Using the Strength-Energy Model and Self-Determination Theory to Examine Drinking-Related Self-Control Failure among University Students

by

Tyler M. Carey
B.A., University of Windsor, 2011
M.Sc., University of Victoria, 2013

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Abstract

Researchers adopting the strength-energy model of self-control (Baumeister et al., 1998) have suggested that taxing situations (i.e., self-control demands) exhaust a limited self-control resource and leave individuals in a state of self-regulatory fatigue known as "ego-depletion." Following the onset of ego-depletion, numerous studies have shown that individuals are more susceptible to lapses in self-control, including failure to resist alcohol consumption. Self-determination theory (SDT; Ryan & Deci, 2000) researchers have contributed to this body of research in at least two major ways. First, they have suggested that psychological need satisfaction may hold a restorative function and buffer against the ego-depleting effects of self-control demands during the day (Ryan & Deci, 2008). Second, they have empirically demonstrated that self-control resources may only be needed to execute responses involving greater controlled (CR) than autonomous (AR) regulation (Moller et al., 2006). Drawing upon each of these perspectives, the current study investigated: a) whether students reporting greater self-control demands during the day would be protected from higher levels of ego-depletion during the evening if they perceived greater psychological need satisfaction during the day, and b) whether students reporting higher levels of ego-depletion during the evening would be at greater risk of alcohol-related self-control failure at night if they reported relatively greater controlled than autonomous regulation for limiting their nighttime drinking. Two independent samples of university students were recruited during the Fall 2015 (Sample 1; n = 175) and Spring 2016 (Sample 2; n = 204) semesters. Across three (Sample 1) and four (Sample 2) week periods, students were prompted to complete measures of self-control demands and psychological need satisfaction during the day, and ego-depletion, alcohol-related self-control failure, and self-regulation for limiting alcohol consumption during the night. Using multilevel

analysis, findings revealed a positive association between self-control demands and ego-depletion. This association was moderated by psychological need satisfaction during some days of the week (Fri/Sat) more than others (Thu/Sun). Findings also revealed a positive association between ego-depletion and alcohol-related self-control failure, but only among Sample 1 participants. Findings did not implicate self-regulation as a moderator of this relationship. The applicability of the strength-energy model is discussed in relation to student drinking behaviour.

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Introduction

In a recent survey conducted by the Substance Abuse and Mental Health Services Administration (SAMHSA, 2013), researchers demonstrated that approximately 40% of college students engage in binge drinking practices on a monthly basis (defined as five or more drinks per drinking occasion). By virtue of their college enrollment status, students were also found to be at greater risk for engaging in binge drinking than same-aged peers who did not identify as full-time college students. These findings converge with a number of large-scale surveys implicating alcohol consumption as a particularly common activity among university and college student populations (e.g., Adlaf, Demers, & Gliksman, 2005; Blanco et al., 2008; Center for Behavioural Health Statistics and Quality, 2015).

Epidemiological findings have surfaced linking student drinking to deleterious outcomes in psychosocial and health-related domains (e.g., academic failure, risky sexual behaviour, illegal activity; Abbey, 2002; Perkins, 2002). In lieu of such consequences, research initiatives have been mobilized to identify risk factors associated with student drinking and associated harms. From a motivational perspective, researchers have identified momentary periods of vulnerability referred to as "self-control dilemmas" (Fishbach & Shah, 2006). Similar to Mischel and colleagues' (1989) delay of gratification or "marshmallow" paradigm, students involved in self-control dilemmas are thought to experience a tension between: (a) succumbing to alcohol temptation (a known-risk factor for student drinking; e.g., Cox et al., 2001; Marczinski, Bryant, & Fillmore, 2005) and (b) inhibiting the temptation to drink in the service of more valued long-term goals. While opting for the latter path is by no means an easy task, it is potentially an important one that may thwart negative consumption patterns and associated individual and/or societal consequences. It is necessary, therefore, to understand the conditions under which

students are more likely to fail versus succeed at exercising self-control over alcohol consumption.

Although individual differences have been found to impact self-control (e.g., Tangney, Baumeister, & Boone, 2004), transient or situational factors – such as a person's experience of self-regulatory fatigue – have also been implicated as important precursors of self-control failure (e.g., Hagger, Wood, & Chatzisarantis, 2010; Muraven, Gagné, & Rosman, 2008). Drawing upon this body of research, the current discussion begins with an exploration of the relationship between situational perceptions of self-regulatory fatigue (i.e., ego-depletion) and self-control failure. Specifically, a large body of research is reviewed within the context of Baumeister and colleagues' strength-energy model of self-control (e.g., Baumeister, Bratslavsky, Muraven, & Tice, 1998; Muraven & Baumeister, 2000).

The Strength-Energy Model of Self-Control

From a strength-energy model perspective, self-control is conceptualized as a process in which individuals intentionally alter their responses or inner states in a goal-directed manner (Baumeister, Schmeichel, & Vohs, 2007). This process is often presumed to involve the down-regulation of immediately gratifying responses (e.g., intake of alcohol, high caloric foods, etc.) in the service of distal goals that yield less momentary pleasure but more adaptive long-term gain (Muraven & Baumeister, 2000). Notably, this conceptualization implies that self-control may be an arduous and taxing process – at least in relation to the alternative possibility of yielding to pre-potent desires. High rates of binge-drinking, overeating, risky sexual behavior, aggression, and various other "problems of volition" provide an indication of just how difficult it may be to exercise self-control in the face of competing desires (Pervin, 1991). In an effort to protect against these public health concerns, researchers adopting the strength-energy model have

focused extensively on trying to identify situations in which people may be more susceptible to lapses of self-control.

Baumesiter and his colleagues suggested that self-control success at any given moment in time depends on the availability of limited self-control resources (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister & Heatherton, 1996; Baumeister, Vohs, & Tice, 2007; Muraven & Baumeister, 2000). Elaborating further, Baumeister and his colleagues suggested that: a) because acts of self-control expend a limited resource, individuals may have a temporarily diminished reserve of the resource after exercising self-control; b) after the limited resource has been partially (or fully) expended, individuals may be less effective at subsequent acts of self-control; c) the same limited resource is used for a wide variety of self-control tasks; thus, exerting self-control in one situation (i.e., resisting high caloric foods) may impair a person's capacity to exert self-control in a completely unrelated context (i.e., resisting an alcoholic beverage); and d) after the resource is depleted, replenishment may occur under a variety of favorable conditions; if the environment does not present favorable (i.e., replenishing) conditions, individuals may be chronically impaired at exercising self-control.

Muraven and Baumeister (2000) described these propositions as having been highly influenced by Freud's (1923, 1957) theory of repression and economic model of the mind. Specifically, they credited Freud with championing ideas about needing a limited psychic energy for controlling socially deviant and deplorable impulses. Ryan and Deci (2008) also noted similarities between Muraven and Baumeister's strength-energy model and Selye's (1975) notion of *adaptive energy*. In particular, they indicated that Selye viewed adaptive energy as a limited resource, distinct from caloric energy, and capable of being applied in response to both psychological and physical stressors. As noted by Ryan and Deci, Selye believed that adaptive

energy could be drained after prolonged exposure to physical and/or psychological demands, subsequently leading to impaired coping and immunological responses.

Energy-based models of self-control failure seem to make intuitive sense in the context of temporal patterns throughout the day. As noted by Baumesiter (2002), “Hardly anyone gets up and breaks a diet first thing in the morning” (p. 673). Instead, people seem increasingly vulnerable to lapses in self-control after long and taxing days involving the accumulation of self-control demands (e.g., waking up earlier than desired; skipping pastries on the way into work; working later to finish a strenuous task; etc.). As discussed below, evidence in support of the strength-energy model also extends well beyond the diurnal cycle of everyday life. While the model is not without its skeptics (e.g., Inzlicht, Schmeichel, & Macrae, 2014), it has received a wealth of empirical support among researchers seeking to evaluate its underlying veracity.

Within laboratory and experimental settings, researchers have frequently tested the strength-energy model using a “dual-task paradigm” (see Hagger, Wood, Stiff, & Chatzisarantis, 2010 for a review). This paradigm involves randomly assigning one group of participants to engage in an initial self-control task before examining whether or not their performance on an unrelated, follow-up self-control task is impaired relative to controls who do not get exposed to the initial self-control task. This experimental procedure was adopted by Baumeister, Bratslavsky, Muraven, and Tice (1998, Experiment 1), who first instructed participants to skip a meal before arriving at the laboratory. Upon arrival, participants were randomly assigned to one of three groups. Participants in the first group were exposed to separate dishes containing radishes and desserts (i.e., cookies and chocolates), and instructed to abstain from eating the desserts, but not the radishes. Participants in the second group were exposed to the same dishes, but without restrictions imposed upon which foods they were allowed to eat. Lastly, participants

in the third group did not receive any exposure to food items at all. Baumeister and his colleagues predicted that participants in the first group would show impaired performance on a subsequent self-control task after being taxed from initial self-control demands (i.e., abstaining from cookies and chocolate). Baumeister and his colleagues found that participants in the first group were able to abstain from the cookies and chocolate with a 100% success rate; however, as predicted, these individuals gave-up significantly faster than both the unrestricted and control participants during a follow-up self-control task assessing behavioral persistence (i.e., unsolvable geometric puzzles). These findings were interpreted as lending support to the strength-energy model of self-control.

As noted by Baumeister (2003), these effects also seem to generalize to self-control tasks demanding restraint over alcohol consumption. Specifically, Baumeister referred to a study conducted by Muraven, Collins, and Nienhaus (2002) involving the manipulation of self-control resources among 58 male social drinkers. Within this study, participants in the experimental group were instructed to engage in the well-known "white bear" thought suppression exercise (see Wegner, 1989; Wegner, Schneider, Carter, & White, 1987), which has been shown in previous research to deplete self-control resources (e.g., Muraven, Tice, & Baumeister, 1998; Tice, Baumeister, Shmueli, & Muraven, 2007). In contrast, participants in the comparison group were instructed to engage in an arithmetic exercise requiring well-learned knowledge and minimal self-control requirements. All participants in the study were later expecting to perform a driving simulation task; thus, motivation for limiting alcohol consumption was manipulated to be strong across both conditions. Before engaging in the driving simulation task, participants were presented with an opportunity to sample a variety of alcoholic beverages. Findings showed that participants in the demanding (thought suppression) condition consumed more alcohol than

participants assigned to the arithmetic group. Notably, these findings were later replicated in a study adopting a similar manipulation of self-control resources (Christiansen, Cole, & Field, 2012). Specifically, Christiansen and colleagues found that increased rates of alcohol consumption were more common among participants instructed to engage in emotional and thought suppression task (i.e., during an evocative film) relative to a control group with no such constraints.

In another alcohol-related study, Muraven and Shmueli (2006) recruited 160 social drinkers before randomly assigning participants to smell either a cup of water or an alcoholic beverage. They hypothesized that social drinkers exposed to the sight and smell of the alcohol beverage (and not drinking it) would exhibit compromised performance on two follow-up self-control tasks (i.e., squeezing a handgrip and a self-stopping task) relative to social drinkers exposed to the sight and smell of water. Findings lent support to this hypothesis. In particular, follow-up performance on tasks requiring self-control was significantly worse among social drinkers with strong trait temptation to drink who were exposed to alcohol cues compared to: a) social drinkers with weak trait temptation to drink who were exposed to alcohol cues, and b) social drinkers exposed to water. Findings were interpreted as suggesting that restraint from *strong* alcohol temptations among participants with high trait temptation to drink results in the greatest expenditure of limited self-control resources and impairment on subsequent self-control performance.

Taking a different methodological approach, Muraven, Collins, Shiffman, and Paty (2005) used an ecologically valid momentary assessment technique to investigate the link between self-control demands and alcohol consumption in naturalistic settings. Findings from this study showed that self-imposed restrictions on alcohol consumption were violated more

frequently on days that accompanied greater self-control demands. Not surprisingly, the impact of experiencing greater self-control demands on alcohol consumption was more pronounced when participants actually endorsed some desire to restrict their alcohol intake. Taken together, these results converge with findings from other studies to suggest that expenditure of self-control resources (i.e., even during seemingly unrelated tasks) results in less effective control during subsequent attempts at limiting alcohol consumption. Indeed, this growing body of research lends further support to the strength-energy model of self-control and its specific application to drinking behaviour.

A Self-Determination Theory Perspective of Regulation

Despite its strong following and wealth of empirical support, the resource model of self-control is not without its shortcomings. For example, self-determination theory (Ryan & Deci, 2000) researchers have suggested that different forms of regulation may maintain or even enhance limited resources rather than deplete them (e.g., Moller, Ryan & Deci, 2006; Ryan & Deci, 2008). From this perspective, self-control resources may not always be required to execute motivated behaviours.

Self-determination theory offers a useful framework for understanding the heterogeneous and multiple forms of regulation underlying motivated behaviours. According to Ryan and Deci, these regulations exist along a continuum ranging from controlled regulations to autonomous regulations (see Fig. 1). The specific forms of regulation displayed along the continuum include: (1) external regulation, (2) introjected regulation, (3) identified regulation, and (4) integrated regulation.

***Controlled forms of regulation*.** The most controlled form of regulation on the continuum corresponds to external regulation (Deci & Ryan, 2000). In accordance with

principles of operant conditioning (e.g., B. F. Skinner, 1953), externally regulated responses are executed only as a means to attain some reward or to avoid some punishment (Deci & Ryan, 2000). Because these responses are executed without a full sense of personal endorsement or willingness to act, they are unlikely to persist after reinforcement contingencies have been lifted from the environment. For example, a college student may limit their drinking at a bar only to avoid possible charges or physical injury that might accompany driving under the influence. If this student were accompanied by a designated driver next time, he or she may engage in binge drinking since punishment contingencies (i.e., incarceration, physical injury, etc.) would no longer be relevant.

The second form of controlled regulation on the continuum corresponds to introjected regulation. Actions involving introjected regulation are performed to either (a) avoid an internal sense of guilt that would otherwise follow from failing to execute or inhibit the response, or (b) obtain an internal sense of pride. In these instances, behavioural contingencies can be considered as existing within the individual instead of in the external environment (as is the case with external regulation). Although introjected regulations reside within individuals, however, Deci and Ryan (2000) suggest that they are *"…still relatively external to the self"* (p. 236). Since motivated behaviours involving this form of regulation are not executed with a full sense of volition or personal endorsement, they are not perceived as originating from the self (deCharms, 1968).

Introjected regulation may be discerned among students who base their self-worth, in part, on their ability to moderate and/or limit alcohol consumption (Ryan & Brown, 2003; Ryan & Deci, 2000). In such instances, the primary motivation for limiting alcohol consumption becomes trying to protect, maintain, or enhance self-esteem. Instead of personally endorsing the

importance of limitation, students adopting this form of regulation may experience a strong compulsion and/or sense of pressure to restrict their intake.

Autonomous forms of regulation. The remaining forms of regulation along the continuum are autonomous and involve deeper internalization of drinking goals (e.g., limiting alcohol consumption). As noted by Ryan and Deci, motivated behaviours involving autonomous forms of regulation are experienced as self-determined (Ryan & Deci, 2000). This phenomenon, referred to as "internal perceived locus of causality" (deCharms, 1968; Heider, 1958), is important to feeling like the source or "origin" of one's own actions.

Within the SDT framework, identified and integrated regulations are classified as distinct types of autonomous self-regulation. With regard to identified regulation, goal-directed behaviours are perceived as personally important and enacted with some sense of personal endorsement or volition (Ryan & Deci, 2000). Integrated regulations, however, involve a deeper internalization of goals relative to identified regulations. In particular, partially internalized goals that were formerly valued (i.e., identification) become fully assimilated (i.e., integrated) into the very core or essence of one's self-concept (Ryan, 1995). Goal-congruent behaviours are viewed not only as personally important, but also as expressions of the self (Deci, Eghrari, Patrick, & Leone, 1994). Autonomous regulation may be evidenced by a student who limits drinking at a party because of an important athletic competition or exam the following day. In this example, the student may experience his acts of limitation as personally important or congruent with his identity as an outstanding athlete or scholar.

Regulation and resource depletion. As discussed by Ryan and Deci (2008), researchers have waged considerable debate about how autonomous and controlled forms of regulation relate to resource depletion and subsequent self-control performance. Unlike controlled forms of

regulation, which are generally viewed as effortful and taxing on self-control resources, Ryan and Deci suggest that controversy has primarily focused on the relationship between autonomous forms of regulation and resource depletion. In their review of the literature, Ryan and Deci described a seminal study conducted by Baumeister and colleagues (1998; Study 2) as the impetus for this debate.

