck and subsequent gambling behavior. *Journal of Experimental Social Psychology*, 39, 184–191.
- Wohl, M. J. A., Stewart, M. J., & Young, M. M. (2011). Personal luck usage scale (PLUS): Psychometric validation of a measure of gambling-related belief in luck as a personal possession. *International Gambling Studies*, 11, 7-21.
- Young, M. M., & Wohl, M. J. A. (2009). The gambling craving scale: Psychometric validation and behavioral outcomes. *Psychology of Addictive Behaviors*, 23, 512-522.

Appendix A: Attribution Models

Figure 1. Weiner's 1985 Attributional Theory of Achievement Motivation and Emotion

Figure 2. Automatic inference and controlled correction processes of current attribution models (reproduced from Lieberman et al., 2002).

Appendix B: Manipulation Checks (Studies 2 & 3)

Figures 3 & 4. An interaction plot between cognitive resources and lottery outcome on the luck manipulation check item (above; study 1) and an interaction plot between cognitive resources and the dice roll outcome on the luck manipulation check item (below; study 2).

Appendix C: Tests of Normality (Q-Q Plots & Histograms; Studies 1-3)

Figures 5 & 6. A histogram (above) and Q-Q (below) of word-fragment completion scores in study 1.

Figures 7 & 8. A histogram (above) and Q-Q (below) of personal control scores in study 1.

Figures 9 & 10. A histogram (above) and Q-Q (below) of locus of causality scores in study 1.

Figures 11 & 12. A histogram (above) and Q-Q (below) of external control scores in study 1.

Figures 13 & 14. A histogram (above) and Q-Q (below) of stability scores in study 1.

Figures 15 & 16. A histogram (above) and Q-Q (below) of the amount bet on roulette in study 2.

Figures 17 & 18. A histogram (above) and Q-Q (below) of slot machine persistence in study 3.

Appendix D: Two-way Interaction Plots (Study 1)

Figure 19 & 20. An interaction plot between cognitive resources and the card draw outcome on the word-fragment completion task (above) and on attributions of personal control (below).

Appendix E: Moderated Moderation Models

Figure 21. A statistical model of multiplicative moderation recreated from Hayes (2012) Process documentation.

Figure 22. A conceptual moderated moderation model displaying a significant 3-way interaction between lottery outcome (coded: win = 1, control = 0), trait beliefs in luck (mean centered; tested at M , $\pm 1SD$), and cognitive resources (coded: load, control) on the amount bet on roulette.

* $p < .05$; ** $p < .01$.

Figure 23. A conceptual moderated moderation model displaying a significant 3-way interaction between lottery outcome (coded: loss = 1, control = 0), trait beliefs in luck (mean centered; tested at M , $\pm 1SD$), and cognitive resources (coded: load, control) on the amount bet on roulette.

* $p < .06$; ** $p < .05$.

Figure 24. A conceptual moderated moderation model displaying a significant 3-way interaction between lottery outcome (coded: win = 1, loss = 0), trait beliefs in luck (mean centered; tested at M , $\pm 1SD$), and cognitive resources (coded: load = 1, control = 0) on slot machine persistence . $*p < .06$.

Appendix F: Tables

Table 1

Study 2 Moderated Moderation Results (Win vs. Control)