As discussed by Ryan and Deci, Baumeister and his colleagues randomly assigned participants to either a "No Choice," "High Choice," or control condition. Within the No Choice condition, participants were told to deliver a speech arguing in favor of raising tuition. Alternatively, participants in the High Choice group were told they could deliver a speech arguing for or against tuition increases, but that "it would help the study a great deal if they chose to read one folder rather than the other" (p. 1257). The control condition was not asked to read a speech.

Following the manipulation stage of their experiment, Baumesiter and colleagues asked participants to engage in a behavioural persistence task. Specifically, participants were asked to trace a series of geometric figures without lifting their pencil (tasks were purposely designed to be impossible). Their findings showed participants in the High Choice group gave-up significantly quicker than participants in the No Choice and control conditions. As noted by Ryan and Deci, these findings seemed to suggest that choice making, a hallmark of autonomously regulated action, contributes toward resource depletion and subsequent self-control impairment. Rejecting this interpretation, however, Ryan and Deci noted an important flaw residing within the manipulation used to establish the High Choice condition. Specifically, Ryan and Deci noted that they would have expected participants in the "High Choice" group to perceive instructions as controlling rather than autonomy-supportive, since a similar

manipulation had been used in previous research to induce an external perceived locus of causality (Pittman, Davey, Alafat, Wetherill, & Kramer, 1980).

Years later, Moller, Deci, and Ryan (2006) conducted what "was virtually a direct replication" of Baumeister and colleague's (1998, Study 2) investigation on choice-making and resource depletion. This time, however, Moller and his colleagues conceptualized choice as accompanying a qualitative split along the dimension of whether participants viewed themselves as: a) truly volitional (autonomous choice) or, b) coerced by others (controlled choice). Moller and his colleagues established their "controlled choice" condition by adopting Baumeister and colleague's "high choice" manipulation, which, as previously discussed, involved an element of coercion. Conversely, Moller and his colleagues established their "autonomous choice" condition by informing participants "that it was entirely up to them which side of the debate they would choose to argue so they could take their time to think about it and then make a choice" (p. 1028). After participants finished delivering their speeches, they were asked to engage in the same self-control task used by Baumeister and colleagues involving unsolvable geometric puzzles. Interestingly, findings showed that participants who made autonomous choices persisted longer on unsolvable geometric puzzles relative to participants who made controlled choices. Moller and his colleagues used this evidence to qualify the conclusions of Baumesiter and his colleagues regarding choice-making and resource depletion. Specifically, Moller and his colleagues suggested that choice-making may not always be depleting of self-control resources; rather, some choices (i.e., those involving controlled regulation) are significantly more depleting of self-control resources than others (i.e., those involving autonomous regulation).

Fortunately, additional studies have been conducted to help clarify this debate. In a novel extension of Baumeister and colleagues (1998) "chocolate-and-radish experiment," Muraven

(2008) sought to examine how different types of regulation moderate the association between initial self-control demands and performance on a follow-up self-control task. During this study, three plates of cookies were presented in front of a group of 82 participants. Participants were then given the following instruction: “We need people in the cookie and no cookie condition, but we especially need people in the no cookie condition. The choice is entirely yours, but we would really appreciate it if you would not eat the cookies.” (p. 3). Only 3 of 82 participants chose to eat at least one cookie. Among the remaining 79 participants, performance on a follow-up self-control task was assessed using a commonly employed handgrip task. On average participants let go of the handgrip quicker after resisting the cookies (61.7 seconds) relative to a pre-task (baseline) handgrip assessment (74 seconds). Interestingly, participants who had relatively more autonomous reasons for resisting the cookies persisted longer on the handgrip task (i.e. relative to their baseline performance) compared to participants who endorsed more controlled reasons for resisting the cookies. Muraven interpreted these findings as suggesting that acts of self-control that involve relatively more autonomous regulation expend fewer self-control resources and prevent subsequent self-control failures.

In another study, Nix, Ryan, Manly, and Deci (1999) assigned participants to one of two conditions involving the Wisconsin Card Sorting Task (WCST). Participants assigned to the first condition were instructed to complete the WCST in a self-directed manner, while participants assigned to the second condition were told to complete the WCST in accordance with an assigned order “based on how someone else chose to sort the cards” (p. 274). This manipulation was intended to cause participants in conditions 1 and 2 to experience internal or external perceived locus of causality, respectively (DeCharms, 1968). In each condition, Ryan and Frederick’s (1997) measure of subjective vitality was administered to participants before and

after completion of the WCST. This measure assesses participants' sense of feeling alive and full of energy. Results showed significant pre-post deterioration in the subjective vitality of participants assigned to the second condition (i.e., who were purposely deprived of agency and initiative during the WSCT), whereas no such drop-off was observed among participants in the first condition (i.e., who were instructed to complete the WSCT in a self-directed manner). These findings were interpreted as suggesting that controlled regulations trigger resource depletion and self-regulatory fatigue, whereas autonomous regulations do not. Although self-control was not assessed on a follow-up task, it is reasonable to speculate that the self-regulatory fatigue experienced by those in the controlled regulation (second) condition would have compromised performance on any subsequent activity (e.g., persistence on an unsolvable anagram task).

Psychological needs and resource depletion. Findings reviewed above suggest that exerting self-control for autonomous reasons may maintain or even enhance energy relative to exerting self-control for controlled reasons, which depletes it. Despite accumulating evidence in support of this idea, questions remain about the underlying processes explaining *why* different regulatory styles seem to be associated with varying levels of energy (i.e., resources) available to the self. This question is explored next by examining theory and research examining the replenishing function of psychological needs.

When individuals' psychological needs are being satisfied, they view themselves as origins of their behaviour (autonomy), meaningfully connected to others (relatedness), and capable of completing challenging tasks (competence) (Baumeister & Leary, 1995; Deci, 1975; Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; White, 1959). As noted by Ryan and Deci (2008), need satisfaction may have an important function with respect to influencing perceptions of energy available to the self (Ryan & Deci, 2008). In particular, Ryan and Deci stated that, "[…]

insofar as vitality represents energy available to the self, psychological nutriments to the self should enhance energy – that is, they should make energy more available to the self." (p. 711). This proposition has been corroborated within empirical research linking subjective vitality to psychological need support (Kasser & Ryan, 1999) and need satisfaction (Ryan & Frederick, 1997).

Muraven and his colleagues have been instrumental in showing how need supportive conditions of the environment may influence the amount of energy available to the self for subsequent acts of self-control (e.g., Muraven, 2008; Muraven, Gagné, & Rosman, 2008; Muraven, Rosman, & Gagné, 2007). In a series of three studies, Muraven and colleagues (2007) demonstrated that participants who were offered performance-contingent rewards during initial self-control tasks performed worse on subsequent tasks of self-control, relative to participants who were not offered conditional rewards (Studies 1 and 2). They then tested a theoretically informed mediation hypothesis, and found that decreased perceptions of autonomy partially explained why participants in conditional rewards group performed worse on subsequent self-control tasks (Study 3). Muraven and his colleagues suggested that by experiencing less need satisfaction, participants in the conditional reward group may have been deprived of the energy needed for successful self-control performance.

Approximately one year later, Muraven, Gagné, and Rosman (2008) conducted a series of investigations examining self-control performance in different social contexts. Their findings revealed that participants who exerted self-control within a need-supportive context performed significantly better on a subsequent task assessing concentration and vigilance (i.e., executive control). Additionally, Muraven and his colleagues found that improved self-control performance among participants in need supportive environments was mediated by enhanced subjective

vitality. Drawing upon relevant theory and research (Ryan & Deci, 2000, 2008; Moller, Deci, & Ryan, 2006), Muraven and colleagues interpreted their findings as suggesting that conditions of the social context influenced participants' need satisfaction and overall energy for later self-control performance.

The Current Study.

The current study represents the first available attempt to unite Baumeister and colleagues' (1998) strength-energy model and Ryan and Deci's (2000) self-determination theory within the context of an applied student drinking model (Fig. 2). Influenced by each of these perspectives, I first examine whether need satisfaction during the day moderates the association between exposure to self-control demands during the day and ego-depletion later in the evening. Second, I examine whether the type of self-regulation endorsed by students for limiting nighttime drinking moderates the association between ego-depletion and self-control failure at night. Based on existing self-determination theory and ego-depletion research, I propose the following two interaction hypotheses:

Hypothesis 1 (H1): Self-control demands during the day will be positively associated with ego-depletion at the end of the day, only when students experience lower levels of need satisfaction during the day.

Hypothesis 2 (H2): Levels of ego-depletion at the end of the day will be positively associated with drinking self-control failure (i.e., discrepancy between self-imposed drink limits in the evening and self-reported consumption in the morning), only when students report greater controlled than autonomous forms of regulation for limiting alcohol consumption.

Each of the above hypotheses are tested using independent samples recruited during the Fall 2015 (Sample 1) and Spring 2016 (Sample 2) academic semesters. Among the main benefits associated with this design are (a) the ability to conduct replication analyses using data collected during the Fall 2015 and Spring 2016 semester and (b) the ability to control for systematic variation in student drinking at different points during the academic year (e.g., Barnett, Orchowski, Read, & Kahler, 2013; Del Boca, Darkes, Greenbaum, & Goldman, 2004; Tremblay et al., 2010). Each of the above hypotheses are also tested using an ecologically valid daily diary methodology (e.g., Bolger, Davis, & Rafaeli, 2003; Delongis, Hemphill, & Lehman, 1992). By stepping outside of the laboratory setting (e.g., dual-task paradigm), this study adds to a relatively small body of research examining ego-depletion (and related phenomena) within real-life settings (see Hofmann, Vohs, & Baumeister, 2012; Muraven, Collins, Shiffman, & Paty, 2005 for notable exceptions).

Method

Participants

Sample 1. Participants were 175 undergraduate students from the University of Victoria. The majority of participants identified as female (85%), Caucasian (76%), and younger than 23 years of age (88%). With regard to drinking characteristics, 23 participants (13%) abstained from alcohol across all occasions. Among non-abstainers, the average rate of alcohol consumption across all days fell within the range of 1-2 standard drinks. When drinking statistics were examined at the daily level, findings revealed that most evenings (71%) did not accompany any alcohol consumption (see Table 1).

Sample 2. Participants were 204 undergraduate students from the University of Victoria. The majority of participants identified as female (76%), Caucasian (63%), and younger than 23 years of age (86%). With regard to drinking characteristics, 30 participants (15%) abstained from alcohol across all occasions. Among non-abstainers, the average rate of alcohol consumption across all days fell within the range of 1-2 standard drinks. When drinking statistics were examined at the daily level, findings revealed that most evenings (71%) did not accompany any alcohol consumption (see Table 1).

Procedure

Using a daily diary methodology, participants were assessed during the Fall 2015 (October-November) and Spring 2016 (March-April) academic semesters. Independent samples were recruited during each semester using the University of Victoria online SONA System. Participants in each sample were asked to complete a pre-survey, a longitudinal diary component, and a post-survey. Each of these study components are described in greater detail below.

Pre-Survey. Following online registration, participants were invited into the laboratory to provide informed consent and complete a brief demographic pre-survey. During the informed consent stage, participants were provided with information about the potential risks and benefits associated with participation, as well as issues related to anonymity, confidentiality, and compensation (i.e., bonus course credit). Participants were specifically alerted to the possibility of experiencing mild distress resulting from increased awareness of drinking behaviour. Due to the highly sensitive nature of drinking data, participants were also notified that responses would be analyzed anonymously and stored on a secure server. After the informed consent stage, participants were invited to complete an online pre-survey assessing trait levels of self-control and demographic variables such as age, gender, ethnicity, height, and weight.

At the end of the pre-survey, participants were given details about the longitudinal requirements of each study and provided with an opportunity to ask questions. Before leaving the laboratory, participants were asked to check their University of Victoria and/or alterative e-mail account(s) for mandatory reminders about each measurement occasion. Participants were also given the option of receiving text-messaging prompts on their mobile devices. Notably, text messaging prompts were provided in addition to, but not in place of e-mail reminders. The study link and URL were embedded within each text and e-mail reminder to facilitate efficient access to daily questionnaires during each measurement occasion.

Daily Surveys. A repeated measures design was implemented to assess participants across four weeks of assessment during the Fall 2015 (Sample 1) and Spring 2016 (Sample 2) academic semesters (Fig. 3).[1] During each week of assessment, participants were asked to complete morning and evening surveys on Thursday, Friday, Saturday, and Sunday. Starting on

[1] There was a technical problem for Sample 1 participants during the fourth week of assessment. Only data collected during the first three weeks of the Spring 2015 semester were analyzed.

Thursday evening, participants were invited to complete an online survey assessing: a) self-control demands from earlier in the day, b) need satisfaction from earlier in the day, b) current levels of ego-depletion, c) limit intentions for the upcoming night, and d) reasons for limiting alcohol consumption for the upcoming night (i.e., self-regulation). The following Friday morning, participants were asked to report their alcohol consumption from Thursday night. This procedure was then repeated on Friday evening and Saturday morning, Saturday evening and Sunday morning, and Sunday evening and Monday morning.

Evening assessments were scheduled to occur between 4:00pm-7:00pm, with the hope that most participants would not yet be intoxicated at this early stage of the night.[2] Morning assessments occurred between 6:00am and 11:00am for Sample 1 and 6:00am and 1:00pm for Sample 2. The morning timeframe for Sample 2 was adjusted to remain open for an additional 2 hours because Sample 1 participants provided feedback indicating that they would have preferred if morning surveys were available later into the afternoon so that they could sleep-in and still complete questionnaires.

Post-Survey. Following the final weekend of assessment, participants were invited back to the laboratory to complete a brief post-survey. During this session, students were debriefed about the purpose of the study, and prompted for questions, comments, or concerns. Participants were given the opportunity to provide feedback within the online survey itself, and in conversation with the research team. To attend to potential harms that may have surfaced because of participation (i.e., mild distress resulting from increased awareness of drinking behavior), participants were directed to a web-page containing the contact information of University of Victoria Student Counselling Services. Before leaving the laboratory, participants

[2] A pilot study conducted before daily diary investigations showed that most students begin drinking at 8:00pm.

were thanked for their involvement and provided with written confirmation of the number of credits they earned throughout the study

Measures

Self-Control Demands. A 4-item measure of self-control demands was adapted from one of the few available studies exploring the impact of self-control demands on alcohol consumption outside of the laboratory setting (Muraven, Collins, Shiffman, & Paty, 2005). Indeed, it has been more commonplace to manipulate self-control demands in laboratory settings by subjecting participants to effortful self-control tasks (e.g., the Stroop task; emotional or thought suppression tasks; etc.). During the late afternoon / early evening, participants were asked to reflect upon their experiences from earlier in the day. Subsequently, participants were asked to rate how often they (a) suppressed their thoughts, (b) controlled their mood, (c) dealt with stress, and (d) felt overwhelmed. Participants provided ratings along a 9-point Likert scale ranging from 1 (*not at all*) to 9 (*almost always*). Responses were averaged across all 4 items to create mean scores representing daily self-control demands.

Need Satisfaction. During the late afternoon / early evening, participants were asked to reflect upon their experiences from earlier in the day. Subsequently, participants were asked to respond to items on the Balanced Measure of Psychological Needs (BMPN; Sheldon & Helpert, 2012). The BMPN included 6 items corresponding to each psychological need outlined within SDT. While each item grouping (i.e., for each need) could be further divided into 3 positively and negatively keyed items, only positively keyed items were used in the computation of need satisfaction total scores[3] – e.g., *"Today I felt close and connected with other people who are*

[3] A multilevel confirmatory factor analysis was conducted using EQS software. Findings revealed a clear distinction between positively and negatively keyed items, suggesting that negatively keyed items may not be measuring the construct of need "satisfaction." Three negatively keyed items were dropped for each need.

important to me" (relatedness), *"Today I took on and mastered hard challenges"* (competence), and *"Today I was really doing what interests me*" (autonomy). Responses to each item were provided along a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

Ego-Depletion. In the context of the dual-task paradigm, ego-depletion has typically been inferred from performance decrements on follow-up self-control tasks. Accordingly, ego-depletion has yet to be extensively studied outside of the laboratory setting using well-established self-report questionnaires. Given the lack of publicly available self-report measures, ego-depletion was assessed using the 6-item version of the Subjective Vitality Scale (SVS; Ryan & Frederick, 1997).[4]

Ryan and Frederick have conceptualized subjective vitality as the positive feeling of having energy available to the self (i.e., having energy that can be harnessed or used to aid in acts of self-regulation). Additionally, they distinguished subjective vitality from high activation states, such as anxiety, that cannot be cultivated or used in the same way to facilitate self-regulation (see Thayer, 1989 for a similar distinction between calm and tense energy). Recognizing these conceptual features, Martela, DeHaan, and Ryan (2016) considered subjective vitality as the polar "opposite" of ego-depleted states involving diminished energy and compromised ability to self-regulate (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Muraven & Baumeister, 2000). In accordance with this reasoning, low scores on the SVS were used to operationalize the construct of ego-depletion. While other researchers have operationalized ego-depletion as reflecting low levels of subjective vitality (e.g., Juhl & Routledge, 2015; McFadden, Rogers, Berry, & Murray, 2014), this practice is not yet commonplace within the literature.

[4] See Bostic, Rubio, & Hood (2000) for a psychometric analysis of the 7-item version of the SVS. Their findings show poor unidimensional fit when the seventh (negatively-keyed) item is retained.

During the late afternoon / early evening, participants were administered the SVS and asked to reflect upon their current feelings of aliveness and energy. Sample items on the SVS included: "*I feel alive and vital", "I feel energized*", and *"I feel awake and alert."* Responses were provided along a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Responses were averaged across all 6 items to create mean scores representing daily subjective vitality. Mean scores were then reverse scored prior to analysis.

Self-Regulation. Self-regulation for limiting alcohol consumption was assessed using a modified version of the Treatment Self-Regulation Questionnaire (TSRQ; Williams, Grow, Freedman, Ryan, & Deci, 1996) adapted to the specific context of drinking behavior. During the late afternoon / early evening, participants were asked to consider the reasons why they might limit their alcohol consumption for the upcoming night. Using a 7-point Likert scale (1=strongly disagree; 7 = strongly agree), participants were then asked to respond to 17 items assessing: controlled regulation – e.g., "*…because others would be upset with me if I did not limit my alcohol use*" (7 items), autonomous regulation – e.g., "*…because limiting my alcohol use is consistent with my personal goals and values*" (7 items), and non-regulation – e.g., "*…I don't see the point in trying to limit my alcohol use tonight*" – (3 items).

Since it is possible to endorse both controlled (i.e., external and introjected regulation) and autonomous (i.e., identified and introjected regulation) reasons for the same behaviour, A Relative Controlled Regulation (RCR) score was computed to assess the proportion of controlled to autonomous regulation for limiting alcohol consumption. This index score was computed by subtracting controlled regulation scores from autonomous regulation scores, with higher scores represented a greater proportion of controlled relative to autonomous regulation for limiting alcohol consumption. Consistent with a large body of self-determination theory research (e.g.,

Grolnick & Ryan, 1987; Lynch, Plant, & Ryan, 2005), items assessing non-regulation were omitted from the computation of the relative index score. Additionally, weighted values were not assigned to different types of regulation prior to computing the relative index score. While this practice has been commonplace in the literature, Chemolli and Gagné (2014) have cautioned against using a weighting procedure that (problematically) assumes the organization of regulations using a continuum structure.

Self-Control Failure. Self-control failure was operationalized as the difference between (1) a participant's self-imposed drinking limit for the upcoming night (Drinking Limit) and (2) a participant's alcohol consumption during the night, as self-reported the following morning (Alcohol Consumption). Positive difference scores were therefore indicative of greater self-control failure, whereas negative difference scores were indicative of (over-)compliance (i.e., over-control) of drinking limits.

To assess drinking limits, participants were asked during the late afternoon / early evening to indicate their intended limit (i.e., maximum number of drinks) for the upcoming night. In increments of 1-2 standard drinks, response options were provided using the following 7-point Likert scale (0 = none: 1 = 1-2 standard drinks, 2 = 3-4 standard drinks; 3 = 5-6 standard drinks; 4 = 7-8 standard drinks; 5 = 9-10 standard drinks; 6 = more than 10 standard drinks). While it was also possible for participants to select options of, "*I don't know*" or "*I don't care*," these responses were coded as missing data in the final analyses to maintain a continuous scale. A conversion table was provided to assist participants in translating their evening drinking limits into standard drink format.

The following morning, alcohol consumption was reported by participants in terms of the number of standard drinks they consumed during the previous night. Response options were

provided along the same 7-point Likert scale noted above. While it was also possible for participants to select options of, "*I don't know*" or "*I don't remember*," these responses were coded as missing data in the final analyses to maintain a continuous scale. A conversion table was once again provided to assist participants in translating their nighttime alcohol consumption into standard drink format.

Analytical Strategy

Due to the nested structure of the data, Hierarchical Linear Modelling, 6th Edition (HLM6) and R Statistics were used to analyze the data within a multilevel modelling (MLM) framework. An MLM approach was used to account for potential statistical confounds resulting from dependency within the dataset. Unlike the traditional ordinary least squares (OLS) approach, MLM software can test for, and appropriately handle dependency within the observed dataset. In the presence of any such dependency, parameter coefficients derived using an OLS approach may lead to artificially inflated estimates, high false positives (i.e., Type 1 error), and poor replicability of findings (Kreft & de Leeuw, 1998). Additionally, patterns of association between variables may vary in valence and/or magnitude depending upon the level of analysis under consideration (e.g., day-level, person-level, etc.). Among the main virtues of MLM is the ability to test for different patterns of association at, or between separate levels of analysis.

In all statistical analyses, morning assessments of alcohol consumption were combined with evening measures from the previous day. For example, Friday morning assessments were combined with Thursday evening measures to form Thursday data; Saturday morning assessments were combined with Friday evening measures to form Friday data; Sunday morning assessments were combined with Saturday evening measures to form Saturday data; and Monday morning assessments were combined with Sunday evening measures to form Sunday data. After organizing the dataset using this structure, multilevel (mixed effects) models were tested using HLM software and R Statistics ("lme4" package; Bates, Maechler, Bolker, & Walker, 2014). Maximum likelihood estimation (MLE) was used as the primary method of estimation, and significance testing of fixed effects was performed using Wald-tests and a Satterwaite

approximation for degrees of freedom. All level-1 predictors were person-mean centered to isolate unique within-person sources of variation (see Hoffman & Stawski, 2009).

Preliminary analyses were conducted first to examine descriptive statistics, missing data patterns, and the mediational base model (i.e., linking self-control demands during the day and alcohol-related self-control failure at night via ego-depletion). Each of the primary moderation hypotheses were then tested within the context of four sub-models accounting for effects related to the day of the week (level 1), week of assessment (level 1), gender (level 2), and age (level 2). It was viewed as extremely important to account for these effects to ensure that theoretical conclusions would not be obfuscated by temporal (i.e., day of the week; week of assessment) and/or demographic variables (i.e. gender; age). Indeed, there is considerable evidence to suggest that constructs such as need satisfaction, ego-depletion, and alcohol consumption vary as a function of temporal and/or demographic variables (e.g., Casswell, Pledger, & Pratrap, 2002; Del Boca, Darkes, Greenbaum, and Goldman; Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; Tremblay et al., 2010; Wilsnack, Vogeltanz, Wilsnack, & Harris, 2000).

Although multiple models were examined controlling for temporal and demographic covariates, a Bonferroni correction was not implemented due to the high degree of dependency between each of the separate tests. In essence, the same two hypotheses were tested multiple times, accounting for temporal and demographic covariates in separate models. Since the Bonferroni correction is not able to account for the correlation structure between highly dependent tests, it can yield an “overcorrection” and drastically reduce statistical power in such cases (see Garcia 2004).

Results

Descriptive Findings and Variance Partitioning

Unconditional models were specified for each construct to examine grand means across all participants and all occasions. Similarly, unconditional models were specified for demographic subgroups to extract group means for different genders and age categories (see Table 2 for a summary). Intraclass correlation coefficients (ICC's) were also computed to quantify the proportion of between-person variance (τ) relative to the total variance ($\sigma^2 + \tau$). These variance estimates were particularly useful toward justifying the application of an MLM approach, since ICC's in the range of .01 – .10 have been shown to invalidate hypotheses tests when OLS regression is used (e.g., Kreft & de Leeuw, 1998). Descriptive findings are summarized in Table 2.

Missing Data Patterns

Missing data patterns were explored to examine whether missing responses were related to alcohol-related variables (i.e., alcohol consumption; drinking limits) in the observed Sample 1 and Sample 2 datasets. Two missing data analyses were conducted. The first analysis examined whether students missed a greater number of evening responses on nights when they consumed more alcohol, while the second analysis tested whether students missed a greater number of morning responses following nights when they set higher Drink Limits.[5] Findings pertaining to each of these analyses are presented below for Samples 1 and 2 datasets.

Missing Data during the Evening. A dichotomous outcome variable was created, representing the presence (1) versus absence (0) of missing data on at least one variable assessed during the evening. A total of 633/2100 (30%; Sample 1) and 854/3264 (26%; Sample 2) cases

[5] While missing responses during the morning may also be related to evening Alcohol Consumption, this pattern could not be assessed since Alcohol Consumption was assessed during the morning.

were identified as containing missing data on at least one variable assessed during the evening. To examine whether missing evening data were more likely to occur on nights when students consumed greater amounts of alcohol, the dichotomous missing data variable was regressed onto person-mean centered Alcohol Consumption.

For Sample 1, findings showed a significant positive association between Alcohol Consumption and the evening missing data outcome, suggesting that students were more likely to provide missing data on nights when they consumed more alcohol, $t(1517) = 2.75$, $p = .006$. For Sample 2, however, findings did not reveal a significant association between Alcohol Consumption and the evening missing data outcome, $t(2583) = .67$, $p = .504$. These findings hold important implications for issues related to the generalizability of Sample 1 findings. Since higher rates of drinking were more likely to be associated with the presence of missing evening data, main findings may hold greater generalizability to situations characterized by lower rates of Alcohol Consumption.

Missing Data during the Morning. A dichotomous outcome variable was created, representing the presence (1) versus absence (0) of missing data on at least one variable assessed during the morning. A total of 574/2100 (27%; Sample 1) and 680/3264 (21%; Sample 2) cases were identified as containing missing data on at least one variable assessed during the morning. To examine whether missing morning data were more likely to occur when students set higher evening Drink Limits, the dichotomous missing data variable was regressed onto person-mean centered Drink Limits.

For Sample 1, findings did not reveal a significant association between Drink Limits and the missing data outcome, $t(1427) = .79$, $p = .431$. For Sample 2, however, findings showed a significant association between Drink Limits and the missing data outcome, suggesting that

students were more likely to miss morning diary entries when they set higher evening Drink Limits, $t(2290) = 2.45$, $p = .015$. These findings hold important implications for the generalizability of Sample 2 findings. Since higher (more lenient) nighttime Drink Limits accompanied more missing data in the mornings, main findings may hold greater generalizability to occasions involving lower Drink Limits (and possibly lower rates of Alcohol Consumption).[6]

Base Model: Ego-Depletion Mediating between SCD and Self-Control Failure

A mediation model was tested to analyze the base model with Ego-Depletion conceptualized as the primary mechanism linking Self-Control Demands (SCD) and Alcohol-Related Self-Control Failure (refer to Figure 2). A two-step approach was used to test the mediation model (Baron & Kenny, 1986). First, Ego-Depletion was regressed onto SCD to explore the relationship between the predictor and mediator variables.[7] Second, direct and indirect effects models were tested to examine all remaining pathways in the mediational model.

In a test of the predictor-mediator relationship, findings showed that students experienced greater Ego-Depletion during the evening when they reported higher levels of daily SCD, $t_{sample\_1}(1353) = 10.32$, $p < .001$; $t_{sample\_2}(2300) = 11.70$, $p < .001$. In a test of the mediator-outcome relationship (controlling for SCD), findings showed that Ego-Depletion was associated with greater Alcohol-Related Self-Control Failure for Sample 1 but not Sample 2 participants, $t_{sample\_1}(1074) = 2.82$, $p = .005$; $t_{sample\_2}(1826) = .56$, $p = .577$. When the direct pathway was examined, findings showed that students did not experience greater Alcohol-Related Self-Control Failure when they reported higher levels of SCD throughout the day, $t_{sample\_1}(1063) = -.21$, $p = .838$; $t_{sample\_2}(2300) = .33$, $p = .742$. Additionally, the mediational (indirect) pathway

[6] The relationship between Alcohol Consumption and missing morning data was impossible to examine, since Alcohol Consumption was assessed in the morning. Drink Limits was used as proxy to explore this relationship.
[7] Note: Gender and Week of Assessment were entered into the model to account for differences in Drink Limits between male and female students and across weeks of assessment.

linking SCD and Alcohol-Related Self-Control Failure via Ego-Depletion was non-significant across both samples, $t_{sample\_1}(1063) = -1.03$, $p = .306$; $t_{sample\_2}(2300) = .18$, $p = .859$.

These findings did not support ego-depletion as a psychological process linking SCD to Alcohol-Related Self-Control Failure. Even though the base model was not supported, each of the moderation hypotheses (refer to Fig. 2) were tested to examine potential moderators of the relationships embedded within the base model. Specifically, Need Satisfaction was conceptualized as an important moderator of the predictor-mediator relationship between SCD and Ego-Depletion, while Relative Controlled Regulation was conceptualized as an important moderator of the mediator-outcome relationship between Ego-Depletion and Alcohol-Related Self-Control Failure.

Main Findings

Multilevel analyses were conducted to examine two separate day-level hypotheses (refer to Fig. 2). The first set of analyses tested whether Need Satisfaction during the day protects against Ego-Depletion at night following high Self-Control Demands (SCD) during the day. It was predicted that SCD during the day would be positively associated with Ego-Depletion at night, only when students report lower levels of Need Satisfaction during the day (H1). The second set of analyses tested whether the type of self-regulation endorsed by students for limiting nighttime drinking moderates the association between Ego-Depletion and Alcohol-Related Self-Control Failure at night. It was predicted that Ego-Depletion at the end of the day would be positively associated with Alcohol-Related Self-Control Failure (i.e., discrepancy between self-imposed drink limits in the evening and self-reported consumption in the morning), only when students report greater Relative Controlled Regulation (RCR; H2). As discussed within the Analytical Plan, each hypothesis was tested within the context of four separate models

accounting for anticipated effects related to (a) the day of the week, (b) week of assessment, (c) gender, and (d) age.

Examining the Moderating Role of Need Satisfaction (Hypothesis 1)

Accounting for Day of the Week. A moderation model was specified to examine whether Need Satisfaction moderates the relationship between Self-Control Demands (SCD) and Ego-Depletion (Hypothesis 1) while accounting for the Day of the Week. Since there were four days of the week (i.e., Thursday, Friday, Saturday, and Sunday), three orthogonal contrasts were specified (k-1 rule) to examine mean differences between Thursday and Sunday, Friday and Saturday, and the combination of Thursday/Sunday and Friday/Saturday (see Table 3). This coding arrangement satisfied each of the major criteria outlined by Judd (2000) for achieving orthogonality between contrast predictors (i.e., the sum of each row was equal to zero; the sum of the cross products for each pair of contrasts was equal to zero). Findings pertaining to this analysis are summarized in Table 4.

Findings indicated that students experienced significantly greater Ego-Depletion on Sundays relative to Thursdays, $t_{sample\_1}(1497) = 3.75$, $p < .001$; $t_{sample\_2}(2474) = 4.97$, $p < .001$. Additionally, findings revealed significantly higher rates of Ego-Depletion on Thursdays/Sundays relative to Fridays/Saturdays for Sample 1 but not Sample 2 participants, $t_{sample\_1}(1497) = 3.75$, $p < .001$; $t_{sample\_2}(2474) = -.59$, $p = .558$. When Day of the Week variables were entered into an empty model, Thursday versus Sunday was no longer a significant Sample 1 predictor, $t(1522) = .36$, $p = .723$. Additionally, Thursday/Sunday versus Friday/Saturday emerged as a significant Sample 2 predictor, $t(2499) = -2.67$, $p = .008$. These findings illustrated a consistent trend characterized by higher rates of Ego-Depletion on Sundays relative to Fridays and Saturdays (Fig. 4).