Predictor	β	<i>SE</i>	<i>t</i>	<i>p</i>
Amount Bet on Roulette				
Constant	-1.46	3.28	-.44	.65
Lottery Outcome	5.94	4.72	1.25	.21
Beliefs in Luck	1.31	0.91	1.43	.15
Cognitive Resources	10.78	4.28	2.51	.01
Lottery Outcome $\times$ Beliefs in Luck	-1.34	1.33	-1.01	.31
Lottery Outcome $\times$ Cognitive Resources	-20.01	4.28	-3.13	.002
Beliefs in Luck $\times$ Cognitive Resources	-2.99	1.26	-2.37	.02
Lottery Outcome $\times$ Beliefs in Luck $\times$ Cognitive Resources	5.48	1.85	2.96	.004
Conditional effect of Lottery Outcome at values of Beliefs in Luck & Cognitive Resources				
Cognitive control by -1SD Beliefs in Luck	2.18	1.21	1.79	.07
Cognitive control by <i>M</i> Beliefs in Luck	1.37	0.77	1.78	.07
Cognitive control by +1SD Beliefs in Luck	0.57	0.98	0.57	.56
Cognitive Load by -1SD Beliefs in Luck	-2.57	0.99	-2.57	.01
Cognitive Load by <i>M</i> Beliefs in Luck	-0.09	0.77	-0.12	.90
Cognitive Load by +1SD Beliefs in Luck	2.37	1.18	2.01	.04
Conditional effect of Lottery Outcome $\times$ Beliefs in Luck Interaction by Cognitive Resources				
Cognitive Control	-1.34	1.33	-1.01	.31
Cognitive Load	4.13	1.28	3.21	.002

Note. Unstandardized coefficients are reported.

Table 2

Study 2 Moderated Moderation Results (Loss vs. Control)

Predictor	β	<i>SE</i>	<i>t</i>	<i>p</i>
Amount Bet on Roulette				
Constant	-1.46	4.14	-0.35	.72
Lottery Outcome	11.59	5.68	2.03	.04
Beliefs in Luck	1.31	1.15	1.13	.26
Cognitive Resources	10.78	5.41	1.99	.05
Lottery Outcome $\times$ Beliefs in Luck	-3.17	1.61	-1.95	.05
Lottery Outcome $\times$ Cognitive Resources	-16.72	7.36	-2.27	.02
Beliefs in Luck $\times$ Cognitive Resources	-2.99	1.59	-1.88	.06
Lottery Outcome $\times$ Beliefs in Luck $\times$ Cognitive Resources	4.51	2.17	2.07	.04
Conditional effect of Lottery Outcome at values of Beliefs in Luck & Cognitive Resources				
Cognitive control by -1SD Beliefs in Luck	2.18	1.21	1.79	.07
Cognitive control by <i>M</i> Beliefs in Luck	1.37	0.77	1.78	.07
Cognitive control by +1SD Beliefs in Luck	0.57	0.98	0.57	.56
Cognitive Load by -1SD Beliefs in Luck	-2.57	0.99	-2.57	.01
Cognitive Load by <i>M</i> Beliefs in Luck	-0.09	0.77	-0.12	.90
Cognitive Load by +1SD Beliefs in Luck	2.37	1.18	2.01	.04
Conditional effect of Lottery Outcome $\times$ Beliefs in Luck Interaction by Cognitive Resources				
Cognitive Control	-3.17	1.61	-1.95	.05
Cognitive Load	1.34	1.46	0.92	.36

Note. Unstandardized coefficients are reported.

Table 3

Study 3 Moderated Moderation Results

Predictor	β	<i>SE</i>	<i>t</i>	<i>p</i>
Amount Bet on Roulette				
Constant	8.74	24.55	0.35	.72
Lottery Outcome	8.45	34.12	0.24	.80
Beliefs in Luck	3.32	7.35	0.45	.65
Cognitive Resources	42.27	28.71	1.47	.14
Lottery Outcome $\times$ Beliefs in Luck	-0.11	9.86	-0.01	.99
Lottery Outcome $\times$ Cognitive Resources	-72.89	42.98	-1.67	.09
Beliefs in Luck $\times$ Cognitive Resources	-9.89	8.53	-1.15	.24
Lottery Outcome $\times$ Beliefs in Luck $\times$ Cognitive Res.	19.10	12.25	1.55	.12
Conditional effect of Lottery Outcome at values of Beliefs in Luck & Cognitive Res.				
Cognitive control by -1SD Beliefs in Luck	8.12	7.66	1.06	.29
Cognitive control by <i>M</i> Beliefs in Luck	8.05	5.32	1.51	.13
Cognitive control by +1SD Beliefs in Luck	7.98	8.48	0.94	.34
Cognitive Load by -1SD Beliefs in Luck	-9.21	6.80	-1.35	.17
Cognitive Load by <i>M</i> Beliefs in Luck	2.49	4.68	0.53	.59
Cognitive Load by +1SD Beliefs in Luck	14.21	6.14	2.31	.02
Conditional effect of Lottery Outcome $\times$ Beliefs in Luck Interaction by Cognitive Res.				
Cognitive Control	-0.11	9.86	-0.01	.99
Cognitive Load	18.99	7.26	2.61	.01

Note. Unstandardized coefficients are reported.