Findings highlighted a significant main effect of SCD, $t_{sample\_1}(1497) = 8.37$, $p < .001$; $t_{sample\_2}(2474) = 8.29$, $p < .001$ and Need Satisfaction, $t_{sample\_1}(1497) = -16.00$, $p < .001$; $t_{sample\_2}(2474) = -20.27$, $p < .001$, suggesting that students experienced higher levels of Ego-Depletion on days when they endorsed greater SCD and less Need Satisfaction.[8] Sample 2 findings also revealed a small but statistically significant interaction, suggesting that Need Satisfaction protected against Ego-Depletion on Thursdays and Sundays more than Fridays and Saturdays, $t(2474) = 2.02$, $p = .043$ (Fig. 5).With respect to the main hypothesis, a significant interaction did not emerge between SCD and Need Satisfaction in either sample, $t_{sample\_1}(1497) = -1.65$ $p = .098$; $t_{sample\_2}(2474) = -.017$ $p = .987$. These findings were qualified, however, by the presence of a significant three-way interaction in each sample. Specifically, Sample 1 findings showed that Need Satisfaction functioned as a stronger buffer against the ego-depleting effects of SCD on Fridays and Saturdays relative to Thursdays and Sundays, $t(1497) = -3.13$, $p = .002$ (Fig. 6). Alternatively, Sample 2 findings showed that that Need Satisfaction functioned as a stronger buffer against the ego-depleting effects of SCD on Fridays relative to Saturdays, $t(2474) = 2.62$, $p = .008$ (Fig. 7).

Accounting for Week of Assessment. A moderation model was specified to examine Hypothesis 1 while accounting for the Week of Assessment. Since the Fall 2015 period (Sample 1) spanned three (valid) weeks of assessment, two orthogonal contrasts were created to assess mean differences between Week 1 (Halloween weekend) and Week 2 and the combination of Weeks 1 and 2 and Week 3 (see Table 5). Since the Spring 2016 period (Sample 2) spanned four weeks of assessment, three orthogonal contrasts were created comparing Week 1 to Week 2, Week 3 to Week 4 (Easter weekend/final exams), and the combination of Weeks 1 and 2 to the

[8] Main effects of SCD and Need Satisfaction were significant across each of the remaining sub-models. To avoid repetition, I describe these effects only once (see Tables 7-9 for full information).

combination of Weeks 3 and 4 (see Table 6). Findings pertaining to this analysis are summarized in Table 7.

Within Samples 1 and 2, each Week of Assessment contrast emerged as a non-significant predictor of Ego-Depletion. Within the context of an empty model, however, Sample 1 findings revealed significantly higher rates of Ego-Depletion on Week 1 (Halloween weekend) relative to Week 2, $t(1528) = -2.05$, $p = .040$ and on the combination of Weeks 1 and 2 relative to Week 3, $t(1528) = 2.43$, $p = .040$ (Fig. 8). Notably, Figure 8 shows a clear spike in Ego-Depletion for Sample 1 participants on the Sunday following Halloween.

Sample 1 findings highlighted a significant interaction between Need Satisfaction and the Week 1 versus Week 2 contrast, suggesting that Need Satisfaction protected against Ego-Depletion on Week 1 (Halloween weekend) more than Week 2, $t(1497) = 2.30$, $p = .022$ (Fig. 9). For Sample 2, a significant interaction emerged between Need Satisfaction and the Week 1/2 versus Week 3/4 contrast, suggesting that Need Satisfaction protected against Ego-Depletion on Weeks 1 and 2 more than Weeks 3 and 4 (Easter weekend/final exams), $t(2492) = 3.21$, $p = .001$ (Fig. 10). With respect to the main hypothesis, findings did not reveal a significant interaction between SCD and Need Satisfaction in either sample, $t_{sample\_1}(1497) = -1.09$, $p = .003$; $t_{sample\_2}(2492) = .17$, $p = .867$. Sample 1 findings did, however, reveal a significant three-way interaction between SCD, Need Satisfaction, and the Week 1 versus Week 2 contrast, suggesting that Need Satisfaction functioned as a stronger buffer against the ego-depleting effects of SCD on Week 2 relative to Week 1 (Halloween weekend), $t(2474) = -2.98$, $p = .003$ (Fig. 11).

Accounting for Gender. A moderation model was specified to examine Hypothesis 1 while accounting for Gender. There was a single participant in each sample omitted based on

their non-identification with male or female Gender categories. Findings pertaining to this analysis are summarized in Table 8.

Findings did not reveal a significant effect of Gender on Ego-Depletion in either sample, $t_{sample\_1}(1515) = -1.28$, $p = .203$, $t_{sample\_2}(2477) = -1.54$, $p = .126$. Furthermore, a significant interaction did not emerge between SCD and Need Satisfaction, $t_{sample\_1}(1515) = -.45$, $p = .657$; $t_{sample\_2}(2477) = -.08$, $p = .939$. The absence of a significant three-way (cross-level) interaction suggested no differences in the strength of the moderation effect between male and female students.

Accounting for Age. A moderation model was specified to examine Hypothesis 1 while accounting for Age effects. Age was centered at a meaningful 0 point (the youngest Age in each sample [18 years old]) to increase interpretability and reduce multicollinearity between the interaction terms and their constituents. Findings pertaining to this analysis are summarized in Table 9.

Findings did not reveal a significant effect of Age on Ego-Depletion in either sample, $t_{sample\_1}(1515) = -.27$, $p = .788$; $t_{sample\_2}(2492) = .74$, $p = .461$. Sample 2 findings did, however, reveal a significant interaction between Need Satisfaction and Age, suggesting that Need Satisfaction protected against Ego-Depletion for younger students more than older students, $t(2492) = -2.84$, $p = .005$ (Fig. 12). With respect to the main hypothesis, a significant interaction did not emerge between SCD and Need Satisfaction in either sample, $t_{sample\_1}(1515) = -1.47$, $p = .143$; $t_{sample\_2}(2492) = -.83$, $p = .404$. Additionally, the absence of a significant three-way (cross-level) interaction suggested no differences in the strength of the moderation effect between younger and older students.

Examining the Moderating Role of Relative Controlled Regulation (Hypothesis 2)

Accounting for Day of the Week. A moderation model was specified to examine whether Relative Controlled Regulation (RCR) moderates the relationship between Ego-Depletion and Alcohol-Related Self-Control Failure (Hypothesis 2) while accounting for the Day of the Week (refer to Table 3 for a review of the orthogonal coding technique used to create Day of the Week contrast predictors). Findings pertaining to this analysis are summarized in Table 10.

Findings revealed lower rates of Self-Control Failure on Fridays and Saturdays relative to Thursdays and Sundays within both samples, $t_{sample\_1}(1165) = -3.90$, $p < .001$, $t_{sample\_2}(1948) = -6.58$, $p < .001$ (Fig. 13). Findings also revealed a significant main effect of Ego-Depletion on Self-Control Failure for Sample 1 but not Sample 2 participants, $t_{sample\_1}(1165) = 2.35$, $p = .019$; $t_{sample\_2}(1948) = .19$, $p = .848$. Accordingly, only Sample 1 participants experienced greater Self-Control Failure on nights involving higher levels of Ego-Depletion. The main effect of Relative Controlled Regulation (RCR) was not significant, suggesting that the type of regulation students endorsed for limiting their consumption had no effect on Self-Control Failure, $t_{sample\_1}(1165) = .06$, $p = .956$; $t_{sample\_2}(1948) = -.88$, $p = .380$.[9]

With respect to the main hypothesis, a significant interaction did not emerge between Ego-Depletion and RCR in either sample, $t_{sample\_1}(1165) = -.21$, $p = .832$; $t_{sample\_2}(1948) = -.13$, $p = .897$. Further, the absence of a significant three-way interaction suggested no differences in the strength of the moderation effect across days of the week.

Accounting for Week of Assessment. A moderation model was specified to examine Hypothesis 2 while accounting for the Week of Assessment (refer to Tables 4 and 5 for a review

[9] The same main effects pattern was observed across each of the remaining sub-models. To avoid repetition, I describe these effects only once (see Tables 11-13 for full information).

of the orthogonal coding technique used to create Week of Assessment contrast predictors). Findings pertaining to this analysis are summarized in Table 11.

Sample 1 findings revealed each of the Week of Assessment contrasts to be non-significant predictors of Self-Control Failure. Despite overlap with Halloween (Week 1), these findings highlighted a general trend characterized by limited variation in Self-Control Failure across weeks of the Fall 2015 assessment period. Sample 2 findings revealed a different pattern involving lower rates of Self-Control Failure during Weeks 3 and 4 (Easter weekend/final exams) relative to Weeks 1 and 2, $t(1948) = -2.37$, $p = .018$ (Fig. 14).

With respect to the main hypothesis, a significant interaction did not emerge between Ego-Depletion and RCR in either sample, $t_{sample\_1}(1169) = .16$, $p = .876$, $t_{sample\_2}(1948) = -.18$, $p = .859$. Furthermore, the absence of a significant three-way interaction suggested no differences in the strength of the moderation effect across Weeks of Assessment.

Accounting for Gender. A moderation model was specified to examine Hypothesis 2 while accounting for effects related to Gender. There was a single participant in each sample omitted based on their non-identification with male or female Gender categories. Findings pertaining to these analyses are summarized in Table 12.

Findings did not reveal a significant effect of Gender on Self-Control Failure in either sample, $t_{sample\_1}(1171) = -.13$, $p = .895$; $t_{sample\_2}(1944) = -.10$, $p = .920$. Sample 1 findings did, however, reveal a significant interaction between Ego-Depletion and Gender, suggesting that female students were more likely to experience Self-Control Failure on nights involving higher levels of Ego-Depletion, $t(1171) = -3.03$, $p = .003$ (Fig. 15). Additionally, Sample 1 findings revealed a significant interaction between RCR and Gender, suggesting that male students were more likely to exhibit Self-Control Failure on nights when they felt more controlled in their

attempts to limit alcohol consumption, $t(1171) = 2.80$, $p = .005$ (Fig. 16).[10] With respect to the main hypothesis, a significant interaction did not emerge between Ego-Depletion and RCR in either sample, $t_{sample\_1}(1171) = -.67$, $p = .506$; $t_{sample\_2}(1944) = .46$, $p = .647$. Furthermore, the absence of a significant three-way interaction suggested no differences in the strength of the moderation effect between male and female students.

Accounting for Age. A moderation model was specified to examine Hypothesis 2 while accounting for Age effects. Age was centered at a meaningful 0 point (the youngest age in each sample [18 years old]) to increase interpretability and reduce multicollinearity between the interaction terms and their constituents. Findings pertaining to these analyses are summarized in Table 13.

Findings did not reveal a significant effect of Age on Self-Control Failure in either sample, $t_{sample\_1}(1173) = .74$, $p = .463$; $t_{sample\_2}(1956) = -.43$, $p = .671$. Furthermore, a significant interaction did not emerge between Ego-Depletion and RCR, $t_{sample\_1}(1173) = -.22$, $p = .825$; $t_{sample\_2}(1956) = .68$, $p = .494$. The absence of a significant three-way interaction suggested no differences in the strength of the moderation effect between younger and older students.

Summary of Main Findings

Multilevel analyses were conducted to examine two moderation hypotheses while accounting for systematic effects related to the day of the week, week of assessment, and demographic variables (i.e., gender and age). The first set of analyses tested whether perceived Need Satisfaction during the day moderates the association between Self-Control Demands (SCD) during the day and Ego-Depletion at night (Hypothesis 1). The second set of analyses tested whether Relative Controlled Regulation (RCR) for limiting alcohol consumption

[10] Sample 1 Gender interactions should be interpreted with caution due to the presence of only 25 male participants. Effects were not replicated in Sample 2 with a higher proportion of male students.

moderates the association between Ego-Depletion and Alcohol-Related Self-Control at night (Hypothesis 2). Each hypothesis was tested using two independent samples during the Fall 2015 (Sample 1) and Spring 2016 (Sample 2) semesters.

With regard to the first hypothesis, findings showed that students reported greater ego-depletion at night when they experienced taxing self-control demands during the day. Although need satisfaction during the day was associated with less ego-depletion at night, only conditional support was obtained for the moderation/buffering hypothesis. In particular, findings showed that need satisfaction buffered against the ego-depleting effects of self-control demands on some days/weeks more than others. During the Fall 2015 semester (Sample 1), a stronger buffering effect was observed on a) Fridays and Saturdays compared to Thursdays and Sundays and b) Week 2 compared to Week 1 (Halloween). During the Spring 2016 term (Sample 2), a stronger buffering effect was observed on Fridays compared to Saturdays. These findings suggest that the buffering role of need satisfaction may be limited to specific temporal contexts. In the general discussion, I speculate further as to why need satisfaction may protect against the ego-depleting effects of self-control demands on some days/weeks more than others.

With regard to the second hypothesis, findings provided mixed support for the direct association between ego-depletion and alcohol-related self-control failure. Only Sample 1 participants experienced greater alcohol-related self-control failure on evenings when they reported greater ego-depletion. Controlling for the day of the week, week of assessment, and demographic characteristics of participants, moderation findings showed that ego-depleted students were not more likely to experience self-control failure on nights when they endorsed higher levels of controlled regulation for limiting their consumption. Thus, in response to the question, does relative controlled regulation increase vulnerability toward drinking lapses when

university students are mentally fatigued (i.e., ego-depleted), the answer appears to be a resounding "no." In light of these findings, the relationship between ego-depletion and alcohol-related self-control failure is examined in much greater detail within the post-hoc section. The role of ego-depletion in a student drinking context is also considered in greater detail within the general discussion section.

Post-Hoc Analysis 1: Why did Students Fail Less on Fridays and Saturdays?

Five post-hoc models were developed to build upon the main findings above. The objective of the first post-hoc model was to examine why, despite higher rates of consumption (Fig. 17), students experienced less Self-Control Failure on Fridays and Saturdays relative to Thursdays and Sundays. As a potential explanation for this discrepancy, it was considered that students may have been less likely to experience Self-Control Failure if they set higher (i.e., more lenient) Drink Limits on Fridays and Saturdays relative to Thursdays and Sundays. In theory, higher Drink Limits should be more difficult to violate.

A mediation model was specified to analyze the following research questions: (1) Do students set higher Drink Limits on Fridays and Saturdays relative to Thursdays and Sundays? (2) Are higher Drink Limits associated with less Self-Control Failure? (3) Do higher Drink Limits explain why Self-Control Failure was less likely to occur on Fridays and Saturdays relative to Thursdays and Sundays (Fig. 18)? A two-step approach was used to test the proposed mediational model. First, Drink Limits was regressed onto each Day of the Week variable to explore the relationship between predictor and mediator variables.[11] Second, direct and indirect effects models were specified to examine all remaining pathways in the mediational model. Findings are summarized in Table 14 and presented in detail below.

[11] Note: Gender and Week of Assessment were entered into the model to account for differences in Drink Limits between male and female students and across weeks of assessment.

Findings showed that higher Drink Limits were set on Fridays and Saturdays relative to Thursdays and Sundays in both samples, $t_{sample\_1}(1508) = 14.48$, $p < .001$; $t_{sample\_2}(2472) = 13.08$, $p < .001$. Consistent with this trend, Figure 19 illustrated a pattern characterized by higher Drink Limits on Fridays and Saturdays relative to Thursdays and Sundays. Notably, Figure 19 also provided preliminary evidence of an inverse association between the mediator (Drink Limits) and outcome (Self-Control Failure) variables. Multilevel findings corroborated this pattern, suggesting that students experienced less Self-Control Failure on days when they set higher Drink Limits, $t_{sample\_1}(1186) = -5.34$, $p < .001$; $t_{sample\_2}(1972) = -19.36$, $p < .001$.

An interesting pattern of findings emerged when direct and indirect pathways were tested. Specifically, findings revealed a significant direct effect suggesting that students experienced less Self-Control Failure on Fridays and Saturdays relative to Thursdays and Sundays, $t_{sample\_1}(1185) = -4.53$, $p < .001$; $t_{sample\_2}(1973) = -6.65$, $p < .001$. In the context of the indirect effects model, however, the size of these coefficients dropped markedly out of the range of statistical significance, $t_{sample\_1}(1186) = 1.50$, $p = .133$; $t_{sample\_2}(1972) = -.82$, $p = .411$. These findings demonstrated that students (1) created more lenient Drink Limits on Fridays and Saturdays, and (2) experienced less Self-Control Failure on Fridays and Saturdays, in part, because of changes in the leniency of their limitation goals.