Appendix G: Three-way Interaction Plots (studies 2 and 3)

Figure 25 & 26. An interaction plot between lottery outcome (win, control) and trait beliefs in luck (low, moderate, high) on the model-predicted expected values of the amount bet on roulette under cognitive load (above) and cognitive control (below).

Figure 27 & 28. An interaction plot between lottery outcome (loss, control) and trait beliefs in luck (low, moderate, high) on the model-predicted expected values of the amount bet on roulette under cognitive load (above) and cognitive control (below).

Figure 29 & 30. An interaction plot between lottery outcome (win, loss) and trait beliefs in luck (low, moderate, high) on the model-predicted expected values of slot machine persistence under cognitive load (above) and cognitive control (below).

Appendix H: Experimental Stimuli

Please wait for the lottery draw...

Appendix I: Experimental Script (Study 1)

Hi, are you here for the gambling study? Good. I'm _____. Please follow me.

The computer in front of you is loaded with a questionnaire, the first page of which is the consent form. Please read the consent form thoroughly and then indicate whether or not you want participate in the study. I'll let you take a couple minutes to read it through and then I will briefly review the study with you before you decide on whether you wish to participate.

(After consent is given)

Thanks for agreeing to participate.

Today we have an extra bonus for you for participating. This bonus is in addition to your course credit. As it turns out, the research coordinator for this study came across some extra research funds. Unfortunately we do not have enough money to pay everyone, but we are offering a draw. Every time we conduct the study, we are having a draw for \$5. How this works is you choose a card from the deck of cards that are spread out over here [point to table] and at some point during the survey, the computer will ask you what card you selected. It will then tell you whether you won an extra \$5 for your participation today.

Do you have any questions?

You can go ahead and select a card and start the questionnaires. Once you have finished please let me know.

Appendix J: Word-fragment Completion Task

se__n

p r__e

l__k

cl__er

t_p_

ma__c

a_t_r

__ttery

s_m p__

c_m p__t

_a__pot

s h_l_

_i_hbone

l__e

____bug

b_r n

hor____e

s h_r_

pe__y

p__n e

fl__t

Appendix K: Research Ethics Board Certificate

RESEARCH ETHICS BOARD – General REB-G

Certification of Ethical Acceptability of Research Involving Human Participants

APPROVAL PERIOD: October 17, 2013 to October 17, 2014
REB NUMBER: 13SE024
TYPE OF REVIEW: Delegated Type 1
RESPONSIBLE FACULTY: Noseworthy, Theodore (tnosewor@uoguelph.ca)
DEPARTMENT: Marketing & Consumer Studies
SPONSOR(S): Ontario Problem Gambling Research Centre

TITLE OF PROJECT: Attitudes and beliefs about gambling

The members of the University of Guelph Research Ethics Board have examined the protocol which describes the participation of the human subjects in the above-named research project and considers the procedures, as described by the applicant, to conform to the University's ethical standards and the Tri-Council Policy Statement, 2nd Edition.

The REB requires that you adhere to the protocol as last reviewed and approved by the REB. The REB must approve any modifications before they can be implemented. If you wish to modify your research project, please complete the Change Request Form. If there is a change in your source of funding, or a previously unfunded project receives funding, you must report this as a change to the protocol.

Unexpected events and incidental findings must be reported to the REB as soon as possible with an indication of how these events affect, in the view of the Responsible Faculty, the safety of the participants, and the continuation of the protocol.