Post-Hoc Analysis 2: Why was Ego-Depletion Associated with Self-Control Failure?

The second post-hoc model considered an alternative mediational hypothesis testing whether Ego-Depletion may have influenced the goal setting process (i.e., Drink Limits), and in turn the likelihood of experiencing Self-Control Failure. To recap, Sample 1 findings revealed a positive relationship between Ego-Depletion and Self-Control Failure, suggesting that students were more likely to experience Self-Control Failure on nights when they endorsed greater levels

of Ego-Depletion. Although Sample 2 findings did not reveal a relationship between Ego-Depletion and Self-Control Failure, a mediational pathway involving Drink Limits was still tested to assess the strength of the indirect effect.

A mediation model was specified to test the following research questions: (1) Are Ego-Depleted students more likely to set higher or lower Drink Limits? b) Do student Drink Limits (i.e., higher or lower) influence the likelihood of Self-Control Failure; and c) Do student Drink Limits mediate the relationship between Ego-Depletion and Self-Control Failure (Fig. 20). A two-step approach was used to test the proposed mediational model. First, Drink Limits was regressed onto Ego-Depletion to explore the relationship between predictor and mediator variables.[12] Next, direct and indirect effects models were specified to examine each of the remaining pathways in the mediational model.[13] Findings are summarized in Table 15 and presented in detail below.

In a test of the relationship between predictor and mediator variables, findings showed that students set lower Drink Limits when they experienced greater Ego-Depletion, $t_{sample\_1}(1504) = -6.11$, $p < .001$; $t_{sample\_1}(2470) = -3.88$, $p < .001$. In a test of the relationship between mediator and outcome variables, findings indicated that students experienced greater Self-Control Failure when they set lower Drink Limits, $t_{sample\_1}(1182) = -13.87$, $p < .001$; $t_{sample\_2}(1970) = -19.48$, $p < .001$. An interesting pattern of findings emerged when direct and indirect pathways were tested within each sample. Consistent with findings from the Main Analyses section, results showed that only Sample 1 participants were more likely to experience Self-Control Failure on nights when they endorsed greater Ego-Depletion, $t_{sample\_1}(1183) = 1.99$, $p = .046$; $t_{sample\_2}(1971)$

[12] Gender, Day of the Week, and Week of Assessment were entered into the model to account for differences in Drink Limits between men and women, weeks of assessment, and days of the week.

[13] Day of the Week was entered into the model to account for differences in Self-Control Failure between days of the week.

= .20, p =.833. In the context of the indirect effects model, however, the Sample 1 coefficient dropped out of the range of statistical significance, $t(1182) = -.58$, p =.565, while the Sample 2 coefficient moved into the range of statistical significance, $t(1971) = -2.05$, p =.040. These findings are both supportive of an indirect pathway linking Ego-Depletion to Self-Control Failure via changes in the leniency of limitation goals. Specifically, students set stricter (i.e., less lenient) Drink Limits that were more easily violated when they reported greater Ego-Depletion.

Post-Hoc Analysis 3: Does RCR Moderate the Ego-Depletion → Drink Limits Link?

The third post-hoc model tested a slightly modified version of Hypothesis 2 examining the moderating role of Relative Controlled Regulation (RCR). To recap, Hypothesis 2 maintained that RCR would moderate the association between Ego-Depletion and Self-Control Failure at night. Since main findings did not reveal a significant interaction between Ego-Depletion and RCR on the behavioural outcome of Self-Control Failure, Post-Hoc Model 3 explored the interaction term in the context of a cognitive goal-setting outcome (i.e., Drink Limits).

A moderation model was developed to explore whether RCR moderates the relationship between Ego-Depletion and Drink Limits (Fig. 20). Similar to the Main Analyses section, this model was tested in the context of four sub-models accounting for: a) Day of Weekend, b) Week of Assessment, c) Gender and d) Age. Findings are summarized in Tables 16 through 19 and presented in detail below.

Accounting for Day of the Week. Findings revealed a significant main effect of Ego-Depletion, $t_{sample\_1}(1490) = -5.45$, p <.001; $t_{sample\_2}(2459) = -4.18$, p <.001 and RCR, $t_{sample\_1}(1490) = 4.24$, p <.001; $t_{sample\_2}(2459) = 5.46$, p <.001, suggesting that students were more likely to set lower Drink Limits when they felt more ego-depleted and less controlled in their

attempts to limit alcohol consumption.[14] Sample 1 findings highlighted a significant interaction between Ego-Depletion and the Thursday/Sunday versus Friday/Saturday contrast, suggesting that Ego-Depletion protected against higher Drink Limits on Fridays and Saturdays relative to Thursdays and Sundays, $t(1490) = -2.20$, $p = .028$ (Fig. 22). Additionally, Sample 1 findings showed that students set higher Drink Limits on Fridays/Saturdays relative to Thursdays/Sundays when they felt more controlled (and less autonomous) in their attempts to limit alcohol consumption $t(1490) = -2.20$, $p = .028$ (Fig. 23). Sample 2 findings revealed a slightly different interaction between RCR and the Day of the Week, indicating that students set higher Drink Limits on Fridays relative to Saturdays when they felt more controlled (and less autonomous) in their attempts to limit alcohol consumption, $t(2459) = -2.23$, $p = .026$ (Fig. 24).

The main interaction between Ego-Depletion and RCR on Drink Limits was non-significant within each sample, $t_{sample\_1}(1490) = .21$, $p = .833$; $t_{sample\_2}(2459) = .46$, $p = .646$. Although these effects were non-significant, Sample 2 findings revealed a significant three-way interaction between Ego-Depletion, RCR, and the Friday versus Saturday contrast variable, $t(2459) = 2.54$, $p = .011$. Figure 25 illustrates that self-regulation mattered most on Fridays, when students endorsed feeling more alive and energetic (i.e., lower Ego-Depletion). In particular, RCR appeared to amplify vulnerability toward setting higher Friday Drink Limits when students felt more alive and energetic.

Accounting for Week of Assessment. Sample 1 findings indicated that students set higher Drink Limits on Week 1 (Halloween weekend) relative to Week 2, $t(1494) = -5.24$, $p < .001$. Furthermore, Sample 2 findings showed that students set higher Drink Limits on Weeks 3 and 4 (Easter weekend/final exams) relative to Weeks 1 and 2, $t(2459) = 5.07$, $p < .001$.

[14] Main effects were largely consistent across each of the remaining sub-models (there was one exception in the Age sub-model). To avoid repetition, I describe these effects only once (see Tables 17-19 for full information).

Interestingly, Figure 19 (refer back) shows that rates of alcohol consumption fell well short of the higher Drink Limits that were being set by Sample 2 participants on Week 4 (Easter weekend/final exams). Accordingly, Easter weekend (final exams) seemed to be characterized by a pattern of over-compliance (i.e., over-control).

Sample 1 findings revealed a significant interaction between Ego-Depletion and the Week 1 (Halloween weekend) versus Week 2 contrast, suggesting that Ego-Depletion protected against higher Drink Limits on Week 1 (Halloween weekend) more than Week 2, $t(1494) = 2.99$, $p = .003$ (Fig. 26). For Sample 2, a significant interaction between RCR and the Week 1/2 versus Week 3/4 contrast indicated that students set higher Drink Limits on Weeks 1 and 2 relative to Weeks 3 and 4 (Easter weekend/final exams) when they felt more controlled (and less autonomous) in their attempts to limit alcohol consumption, $t(2459) = 2.99$, $p = .003$ (Fig. 27). The main interaction between Ego-Depletion and RCR on Drink Limits was non-significant within each sample, $t_{sample\_1}(1494) = -.28$, $p = .782$; $t_{sample\_2}(2459) = -.01$, $p = .994$. Further, the absence of a significant three-way interaction suggested no differences in the strength of the moderation effect between Weeks of Assessment.

Accounting for Gender.[15] Findings revealed significant and marginally significant effects of Gender on Drink Limits, with female students setting lower Drink Limits relative to male students, $t_{sample\_1}(1490) = 3.81$, $p < .001$; $t_{sample\_2}(2453) = 1.95$, $p = .053$. Sample 2 findings also revealed a significant interaction between Gender and Ego-Depletion, suggesting that Ego-Depletion protected against higher Drink Limits for male students more than female students, $t(2453) = -2.08$, $p = .038$ (Fig. 28). The main interaction between Ego-Depletion and RCR on Drink Limits was non-significant within each sample, $t_{sample\_1}(1490) = -1.42$, $p = .155$; t

[15] A single participant was omitted from Samples 1 and 2 based on their non-identification with male or female Gender categories

$_{sample\_2}(2453) = .60$, $p = .546$. Further, the absence of a significant three-way interaction suggested no differences in the strength of the moderation effect between male and female students.

Accounting for Age. [16] Findings revealed a significant effect of Age on Drink Limits for Sample 2 participants, suggesting that younger students set lower Drink Limits than older students, $t_{sample\_1}(1498) = .07$, $p = .948$; $t_{sample\_2}(2467) = 3.47$, $p < .001$. Interestingly, findings did not show a significant main effect of Ego-Depletion on Drink Limits for Sample 2 participants, suggesting that Ego-Depletion was no longer associated with lower Drink Limits after accounting for this Age effect, $t_{sample\_1}(1498) = -6.25$, $p < .001$; $t_{sample\_2}(2467) = -1.47$, $p = .14$. The main interaction term between Ego-Depletion and RCR on Drink Limits was non-significant within each sample, $t_{sample\_1}(1490) = -.26$, $p = .793$; $t_{sample\_2}(2467) = .99$, $p = .323$. Further, the absence of a significant three-way interaction suggested no differences in the strength of the moderation effect across Age ranges.

Post-Hoc Analysis 4: Does RCR Moderate the Drink Limits → Self-Control Failure Link?

The fourth post-hoc model tested another version of Hypothesis 2 by supplanting Ego-Depletion with Drink Limits as the main predictor variable of interest. With this modification, Post-Hoc Model 4 explored whether RCR provided additional risk of Self-Control Failure in the context low (and more easily violated) Drink Limits.

A moderation model was developed to explore the effect of RCR on the relationship between Drink Limits and Self-Control Failure (Fig. 29). Like the Main Findings section, this model was tested in the context of four sub-models accounting for: a) Day of Weekend, b) Week of Assessment, c) Gender and d) Age. Findings are summarized in Tables 20 through 23 and

[16] For Samples 1 and 2, Age was centered at 18 years old to increase interpretability and reduce multicollinearity between the interaction terms and their constituents.

presented in detail below. Main effects for Drink Limits and RCR are not described in text since they are reported elsewhere in the results section.

Accounting for Day of Weekend. Sample 1 findings revealed a significant interaction between Drink Limits and the Thursday/Sunday versus Friday/Saturday contrast variable, suggesting that students (over-)complied with higher Drink Limits on Thursdays and Sundays relative to Fridays and Saturdays, $t(1167) = 5.04$, $p < .001$ (Fig. 30). Sample 2 findings revealed a marginally significant interaction between RCR and the Thursday/Sunday versus Friday/Saturday contrast variable, suggesting that students experienced greater Self-Control Failure on Fridays and Saturdays when they felt more controlled (and less autonomous) in their attempts to limit alcohol consumption (1949) = 1.83, $p < .067$ (Fig. 31).

With respect to the main interaction term, findings revealed a significant interaction between Drink Limits and RCR on Self-Control Failure for Sample 2 participants only, $t_{sample\_1}(1167) = -.59$, $p < .555$; $t_{sample\_2}(1949) = -2.63$, $p = .009$. This finding demonstrated that Sample 2 participants were more likely to violate lower drinking restrictions when they felt more controlled in their attempts to limit alcohol consumption (Fig. 32). Although the main interaction term was non-significant among Sample 1 participants, a three-way interaction emerged between Drink Limits, RCR, and the Friday versus Saturday contrast, $t(1167) = -2.24$, $p = .025$. This finding provided qualified evidence, suggesting that Sample 1 participants were more likely to violate lower drinking restrictions on Saturdays when they felt more controlled in their attempts to limit alcohol consumption (Fig. 33). Since Halloween occurred during a Saturday, this finding may be underscoring the importance of feeling less controlled (and more autonomous) during attempts to limit lower Halloween Drink Limits.

Accounting for Week of Assessment. Sample 1 findings showed that students experienced greater Self-Control Failure on Week 1 (Halloween weekend) relative to Week 2, $t(1171) = -2.46$, $p = .014$. With regard to Sample 2 findings, each of the Week of Assessment contrasts emerged as non-significant predictors of Self-Control Failure. Sample 1 findings revealed a significant interaction between Drink Limits and the Week 1 (Halloween weekend) versus Week 2 contrast variable, suggesting that students were less likely to violate higher Drink Limits on Week 2 relative to Week 1 (Halloween weekend), $t(1171) = -3.62$, $p < .001$ (Fig. 34). For Sample 2, findings revealed a significant interaction between Drink Limits and the Week 1/2 versus Week 3/4 contrast variable, suggesting that students were less likely to violate higher Drink Limits on Weeks 3 and 4 (Easter weekend/final exams) relative to Weeks 1 and 2, $t(1949) = -5.05$, $p < .001$ (Fig. 35). Sample 2 findings also revealed a marginally significant interaction between Drink Limits and the Week 3 versus Week 4 variable, $t(1949) = -1.89$, $p = .059$, suggesting that students were especially likely to (over-)comply with higher Drink Limits on Week 4 (Easter weekend/final exams) relative to Week 3 (refer to Figure 19).

With respect to the main interaction term, findings revealed a significant interaction between Drink Limits and RCR on Self-Control Failure for Sample 2 participants but not Sample 1 participants, $t_{sample\_1}(1171) = 1.05$, $p = .295$; $t_{sample\_2}(1949) = -2.72$, $p = .006$. Once again, this finding showed that Sample 2 participants were more likely to violate lower drinking restrictions when they felt more controlled in their attempts to limit alcohol consumption (Fig. 36). Although the interaction term was not significant among Sample 1 participants, an interesting pattern of findings surfaced in the context of a three-way interaction involving the Week 1/2 versus Week 3 contrast variable, $t(1171) = -1.99$, $p = .047$. Specifically, Sample 1 participants were more likely

to violate higher Drink Limits on Weeks 1 and 2 when they felt more controlled (and less autonomous) in their attempts to limit alcohol consumption (Fig. 37).

A significant three-way interaction also emerged for Sample 2 participants, involving the Week 3 versus Week 4 (Easter weekend/final exams) contrast, $t(1949) = -3.55$, $p < .001$. When students felt more controlled (and less autonomous) in their attempts to limit alcohol consumption during Week 4 (Easter Weekend/final exams), they were (1) at greater risk of violating lower Drink Limits and (2) at lower risk of violating higher Drink Limits (Fig. 38). These findings implicate RCR as both a vulnerability and protective factor during final exams depending on content of students' Drink Limits.

Accounting for Gender.[17] Findings highlighted a marginally significant interaction between Gender and Drinking Limits on Self-Control Failure for Sample 1 participants only, $t_{sample\_1}(1173) = -1.92$, $p = .056$; $t_{sample\_2}(1945) = -.86$, $p = .393$. In particular, Sample 1 findings showed that lower Drinking Limits conferred greater risk toward Self-Control Failure for male students (Fig. 39). Sample 1 findings also revealed a significant interaction between Gender and RCR, indicating that male students were more likely to violate drinking restrictions when they felt more controlled in their attempts to limit alcohol consumption, $t(1173) = 2.80$, $p = .005$ (Fig. 40).

A significant interaction did not emerge between Drink Limits and RCR on Self-Control Failure in either sample, $t_{sample\_1}(1173) = -.19$, $p = .846$; $t_{sample\_2}(1945) = -.86$, $p = .393$. Despite the absence of a significant two-way interaction effect, findings revealed a pair of significant three-way interactions involving the Gender variable. For Sample 1, male students were more likely to violate higher Drinking Limits when they felt more controlled in their attempts to limit alcohol

[17] A single participant was omitted from Samples 1 and 2 based on non-identification with male or female Gender categories

consumption, $t(1173) = 2.88$, $p = .004$ (Fig. 41). [18] For Sample 2, however, male students were more likely to violate lower Drinking Limits when they felt more controlled in their attempts to limit alcohol consumption, $t(1945) = -2.07$, $p = .038$ (refer to Fig. 41). Contrary to Sample 1, male students in Sample 2 were also more likely to (over-)comply with higher Drink Limits when they felt more controlled in their attempts to limit alcohol consumption. While these findings are not easily reconcilable, inferences drawn from Sample 2 should be given greater weight since there were a greater proportion of male students in the sample.

Accounting for Age.[19] The main interaction term between Drink Limits and RCR was non-significant for each sample, $t_{sample\_1}(1175) = 1.38$, $p = .167$; $t_{sample\_2}(1957) = -.53$, $p = .596$. For Sample 2, however, an interesting pattern of findings emerged within the context of a three-way interaction with Age, $t(1957) = -2.18$, $p = .029$. In particular, older students were more likely to violate low Drink Limits when they felt more controlled in their attempts to limit alcohol consumption (Fig. 42).

Post-Hoc Analysis 5: Re-Testing H2 Accounting for Differences in Effortful Self-Control

The fifth and final post-hoc model considered an important caveat to findings obtained in relation to Hypothesis 2. It is perhaps not surprising that RCR failed to moderate the association between Ego-Depletion and Self-Control Failure since no distinction was made between whether or not students were actually trying to exert effortful self-control. In the context of amotivation, non-regulation, and/or lack of effortful self-control, "limiting" may no longer be considered an effortful *self-control task.* During these occasions, it becomes impossible to test predictions built upon the strength-energy model of *self-control*. This point has been aptly described by Muraven

[18] Sample 1 Gender interactions should be interpreted with caution due to the presence of only 25 male participants. Effects were not replicated in Sample 2 with a higher proportion of men.

[19] Age was centered at 18 years old to increase interpretability and reduce multicollinearity between the interaction terms and their constituents.

(2012), who noted that *"…the initial exertion of self-control only affects [later] tasks that require self-control"* (p. 112). In support of this position, Muraven referenced an earlier study where he and his colleagues showed that individuals were less affected by the initial exertion of self-control when they were not tempted to drink (Muraven, Collins, & Nienhaus, 2002).

Although different levels of temptation were assessed during the current study (i.e., using the Alcohol Urge Questionnaire; Bohn, Krahn, & Staehler, 1995), scores on this questionnaire were not used to distinguish between effortful versus non-effortful self-controllers. The decision was informed by findings showing that students endorsed less Intention to Limit on nights when they experienced greater levels of Temptation/Urge, $t_{sample\_1}(1487) = -9.69$, $p < .001$; $t_{sample\_2}(2437) = -13.15$, $p < .001$. Thus, instead of trying to inhibit or downregulate temptation, students in the current study were more likely to acquiesce or "give-in" to stronger urges to drink. In light of these findings, "Intention to Limit" was used instead of Temptation/Urge to discriminate between occasions characterized by the presence versus absence of self-control. Intention to Limit was assessed along a 5-point Likert scale ranging from 1 (*I definitely won't set a limit on my drinking tonight*) to 5 (*I definitely will set a limit on my drinking tonight*).

A moderation model was tested to explore the three-way interaction between Ego-Depletion, Intention to Limit, and RCR on Self-Control Failure (Fig. 43). Unlike each of the previous moderation analyses, this model was not tested in the context of separate sub-models due to the various statistical and conceptual challenges associated with estimating higher-order (i.e., four-way) interaction terms (e.g., poor reliability of higher-order interaction estimates, interpretive challenges, etc.; see Chaplin, 2007). Findings pertaining to Post-Hoc Model 5 are summarized in Table 24 and presented in detail below.

Findings revealed a significant main effect of Intention to Limit on Self-Control Failure, suggesting that students experiencing greater Self-Control Failure on nights when then endorsed greater Intention to Limit, $t_{sample\_1}(1153) = 3.76$, $p < .001$; $t_{sample\_2}(1916) = 5.97$, $p < .001$. With respect to the main hypothesis, findings did not reveal the presence of a significant three-way interaction in either sample, $t_{sample\_1}(1153) = -.28$, $p = .778$; $t_{sample\_2}(1916) = -1.31$, $p = .190$. Accordingly, the interaction between Ego-Depletion and RCR did not appear to depend upon different levels of Intention to Limit.

Discussion

The purpose of the current research was to test a combined strength-energy and self-determination theory (SDT) model of student drinking (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Ryan & Deci, 2000). To attain this objective, I examined whether students reported greater ego-depletion at night when they experienced greater self-control demands during the day, and whether daily variation in perceived need satisfaction moderated this relationship. I also examined whether students were more prone toward alcohol-related self-control failure when they reported greater ego-depletion during the evening, and whether the type of self-regulation students reported for limiting their drinking moderated this relationship. A daily diary approach involving two independent samples was used to test each of these questions during the Fall 2015 (Sample 1) and Spring 2016 (Sample 2) academic terms. Findings comparing each sample are summarized in Table 25 and described in detail below.

Across both samples, findings showed that students reported greater ego-depletion at night when they experienced higher self-control demands during the day. This relationship persisted even after accounting for the day of the week, week of assessment, and demographic characteristics of students (i.e., age and gender). These findings are consistent with a large body of experimental research involving the dual-task paradigm (i.e., administering sequential self-control tasks and observing lower performance on the latter task; see Hagger, Wood, Stiff, & Chatzisarantis, 2010 for a review). Findings also add to a relatively small body of research that provides evidence of ego-depletion in real-life settings (i.e., outside of the laboratory context; e.g., Hofmann, Vohs, & Baumeister, 2012).

Conditional support for the SDT-informed moderation hypothesis was obtained, suggesting that need satisfaction served a greater buffering role against the ego-depleting effects

of taxing situations on some days and weeks more than others. These findings add to existing theory and research by suggesting that need satisfaction may buffer against ego-depletion following exposure to taxing situations, but only during specific occasions (e.g., Muraven, Gagné, and Rosman, 2008; Ryan & Deci, 2008). Further interpretation of these temporally bound (contextual) effects is provided later in the discussion (see section, "Time Matters: A Temporal Perspective of Ego-Depletion and Self-Control Failure").

With regard to the second main hypothesis, mixed findings revealed that only Sample 1 participants were more likely to experience alcohol-related self-control failure on evenings when they reported greater ego-depletion. These findings are only in partial agreement with previous research suggesting that ego-depletion confers vulnerability toward alcohol-related self-control failure in non-student populations (Muraven, Collins, Shiffman, & Paty, 2005; Muraven & Shmueli, 2006). Contrary to existing findings integrating SDT and ego-depletion frameworks (refs), findings did not implicate self-regulation as a significant moderator of the relationship between ego-depletion and alcohol-related self-control failure. Specifically, the relationship between ego-depletion and alcohol-related self-control failure did not increase in strength on nights when students reported relatively greater controlled than autonomous regulation for limiting nighttime drinking.

While these findings appear to suggest no differences in resource utilization between autonomous and controlled acts of drinking restraint, they may alternatively reflect an unexpected relationship between ego-depletion and alcohol consumption that was observed during the post-hoc analyses. Specifically, post-hoc findings showed that after statistically removing the effects of drink limits from the operationalization of alcohol-related self-control failure (operationalized as drink limits during the evening minus alcohol consumption reported

the following morning), ego-depletion was either not associated with alcohol consumption (Sample 1) or associated with less (not more) alcohol consumption (Sample 2). With regard to the moderation hypothesis, therefore, relative controlled regulation could not amplify a risk association that failed to exist from the start.

As demonstrated within Table 25, the statistical conclusions that were reached for each of the main research questions were more often congruent than incongruent between independent samples. There were, however, a number of incongruent interaction terms (i.e., peripheral to the main research questions) that are reported in the text but not represented in Table 25. Such differences are put into context within Table 25, which illustrates a number of important demographic, methodological, and substantive differences between samples on key theoretical variables. Incongruities between samples surfaced frequently when temporal variables were accounted for in the statistical models. Patterns of association occurring within a specific temporal context for Sample 1 participants often surfaced within a different temporal context for Sample 2 participants, or sometimes not at all. For example, need satisfaction moderated the relationship between self-control demands and ego-depletion during Week 1 for Sample 1 participants, and Weeks 3 and 4 for Sample 2 participants. Potential explanations about why statistical relationships in the current study were bound by temporal constraints are considered in detail later in the discussion.

In addition to temporal differences, there were a handful of incongruent findings between samples involving gender. For example, findings revealed that the positive relationship between ego-depletion and alcohol-related self-control failure was stronger for female students than male students among Sample 1 but not Sample 2 participants. These findings are considered further in Table 25, which indicates that Sample 1 was comprised of significantly fewer male students than

Sample 1. The low number of male students in Sample 1 suggests that findings may lack generalizability toward the male student body and be more prone to the influence of statistical outliers (i.e., estimates involving gender may lack reliability and replicability).

In the following discussion, I begin by examining inconsistent findings within the ego-depletion literature. Potential moderators of ego-depletion are considered and assessed in relation to the lack of support for the relationship between ego-depletion and alcohol-related self-control failure. In the second section, I attempt to understand why ego-depletion and constructs involved in the operationalization of alcohol-related self-control failure (i.e., alcohol consumption and drink limits) were significantly impacted by temporal context. In the third section, I revisit the role of ego-depletion in a student-drinking context. In the fourth section, I discuss the influence of temporal and situational factors (i.e., ego-depletion) on drinking limitation goals and in turn, alcohol-related self-control failure. To conclude, I propose directions for future research and treatment implications.

Moderators of Ego-Depletion

Despite its long history and rich tradition within social psychological science, ego-depletion research has been the target of recent skepticism among experts in the field (e.g., Inzlicht, Schmeichel, & Macrae, 2013). In particular, researchers have raised important questions about both a) the underlying veracity of supposed depletion mechanisms (i.e., glucose metabolism) and b) limited generalizability due to important moderating variables (see Mann, de Ritter, & Fujita, 2013; Inzlicht et al., 2013). Among the different moderating variables that have been shown to attenuate depletion effects are task motivation (i.e., offering cash incentives for follow-up depletion tasks), believing that self-control is unlimited, rest, positive mood inductions, and even praying (see Mann et al., 2013 for a review). Notably, researchers have also

questioned the generalizability of ego-depletion effects across different behavioural domains and heterogeneous participant groups (e.g., Lurquin et al., 2016). Much of the recent interest in moderators of ego-depletion has surfaced because of mixed effects within the literature (see Hagger, Wood, Stiff, & Chatzisarantis, 2010 for a meta-analysis; Lurquin et al., 2016).

As noted by Hagger and colleagues, one of the primary moderators of ego-depletion includes the nature of the follow-up behavioural task. To assess the impact of ego-depletion on self-control performance, Hagger and colleagues note that researchers have placed demands on participates to engage in a variety of different tasks (i.e., some requiring the control of attention, others requiring the suppression of emotions, impulses, thoughts, etc; see Baumeister, Vohs, & Tice, 2007). While the strength-energy model is suspected to draw upon the same "limited resource" for tasks involving all of these elements (Baumeister, Bratslavsky, Muraven, & Tice, 1998), Hagger and colleagues considered that ego-depletion may depend upon which of these self-control "ingredients" are engaged within sequential laboratory tasks.

Based on their meta-analytic findings, Hagger and colleagues concluded that the generalizability of depletion effects is not significantly impacted by the nature of follow-up self-control tasks. However, no attempt was made to examine how contextual and/or demographic variables interact with the nature of self-control tasks to influence the generalizability of ego-depletion findings (i.e., whether some groups of people experience greater ego-depletion after tasks involving thought suppression, emotional suppression, impulse control [etc.] than others). Furthermore, Hagger and colleagues examined differences among very specific ingredients of self-control rather than assessing how ego-depletion differ across broad self-control (behavioural) domains (i.e., exerting self-control in a drinking context, exercise context, eating context, etc.).

Results from the current study raise important questions about whether or not the nature of the self-control task (i.e., "*what the self-control task is*") interacts with contextual and/or demographic factors (i.e., "*who the self-control performers are*") to impact upon the generalizability of depletion findings. If most university students experience alcohol as lacking in potency or motivational salience, ego-depletion may not be expected to facilitate alcohol-related self-control failure compared to other demographic samples (i.e., clinical populations of individuals with physiological dependence). Several analogous examples serve as equally useful examples about how demographic factors might interact with the nature of the self-control task to influence ego-depletion findings. Consider the widely-used ego-depletion manipulation in which participants are asked to suppress emotional responses during an evocative film (e.g., Schmeichel, Vohs, & Baumeister, 2003). Participants with psychopathic traits (i.e., cold, callous, and emotionally disconnected) may not necessarily experience the same degree of difficulty suppressing non-existent or weak emotional reactions relative to individuals who possess the capacity for empathy. To take another example, participants who have never been exposed (or only modestly exposed) to Facebook may have little difficulty resisting the social media website following a long and taxing day. Whether a response is to be appropriately classified as a "self-control task," – i.e., *"…rated as high in difficulty, effort, and unpleasantness* (see Hagger et al., 2010, p. 500) – likely depends upon a) what the activity is, and b) who is performing the activity.

Time Matters: A Temporal Perspective of Ego-Depletion and Self-Control Failure

Time has been implicated as an important moderator of both ego-depletion and alcohol consumption among post-secondary students. In one of the few available ecological studies on ego-depletion, for example, Hofmann, Vohs, and Baumeister (2012) used a momentary assessment methodology to examine diurnal and weekly variation in desire strength. Across 15

different temptations, they found that desire strength differed as a function of both the time of day and week of assessment. Because participants were shown to make active attempts to resist desires that varied in strength throughout the day and/or week, Hofmann and colleagues' findings suggest that ego-depletion may be more prominent at different times of the day and/or week. With regard to alcohol consumption, researchers have consistently found that university students tend to consume more alcohol on Fridays and Saturdays, event-specific holidays (e.g., Halloween and St. Patrick's Day), and at the beginning of an academic semester (e.g., Welcome Weeks; Del Boca, Darkes, Greenbaum, & Goldman, 2004; Tremblay et al., 2010). These findings point toward the influence of temporal context on alcohol consumption (and by virtue, alcohol-related self-control failure).

In the current study, ego-depletion was also found to vary across time. In particular, ego-depletion was found to be consistently higher on Sundays relative to Fridays and Saturdays. In light of the existing link between future-oriented thinking and self-regulatory fatigue (e.g., Linden, Frese, & Meijman, 2003), students may have experienced greater ego-depletion on Sundays while planning and organizing their activities for the upcoming week. Findings also showed that need satisfaction buffered against the depleting effects of self-control demands on some days of the week more than others did. For example, Sample 1 findings showed that need satisfaction served a greater buffering role on Fridays and Saturdays compared to Thursdays and Sundays. These findings can be interpreted within the context of previous research showing that levels of need satisfaction peak during weekends before descending again during weekdays (Reis, Sheldon, Gable, Roscoe, and Ryan, 2000; Ryan, Bernstein, & Brown, 2010). If Sample 1 participants experienced a greater sense of autonomy, relatedness, and competence on Fridays

and Saturdays, the stronger "dosage" of psychological nutriments may have been more effective in terms of replenishing lost resources following taxing situations (Ryan & Deci, 2008).

Unlike Sample 1 findings, there was no difference in the buffering role of need satisfaction against ego-depletion between Thursdays and Sundays versus Fridays and Saturdays for Sample 2 participants, suggesting a possible effect of the end of the Spring academic term. If Fridays and Saturdays accompanied less need satisfaction during Spring exams (Sample 2) compared to the middle of the fall term (Sample 1), replenishment may have been less effective (i.e., less potent) during Fridays and Saturdays for Sample 2 participants compared to Sample 1 participants. Interestingly, the replenishing role of need satisfaction was higher on Fridays relative to Saturdays for Sample 2 participants following exposure to self-control demands. The likelihood of experiencing taxing situations may have been much greater on Fridays than Saturdays (particularly if students had Friday classes, assignments due, etc.), thereby making the buffering role of need satisfaction more important (and more statistically significant) on Fridays relative to Saturdays.

At the level of each week, findings showed that need satisfaction served a stronger buffering effect against ego-depletion on Week 2 versus Week 1 (Halloween Weekend) for Sample 1 participants. Students may have been increasingly likely to engage in leisure activities (e.g., TV viewing; physical activity; etc.) and/or experience a positive mood shift during holidays (i.e., Halloween) that have been shown to have replenishing effects similar to that of psychological need satisfaction (see Inzlicht & Schmeichel, 2012; Inzlicht, Schmeichel, & Macrae, 2013 for reviews). The revitalizing function of psychological need satisfaction, therefore, may not have been as important in the context of various other replenishing mechanisms during holiday periods.