If research participants are in the care of a health facility, at a school, or other institution or community organization, it is the responsibility of the Principal Investigator to ensure that the ethical guidelines and approvals of those facilities or institutions are obtained and filed with the REB prior to the initiation of any research protocols.

The Tri-council Policy Statement, 2nd Edition, requires that ongoing research be monitored by, at a minimum, a final report and, if the approval period is longer than one year, annual reports. Continued approval is contingent on timely submission of reports.

Membership of the Research Ethics Board - General: S. Banerjee, *Community Member*; J. Carson, *Community Member*; S. Chuang, *FRAN (alt)*; K. Chuong, *Graduate Student*; J. Clark, *PoliSci (alt)*; J. Dwyer, *FRAN*; M. Dwyer, *Legal*; B. Ferguson, *CME (alt)*; B. Giguere, *Psychology (alt)*; B. Gottlieb, *Psychology*; S. Henson, *OAC (alt)*; S. Hickson, *COA*; L. Kuczynski, *Chair*; A. Lauzon, *OAC*; R. Ragan, *Legal (alt)*; C. Rice, *FRAN*; V. Shalla, *SOAN (alt)*; R. Stansfield, *SOAN*; J. Wood, *Graduate Student (alt)*; S. Yi, *CME*.

Approved:
 per
 Chair, Research Ethics Board- General

Date: _____

Appendix L: Survey Instruments

Causal Attributions Scale

The card draw outcome was:		
Reflects an aspect of yourself	9 8 7 6 5 4 3 2 1	Reflects an aspect of the situation
Manageable by you	9 8 7 6 5 4 3 2 1	Not manageable by you
Permanent	9 8 7 6 5 4 3 2 1	Temporary
Something you can regulate	9 8 7 6 5 4 3 2 1	Something you cannot regulate
Something over which others have control	9 8 7 6 5 4 3 2 1	Something over which others have no control
Something inside of you	9 8 7 6 5 4 3 2 1	Something outside of you
Stable over time	9 8 7 6 5 4 3 2 1	Variable over time
Under the power of other people	9 8 7 6 5 4 3 2 1	Not under the power of other people
Something about you	9 8 7 6 5 4 3 2 1	Something about others
Something over which you have power	9 8 7 6 5 4 3 2 1	Something over which you have no power
Unchangeable	9 8 7 6 5 4 3 2 1	Changeable
Something other people can regulate	9 8 7 6 5 4 3 2 1	Something other people cannot regulate

Dysexecutive Function Questionnaire

1. I have problems understanding what other people mean unless they keep things simple and straightforward.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

2. I act without thinking, doing the first thing that comes to mind.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

3. Sometimes I talk about events or details that never actually happened, but I believe did happen.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

4. I have difficulty thinking ahead or planning for the future.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

5. I sometimes get over-excited about things and can be a bit 'over-the-top' at these times.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

6. I get events mixed up with each other, and get confused about the correct order of events.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

7. I have difficulty realising the extent of my problems and am unrealistic about the future.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

8. I seem lethargic, or unenthusiastic about things.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

9. I do or says embarrassing things when in the company of others.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

10. I really want to do something one minute, but couldn't care less about it the next.

1	2	3	4	5
----------	----------	----------	----------	----------

Strongly Disagree	Strongly Agree
-------------------	----------------

11. I have difficulty showing emotion.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

12. I lose my temper at the slightest thing.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

13. I seem unconcerned about how I should behave in certain situations.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

14. I find it hard to stop repeating saying or doing things once started.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

15. I tend to be very restless and 'can't sit still' for any length of time.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

16. I find it difficult to stop doing something even if I know I shouldn't.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

17. I will say one thing, but do something different.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

18. I find it difficult to keep my mind on something, and am easily distracted.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

19. I have trouble making decisions, or deciding what I want to do.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

20. Am unaware of, or unconcerned about, how others feel about my behaviour.

1	2	3	4	5
Strongly Disagree			Strongly Agree	

Beliefs in Good Luck Scale

1. I consider myself a lucky person.

1	2	3	4	5	6
Strongly Disagree			Strongly Agree		

2. I often feel like its my lucky day.

1	2	3	4	5	6
Strongly Disagree			Strongly Agree		

3. I consistently have good luck.

1	2	3	4	5	6
Strongly Disagree			Strongly Agree		

4. Luck works in my favor.

1	2	3	4	5	6
Strongly Disagree			Strongly Agree		

5. Luck plays an important part in everyone's life.

1	2	3	4	5	6
Strongly Disagree			Strongly Agree		

6. Some people are consistently lucky and others are unlucky.

1	2	3	4	5	6
Strongly Disagree			Strongly Agree		

7. I believe in luck.

1	2	3	4	5	6
Strongly Disagree			Strongly Agree		

8. I don't mind leaving things to chance because I'm a lucky person.

1	2	3	4	5	6
Strongly Disagree			Strongly Agree		

9. There is such a thing as luck that favors some people but not others.

1	2	3	4	5	6
Strongly Disagree			Strongly Agree		

10. Even the thing in life I can't control tend to go my way because I'm lucky.

1	2	3	4	5	6
Strongly Disagree			Strongly Agree		

11. It's a mistake to base any decision on how lucky you feel.

1	2	3	4	5	6
Strongly Disagree			Strongly Agree		

12. Luck is nothing more than random chance.

1	2	3	4	5	6
Strongly Disagree			Strongly Agree		

Positive and Negative Affect Schedule (luck embedded)

This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate how you currently feel. Use the following scale to record your answers:

Interested	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Distressed	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Excited	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Upset	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Strong	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Guilty	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Scared	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Hostile	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Enthusiastic	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Lucky	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Irritable	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Proud	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Alert	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Ashamed	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Inspired	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Nervous	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Determined	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Attentive	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Jittery	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Active	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely
Afraid	Very slightly/not at all	A little	Moderately	Quite a bit	Extremely

Problem Gambling Severity Index-9

Instructions: THINK ABOUT THE LAST 12 MONTHS and tell us, as truthfully as you can, about your gambling. Some of the items may not seem to apply to you. In this case, please answer 1 (for 'Never').

1. Have you bet more than you could really afford to lose?

1	2	3	4	5
Strongly Disagree			Strongly Agree	Don't Know

2. Still thinking about the last 12 months, have you needed to gamble with larger amounts of money to get the same feeling of excitement?

1	2	3	4	5
Strongly Disagree			Strongly Agree	Don't Know

3. When you gambled, did you go back another day to try to win back the money you lost?

1	2	3	4	5
Strongly Disagree			Strongly Agree	Don't Know

4. Have you borrowed money or sold anything to get money to gamble?

1	2	3	4	5
Strongly Disagree			Strongly Agree	Don't Know

5. Have you felt that you might have a problem with gambling?

1	2	3	4	5
Strongly Disagree			Strongly Agree	Don't Know

6. Has gambling caused you any health problems, including stress or anxiety?

1	2	3	4	5
Strongly Disagree			Strongly Agree	Don't Know

7. Have people criticized your betting or told you that you had a gambling problem, regardless of whether or not you thought it was true?

1	2	3	4	5
Strongly Disagree			Strongly Agree	Don't Know

8. Has your gambling caused any financial problems for you or your household?

1	2	3	4	5
Strongly Disagree			Strongly Agree	Don't Know

9. Have you felt guilty about the way you gamble or what happens when you gamble?

1	2	3	4	5
Strongly Disagree			Strongly Agree	Don't Know

GENERAL ASSESSMENT (*Funnel Debriefing*)

INSTRUCTIONS: Please answer the following questions very briefly in the space provided.

1. Do you have any questions that you would like answered about the study so far? If so, what?
2. Has there been anything about the study so far that was disrupting, puzzling, or that you wondered about?
3. Please describe in your own words what you think the study is about.
4. Have you had cause to wonder whether or not there might be aspects of the study that have not been explained to you? If so, what have you had cause to wonder about?

PLEASE LET THE EXPERIMENTER KNOW WHEN YOU ARE FINISHED