Consistent with previous research (e.g., Del Boca, Darkes, Greenbaum, & Goldman, 2004; Tremblay et al., 2010), students were more likely to consume larger amounts of alcohol on Fridays and Saturdays compared to Thursdays and Sundays. Researchers wishing to operationalize self-control failure in accordance with their own standards of overindulgence (i.e., rather than participants own drinking limits) may interpret these findings as suggesting a greater propensity toward volitional breakdown during Fridays and Saturdays compared to Thursdays and Sundays. In the current study, however, alcohol-related self-control was operationalized in accordance with students' own drinking limits rather than an objective benchmark defined by the researcher. Because self-imposed drink limits were shown to be more lenient (and harder to violate) during the same occasions that were associated with higher levels of drinking (i.e., Fridays and Saturdays), higher quantities of alcohol consumption were not necessarily associated with greater rates of alcohol-related self-control failure.

While the temporal context (i.e., day of the week and week of assessment) clearly seemed to influence each individual facet of alcohol-related self-control failure (i.e., alcohol consumption and drink limits), the relationship between ego-depletion and self-control failure did not seem to depend on the day of the week or week of assessment. It is unclear as to whether temporal context would have moderated the relationship between ego-depletion and self-control failure if, in the population of interest (i.e. university students), alcohol consumption was impacted in a manner more consistent with the assumptions embedded within the strength-energy model of self-control (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Muraven & Baumeister, 2000).

Too Tired to Drink: Reconsidering Drinking Motives among University Students

In a series of post-hoc analyses, findings showed that ego-depletion *does not* confer risk for alcohol-related self-control failure (operationalized as drink limits minus alcohol consumption). In fact, after accounting for the relationship between ego-depletion and (lower) drink limits, findings showed that ego-depletion was either not associated with alcohol consumption (Sample 1) or associated with less (not more) alcohol consumption (Sample 2). These findings raise the important question, "*Contrary to the strength-energy model of self-control, why doesn't ego-depletion seem to confer vulnerability toward alcohol consumption among university students?"*

In attempting to address this question, it became necessary to explore why students drink alcohol in the first place (i.e., student drinking motives). For over two decades, the literature on drinking motives has conceptualized three main reasons for consuming alcohol: (1) social motives (i.e., drinking to obtain social benefits), (2) enhancement motives (i.e., drinking to increase positive affect), and (3) coping motives (i.e., drinking to reduce negative affect; Cooper, Russel, Skinner, & Windle, 1992). Two years later, Cooper (1994) also considered a fourth "conformity motive" (i.e., drinking to avoid rejection), which she speculated (in addition to social motives) may be particularly salient among young persons. Researchers have since corroborated Cooper's predictions by demonstrating the strong influence of conformity and social drinking motives among post-secondary students (e.g., Neighbors, Larimer, Geisner, & Knee, 2004). A number of compelling anecdotes also exist within the literature from students discussing the social pressures and expectations they experience to drink alcohol within university and college settings (e.g., Rabow & Duncan-Schill, 1995).

What is the relevance of this body of literature toward the unforeseen relationship between ego-depletion and alcohol consumption? To the extent that students feel controlled in their drinking behaviours (i.e., like they "have to" drink in order to fit-in, gain social approval, etc.), alcohol consumption may be viewed more appropriately as a controlled activity rather than as a behaviour students enjoy for its own sake (Ryan & Deci, 2000). Provided that significant energy is needed to partake in controlled regulatory acts (Moller, Deci, & Ryan, 2006), alcohol consumption may not appear particularly appealing to students in the context of self-regulatory fatigue. Consistent with this reasoning, Hoffman, Vohs, and Baumeister (2012) found that participants (73% university students) reported desires for alcohol and tobacco as having the lowest strength among 15 different temptations (e.g., leisure, sleep, sex, eating, nonalcoholic drinks, media use, etc.). Additionally, they found that participants were overwhelmingly successful at resisting alcohol-related temptations when they arose, suggesting that it may not have been particularly difficult for students to override weak alcohol-related "desires." These findings compliment the drinking motives literature in suggesting a) that the majority of students may not be tempted by alcohol.

There are compelling theoretical reasons to suspect that students may be less motivated to engage in controlled drinking behaviours following exposure to taxing situations (see Inzlicht & Schmeichel, 2012; Inzlicht, Schmeichel, & Macrae, 2013). After exerting self-control during initially taxing situations, Inzlicht and colleagues suggest that individuals experience an evolutionarily endowed motivational and attentional shift away from controlled behaviours that people feel they "have to" perform toward autonomous behaviours that people feel like they "want to" perform. Consistent with this idea, students in the current study may have experienced a motivational and attentional shift away from controlled drinking behaviours after experiencing

ego-depletion from taxing self-control demands throughout the day. It is also worth noting that social drinking events often require the investment of significant energy (e.g., transporting oneself to a bar or friends house, self-monitoring in social situations, etc.). In the context of ego-depletion, the energy available to engage in controlled drinking behaviours may seem insufficient in relation to the energy investment required to consume alcohol. Proximal leisure temptations (e.g., media usage; sleeping; etc.) may be seen as a welcomed alternative to drinking behaviour following taxing days and perceptions of ego-depletion.

It is not only interesting to look at the relationship between ego-depletion and alcohol consumption from the perspective of students drinking less when depleted and mentally exhausted, it is also interesting to consider that students drank more alcohol when feeling alive and vital. This finding is particularly intriguing when interpreted in the context of the rising epidemic among post-secondary students toward the joint consumption of energy drinks and alcoholic beverages (Kapner, 2008; Malinauskas, Aeby, Overton, Carpenter-Aeby, & Barber-Heidal, 2007). There appears to be something very important to university students about feeling energetic that increases the motivational salience of drinking behaviour. If drinking is, in fact, an exhausting and controlled undertaking for university students, it makes sense why energy (in the form of caffeinated beverages) would be a coveted resource while participating in social drinking events. In light of the existing link between controlled behavioural enactments and resource depletion (e.g., Moller, Deci, & Ryan, 2006), it would be interesting to examine if, after drinking for social and/or conformity reasons, students experience greater levels of ego-depletion and a resulting tendency toward the use of energy (or other caffeinated) drinks for compensatory reasons.

Daily and Situational Changes in Drinking Limitation Goals

The current research adds to the existing literature on student drinking by exposing the cognitive goal-setting processes underlying alcohol consumption and self-control failure. Consistent with temporal studies of student drinking (e.g., Del Boca, Darkes, Greenbaum, & Goldman, 2004; Tremblay et al., 2010), findings showed that students consumed greater amounts of alcohol on Fridays and Saturdays relative to Thursdays and Sundays. However, despite higher rates of consumption, the probability of experiencing alcohol-related self-control failure on Fridays and Saturdays was significantly lower than on Thursdays and Sundays relative to Fridays and Saturdays. Across both independent samples, post-hoc findings showed that this paradox could be explained by the fact that students set significantly higher (i.e., more lenient) drink limits on Fridays and Saturdays that were harder to violate. In essence, students "cheated" on Fridays and Saturdays by setting limitation goals that were more difficult to violate.

There are at least two explanations for the observed shift in goal leniency on Fridays and Saturdays relative to Thursdays and Sundays. First, there is some evidence to suggest that students experience stronger social pressures and normative influence to drink on weekends relative to weekdays (e.g., Rabow & Duncan-Schill, 1995). If students forecasted that it would be difficult for them to "say no" or resist peer influence on Fridays and Saturdays, they may have been more likely to set lenient drinking limits as a form of psychological safety. Indeed, the formation of lenient limitation goals would provide an infallible way to sidestep self-control failure in the face of strong social pressures to drink. A second reason underlying the observed shift toward lenient weekend drink limits may be related to academic contingencies and student workload (Del Boca, Darkes, Greenbaum, & Goldman, 2004; Rabow & Duncan-Schill, 1995; Rabow & Neuman, 1984). Specifically, students may have found it more acceptable to set

lenient drink limits during periods of academic downtime (e.g., Fridays and Saturdays), particularly if they were not required to attend class the following morning.

In addition to daily variation across the weekend, findings showed that situational ego-depletion had a significant effect on the relative leniency of drink limits. In particular, alcohol consumption seemed even less appealing to students in the context of ego-depletion, as evidenced by the fact that students planned to drink less on evenings when they reported greater ego-depletion. Interestingly, three-way interaction findings implicated ego-depletion as a particularly strong correlate of stricter limitation goals during high-risk drinking occasions (e.g., Fridays and Saturdays; Halloween). On Halloween, for example, students set maximum drink limits near the binge-drinking cut-off when they felt more alive and energetic (i.e., between 3-4 drinks and 5-6 standard drinks) and drink limits that were moderate in content when they felt more ego-depleted (i.e., between 1-2 and 3-4 standard drinks). Because students established stricter limitation goals when they were mentally fatigued, they were also more likely to violate those goals and experience self-control failure.

Drawing again upon the drinking motives literature, it is worth speculating about the energy costs associated with drinking behaviours that are largely controlled (i.e., performed for social and conformity reasons) for a large proportion of the student population (Neighbors, Larimer, Geisner, & Knee, 2004; Rabow & Duncan-Schill, 1995). If students were feeling vital and full of energy, they may have perceived themselves as having the requisite energy to engage in controlled acts of drinking that presumably require such resource investment. Furthermore, it seems likely that any such perception (i.e., of being full of energy) would be reflected in higher rather than lower drinking limits.

Although researchers have strongly championed physiological (e.g., Gailliot et al., 2007) and motivational (e.g., Inzlicht, Schmeichel, & Macrae, 2013) explanations for depletion effects, findings from the current research indicate that cognitive changes (i.e., shifting goal content) may also explain the relationship between ego-depletion and self-control failure. Notably, shifting (i.e., lower) goals may only be a relevant mechanism if the behavioural outcome (e.g., alcohol consumption) – as it may have been in this case – lacks potency and/or occurs infrequently within the sample. If university students are not generally tempted or attracted by alcohol (Hofmann, Vohs, & Baumesiter, 2012), it makes sense that they would plan to drink even less in the context of ego-depletion. Alternatively, if researchers were to examine clinical samples of individuals with alcohol dependency, they may find that ego-depletion accompanies no change in limitation goals or higher (i.e., more lenient) drink limits. As noted below, further research is needed to examine the impact of ego-depletion on goal-setting processes in the context of mediational models with different populations and behavioural outcomes.

Limitations and Future Research

In keeping with spirit of the current study, one of the most important avenues for future research involves attempts to replicate the current findings. Replication efforts will be particularly important for the current study since findings were found to run contrary to the assumptions embedded within the strength-energy model (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Muraven & Baumeister, 2000). Additional research in this area may provide researchers will a much richer understanding about the motivational and energy dynamics associated with student drinking, and lead to changes in the way that student drinkers are perceived in the media and society at large.

Across all participants and all occasions, students in both samples reported an average rate of alcohol consumption that was less than 1-2 standard drinks. It should be noted that these statistics portray somewhat of an underestimation of "true" drinking rates within each sample, as alcohol consumption and/or (higher) drink limits were associated with the presence of missing data. Nonetheless, these descriptive statistics findings suggest that many (if not the majority) of students seem to be responsible drinkers. While we currently know a great deal about prevalence rates and consequences of hazardous forms of drinking in college and university settings, far less is known about how post-secondary students manage to stay "dry" within high-risk campus environments. This imbalance within the literature highlights the need for further research adopting resilience and self-regulatory frameworks in a student-drinking context.

There is also growing evidence suggesting that the effect of ego-depletion on subsequent self-control performance may not be as strong or robust as the extant literature suggests (see Lurquin et al., 2016). It is possible, therefore, that current findings accurately reflect a psychological phenomenon that simply does not exist (e.g., Carter, Kofler, Forster, & McCullough, 2015; Carter & McCullough, 2014). It is also possible that ego-depletion exists, but only under specific conditions. As noted by Lurquin and colleagues, *"ego-depletion may be easier to detect with particular types of self-control tasks or with particular types of participants"* (p. 189). In light of mixed findings (including the current study), there is substantial need to examine potential moderators of ego-depletion using different samples and behavioural (self-control) outcomes.

In a student-drinking context, researchers may also wish to examine ego-depletion using different sub-populations of university and college students. Specifically, it will be important to examine whether or not ego-depletion functions differently for heavy versus low-moderate

student drinkers comprising the current two samples. Researchers who manage to attain greater variation among student drinking behaviours may find, that after long and taxing days, heavy drinkers set higher (rather than lower) drink limits and consume more (rather than less) alcohol. Researchers may also wish to adopt different methodological approaches for investigating ego-depletion among student drinkers. For example, researchers can invoke laboratory manipulations (e.g., thought suppression tasks) to ensure that some students are depleted (i.e., experimental condition) while others are not (i.e., control participants) before exposing them to high-risk drinking situations. If depletion effects lack generalizability using different student samples and/or methodological approaches, researchers may wish to examine alternative student health-behaviours within a strength-energy model framework. Consistent with the mandate of the current study, it will also be important to clarify if and how different forms of self-regulation (i.e., controlled versus autonomous) interact with ego-depletion to influence self-control outcomes.

An equally important avenue for future research is to examine the mechanisms by which ego-depletion contributes to impaired self-control performance. Indeed, it is of paramount importance to understand how ego-depletion affects subsequent self-control performance so that treatment efforts can be tailored to intervene within the underlying process mechanisms. As previously noted, there is a great deal of disagreement among researchers about the processes underlying ego-depletion and self-control impairment. While some researchers have invoked physiological explanations to explain ego-depletion effects (e.g., depleted blood glucose; e.g., Gailliot et al., 2007), others have proposed that a motivational and attentional shift occurs following exposure to taxing situations (e.g., Inzlicht, Schmeichel, & Macrae, 2013). Findings

from the current study suggest, that in some contexts, a cognitive goal-setting mechanism may also underlie the relationship between ego-depletion and self-control failure.

Treatment Implications

Although I use this section as an opportunity to propose ideas for intervention, findings are too new to justify the mobilization of findings into clinical or community practice. It is important to note that the current study is limited primarily to low-moderate (female) student drinkers and lacking in generalizability to the full spectrum of university students. The intervention strategies noted below are intended only to stimulate further thought, and should not be implemented in the absence of further evidence.

The current study highlights the potential utility of event-specific interventions tailored specifically to university students during temporal periods of risk (see Neighbors et al., 2007). Since students planned to consume (and did consume) more alcohol during Fridays and Saturdays (particularly Halloween), resources might be effectively (and efficiently) directed toward event-specific interventions on Fridays and Saturdays (particularly if Halloween falls on a Friday or Saturday).

A common motivational intervention used to curb heavy patterns of student drinking has involved targeting misperceptions of drinking norms on college and university campuses (e.g., Bewick et al., 2010; LaBrie, Hummer, Neighbors, & Pedersen, 2008; Neighbors, Larimer, & Lewis, 2004;). One of the main objectives of this prevention strategy is to increase the discrepancy between normative rates of alcohol consumption in relation to student's own drinking behaviour. In essence, this method of treatment encourages students to limit their alcohol consumption because their peers are doing the same. Although this approach has acquired a great deal of empirical support (e.g., Agostinelli, Brown, & Miller, 1995; Neighbors,

Larimer, & Lewis, 2004), current findings suggest that it may also be important to facilitate students' autonomous motivation for limiting alcohol consumption. Specifically, post-hoc findings showed that students with controlled drinking motives tended to set much higher drink limits and tended to violate lower drink limits. Although controlled motives can sometimes provide effective ways to promote short-term behavioural change, research shows that effective long-term changes are made when individuals begin to internalize the importance of abstinence or moderation goals (see Ng et al., 2012 for a review). Thus, brief interventions involving motivational interviewing techniques (e.g., increasing ambivalence; using the student's own change talk; "rolling" with client resistance) may be an effective means of supporting student autonomy and drinking-related behaviour change (see Markland, Ryan, Tobin, & Rollnick, 2005).

Current findings also highlight the importance of attending to temporal fluctuations in students' subjective vitality. Specifically, students reported higher maximum drink limits when they experienced a greater sense of feeling alive and energetic. Mixed findings also showed that Sample 2 participants (but not Sample 1 participants) consumed more alcohol when they experienced a greater sense of feeling alive and energetic. Health services providers may wish to attend to annual and/or weekly changes in factors that might affect students' subjective sense of energy (e.g., academic schedules; seasonal changes; etc.), since students may be at greater risk for heavy alcohol consumption and associated consequences during these time periods. Interventionists might choose to help students brainstorm ways to mobilize their energy toward sober activities during high-risk occasions.

Conclusion

Among university students, ego-depletion was not shown to be a psychological vulnerability factor linking self-control demands during the day to alcohol-related self-control failure at night. Further, the type of self-regulation students reported for limiting alcohol consumption at night did not strengthen the relationship between ego-depletion and alcohol-related self-control failure. Contrary to popular belief, this research demonstrates that students experiencing ego-depletion at night are not necessarily at-risk of consuming greater amounts of alcohol. In fact, some evidence was obtained to suggest that ego-depletion may curb (rather than enhance) student drinking behaviours.

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Appendix A

Table 1.

Descriptive statistics for Sample 1 and 2 participants

	Sample 1 (Fall, 2015)		Sample 2 (Spring, 2016)	
	N	Percentage	N	Percentage
Student-Level				
Gender				
Female	149	85%	157	77%
Male	25	14%	46	23%
Both or Neither	1	<1%	1	<1%
Age (years)				
19 and under	79	45%	58	28%
20 – 22	76	43%	117	57%
23 and above	20	11%	29	14%
Ethnicity				
Caucasian	133	76%	128	63%
Chinese/East Asian	17	10%	30	15%
Other	25	14%	46	23%
Alcohol Consumption[a]				
None	23	14%	30	15%
1-2 Standard Drinks	139	82%	161	81%
3-4 Standard Drinks	7	4%	8	4%
5-6 Standard Drinks	2	1%	0	0%
7-8 Standard Drinks	1	<1%	1	<1%
9-10 Standard Drinks	0	0%	0	0%
10+ Standard Drinks	0	0%	0	0%

Note. Sample 1 (N = 175); Sample 2 (N = 204).
[a]Sample 1 (Valid N= 170); Sample 2 (Valid N = 200)

Table 2.

Descriptive statistics for all participants and demographic subgroups

	Male β (*SE*)	Female β (*SE*)	19 and Under β (*SE*)	20-22 β (*SE*)	23 and Above β (*SE*)	Total Sample β (*SE*)	ICC
SCD							
Sample 1	4.07 (.13)	4.54 (.12)	4.30 (.19)	4.59 (.16)	4.77 (.39)	4.48 (.12)	.48
Sample 2	3.71 (.23)	4.38 (.14)	4.59 (.23)	4.02 (.15)	4.27 (.25)	4.22 (.12)	.58
Need Satisfaction							
Sample 1	4.59 (.14)	4.58 (.06)	4.64 (.08)	4.53 (.07)	4.53 (.15)	4.58 (.05)	.38
Sample 2	4.53 (.10)	4.49 (.06)	4.73 (.08)	4.60 (.07)	4.75 (.14)	4.66 (.05)	.41
Ego-Depletion							
Sample 1	3.84 (.19)	4.20 (.08)	4.14 (.12)	4.09 (.11)	4.39 (.23)	4.14 (.08)	.43
Sample 2	3.78 (.15)	4.69 (.06)	3.92 (.14)	4.02 (.09)	3.94 (.19)	3.98 (.07)	.47
RCR							
Sample 1	-1.24 (.28)	-2.01 (.12)	-1.83 (.18)	-1.79 (.17)	-2.47 (.31)	-1.89 (.11)	.75
Sample 2	-1.38 (.21)	-2.13 (.13)	-1.75 (.19)	-1.85 (.15)	-2.80 (.29)	-1.95 (.11)	.79
Autonomous Regulation							
Sample 1	4.12 (.31)	5.01 (.11)	4.92 (.16)	4.84 (.16)	4.87 (.29)	4.88 (.11)	.77
Sample 2	4.68 (.22)	5.25 (.11)	5.07 (.19)	5.06 (.13)	5.42 (.20)	5.11 (.10)	.80
Controlled Regulation							
Sample 1	2.88 (.33)	3.00 (.11)	3.09 (.16)	3.06 (.15)	2.39 (.27)	2.99 (.11)	.79
Sample 2	3.31 (.21)	3.12 (.12)	3.32 (.20)	3.21 (.13)	2.62 (.25)	3.16 (.10)	.80
Self-Control Failure							
Sample 1	-.48 (.14)	-.41 (.04)	-.36 (.06)	-.51 (.07)	-.34 (.13)	-.42 (.04)	.16
Sample 2	-.36 (.11)	-.36 (.04)	-.41 (.06)	-.31 (.06)	-.41 (.08)	-.36 (.04)	.22
Drinking Limits							
Sample 1	2.32 (.29)	1.33 (.09)	1.37 (.14)	1.59 (.14)	1.57 (.30)	1.49 (.10)	.27
Sample 2	1.82 (.19)	1.34 (.11)	1.25 (.13)	1.54 (.13)	1.70 (.30)	1.48 (.10)	.33
Alcohol Consumption							
Sample 1	1.07 (.13)	.66 (.05)	.71 (.07)	.71 (.07)	.76 (.11)	.72 (.05)	.09
Sample 2	.89 (.14)	.52 (.04)	.56 (.06)	.59 (.06)	.71 (.14)	.60 (.05)	.18

ICC = Intraclass Correlation Coefficient; SCD = Self-Control Demands; RCR = Relative Controlled Regulation

Table 3.

Orthogonal coding for 3 Day of the Week contrasts

Thursday	Friday	Saturday	Sunday
-1	0	0	1
0	-1	1	0
-1	1	1	-1

Table 4.

Hypothesis 1: Accounting for Day of the Week (DV = Ego-Depletion)

	Unconditional Model		Moderation Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	4.15** (.08)	3.98** (.07)	4.14** (.08)	3.98** (.07)
Thu vs. Sun			.14** (.04)	.14** (.03)
Fri vs. Sat			.03 (.04)	.03 (.03)
Thu/Sun vs. Fri/Sat			-.11** (.02)	-.01 (.02)
SCD			.14** (.02)	.12** (.01)
NS			-.53** (.03)	-.51** (.03)
Interaction Effects				
Thu vs. Sun * SCD			.00 (.03)	-.01 (.02)
Fri vs. Sat * SCD			.01 (.02)	.00 (.02)
Thu/Sun vs. Fri/Sat * SCD			-.03 (.02)	.00 (.01)
Thu vs. Sun * NS			.03 (.05)	-.01 (.03)
Fri vs. Sat * NS			-.03 (.05)	-.02 (.04)
Thu/Sun vs. Fri/Sat * NS			-.02 (.03)	.05* (.03)
SCD * NS			-.04 (.02)	.00 (.02)
Thu vs. Sun * SCD * NS			.03 (.03)	.03 (.02)
Fri vs. Sat * SCD * NS			-.03 (.03)	.06** (.02)
Thu/Sun vs. Fri/Sat * SCD * NS			-.06** (.02)	.01 (.02)
Random Effects				
Level 1 Variance (σ^2)	1.20 (1.10)	1.09 (1.04)	.90 (.95)	.85 (.92)
Random Intercept (u_{0i})	.85 (.92)	.92 (.96)	.89 (.94)	.94 (.97)
Model Fit				
Deviance (-2 LL)	4951.70	7802.40	4515.30	7182.50
AIC	4957.70	7808.40	4551.30	7218.50

SCD = Self-Control Demands; NS = Need Satisfaction
Contrast Codes: Thu = 0 Sun = 1; Fri = 0 Sat = 1; Thu/Sun = 0 Fri/Sat = 1
*p < .05, **p <.01

Table 5.

Sample 1: Orthogonal coding for Week of Assessment contrasts

Week 1	Week 2	Week 3
-1	1	0
-1	-1	2

Table 6.

Sample 2: Orthogonal coding for Week of Assessment contrasts

Week 1	Week 2	Week 3	Week 4
1	-1	0	0
0	0	-1	1
-1	-1	1	1

Table 7.

Hypothesis 1: Accounting for Week of Assessment (DV = Ego-Depletion)

	Unconditional Model		Moderation Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	4.15** (.08)	3.98** (.07)	4.17** (.08)	3.98** (.07)
Week 1 vs. 2			-.02 (.03)	.02 (.03)
Week 3 vs. 4				-.04 (.03)
Week 1/2 vs. 3			.03 (.02)	
Week 1/2 vs. 3/4				.02 (.02)
SCD			.14** (.02)	.11** (.01)
NS			-.54** (.03)	-.50** (.03)
Interaction Effects				
Week 1 vs. 2 * SCD			.02 (.02)	.01 (.02)
Week 3 vs. 4 * SCD				-.02 (.02)
Week 1/2 vs. 3 * SCD			.00 (.01)	
Week 1/2 vs. 3/4 * SCD				.00 (.02)
Week 1 vs. 2 * NS			.10* (.04)	.00 (.04)
Week 3 vs. 4 * NS				.07 (.04)
Week 1/2 vs. 3 * NS			.03 (.03)	
Week 1/2 vs. 3/4 * NS				.09** (.03)
SCD * NS			-.02 (.02)	.00 (.02)
Week 1 vs. 2 * SCD * NS			-.07** (.02)	.01 (.02)
Week 3 vs. 4 * SCD * NS				.01 (.02)
Week 1/2 vs. 3 * SCD * NS			.00 (.01)	
Week 1/2 vs. 3/4 * SCD * NS				.02 (.02)
Random Effects				
Level 1 Variance (σ^2)	1.20 (1.10)	1.09 (1.04)	.92 (.96)	.85 (.92)
Random Intercept (u_{0i})	.85 (.92)	.92 (.96)	.89 (.94)	.93 (.97)
Model Fit				
Deviance (-2 LL)	4951.70	7802.40	4543.70	7200.70
AIC	4957.70	7808.40	4571.70	7236.70

SCD = Self-Control Demands; NS = Need Satisfaction

Sample 1 Contrast Codes: Week -1 = 0 Week 2 = 1; Week 1/2 = -1 Week 3 = 2

Sample 2 Contrast Codes: Week 1 = 1 Week 2 = -1; Week 3 = -1 Week 4 = 1; Week 1/2 = -1 Week 3/4 = 1

*p < .05, **p <.01

Table 8.

Hypothesis 1: Accounting for Gender (DV = Ego-Depletion)

	Unconditional Model		Moderation Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	4.15** (.08)	3.98** (.07)	4.19** (.08)	4.02** (.08)
Gender[a]			-.35 (.22)	-.25 (.16)
SCD			.15** (.04)	.12** (.02)
NS			-.54** (.02)	-.48** (.03)
Interaction Effects				
Gender * SCD			-.09 (.06)	-.04 (.03)
Gender * NS			-.07 (.10)	-.05 (.03)
SCD * NS			-.04 (.02)	.00 (.02)
Gender * SCD * NS			.07 (.08)	-.02 (.04)
Random Effects				
Level 1 Variance (σ^2)	1.20 (1.10)	1.09 (1.04)	.92 (.96)	.84 (.92)
Random Intercept (u_{0i})	.85 (.92)	.92 (.96)	.87 (.93)	.93 (.96)
Model Fit				
Deviance (-2 LL)	4951.70	7802.40	4531.10	7134.80
AIC	4957.70	7808.40	4551.10	7154.80

SCD = Self-Control Demands; NS = Need Satisfaction

[a]Female = 0 Male = 1; one participant in each sample was removed due to non-identification with male or female Gender categories

*p < .05, **p <.01

Table 9.

Hypothesis 1: Accounting for Age (DV = Ego-Depletion)

	Unconditional Model		Age Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	4.15** (.08)	3.98** (.07)	4.24** (.36)	3.90** (.12)
Age[a]			.00 (.02)	.03 (.04)
SCD			.14** (.02)	.13** (.02)
NS			-.48** (.04)	-.39** (.05)
Interaction Effects				
Age * SCD			.00 (.00)	-.01 (.01)
Age * NS			-.02 (.01)	-.04**(.02)
SCD * NS			-.04 (.03)	-.03 (.03)
Age * SCD * NS			.00 (.01)	.01 (.01)
Random Effects				
Level 1 Variance (σ^2)	1.20 (1.10)	1.09 (1.04)	.93 (.96)	.86 (.93)
Random Intercept (u_{0i})	.85 (.92)	.92 (.96)	.88 (.94)	.94 (.97)
Model Fit				
Deviance (-2 LL)	4951.70	7802.40	4557.80	7212.30
AIC	4957.70	7808.40	4577.80	7232.30

SCD = Self-Control Demands; NS = Need Satisfaction

[a]centered at the youngest Age in each sample (18 years old) to increase interpretability of the intercept and reduce multicollinearity; *p < .05, **p <.01

Table 10.

Hypothesis 2: Accounting for Day of the Week (DV = Self-Control Failure)

	Unconditional Model		Moderation Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	-.42** (.04)	-.36** (.04)	-.43** (.04)	-.37** (.04)
Thu vs. Sun			.04 (.04)	-.01 (.03)
Fri vs. Sat			-.02 (.04)	.03 (.03)
Thu/Sun vs. Fri/Sat			-.10** (.03)	-.14** (.02)
DEP			.06* (.03)	.00 (.02)
RCR			.00 (.04)	-.02 (.02)
Interaction Effects				
Thu vs. Sun * DEP			.00 (.04)	.01 (.03)
Fri vs. Sat * DEP			-.04 (.04)	.01 (.03)
Thu/Sun vs. Fri/Sat * DEP			.02 (.03)	.00 (.02)
Thu vs. Sun * RCR			-.03 (.05)	.00 (.04)
Fri vs. Sat * RCR			.02 (.05)	.03 (.04)
Thu/Sun vs. Fri/Sat * RCR			.02 (.04)	.01 (.03)
DEP * RCR			-.01 (.03)	.00 (.02)
Thu vs. Sun * DEP * RCR			.02 (.05)	.00 (.03)
Fri vs. Sat * DEP * RCR			-.08 (.05)	-.03 (.03)
Thu/Sun vs. Fri/Sat * DEP * RCR			-.06 (.03)	.08 (.02)
Random Effects				
Level 1 Variance (σ^2)	.87 (.93)	.87 (.76)	.84 (.92)	.86 (.74)
Random Intercept (u_{0i})	.16 (.40)	.20 (.45)	.16 (.40)	.19 (.44)
Model Fit				
Deviance (-2 LL)	3351.00	5318.60	3294.60	5231.30
AIC	3357.00	5324.60	3330.60	5267.30

DEP = Ego-Depletion; RCR = Relative Controlled Regulation
Contrast Codes: Thu = 0 Sun = 1; Fri = 0 Sat = 1; Thu/Sun = 0 Fri/Sat = 1
*p < .05, **p <.01

Table 11.

Hypothesis 2: Accounting for Week of Assessment (DV = Self-Control Failure)

	Unconditional Model		Week Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	-.42** (.04)	-.36** (.04)	-.43** (.04)	-.36** (.04)
Week 1 vs. 2			-.01 (.03)	-.01 (.03)
Week 3 vs. 4				-.04 (.03)
Week 1/2 vs. 3			.00 (.01)	
Week 1/2 vs. 3/4				-.05* (.02)
DEP			.07** (.03)	.01 (.02)
RCR			.01 (.04)	-.03 (.03)
Interaction Effects				
Week 1 vs. 2 * DEP			-.02 (.03)	.02 (.03)
Week 3 vs. 4 * DEP				.02 (.03)
Week 1/2 vs. 3 * DEP			.02 (.05)	
Week 1/2 vs. 3/4 * DEP				.01 (.02)
Week 1 vs. 2 * RCR			.01 (.05)	.03 (.04)
Week 3 vs. 4 * RCR				-.04 (.04)
Week 1/2 vs. 3 * RCR			-.03 (.03)	
Week 1/2 vs. 3/4 * RCR				.01 (.03)
DEP * RCR			.01 (.04)	.00 (.02)
Week 1 vs. 2 * DEP * RCR			.05 (.05)	-.02 (.03)
Week 3 vs. 4 * DEP * RCR				.01 (.04)
Week 1/2 vs. 3 * DEP * RCR			-.04 (.02)	
Week 1/2 vs. 3/4 * DEP * RCR				-.03 (.02)
Random Effects				
Level 1 Variance (σ^2)	.87 (.93)	.87 (.76)	.86 (.93)	.76 (.87)
Random Intercept (u_{0i})	.16 (.40)	.20 (.45)	.16 (.39)	.19 (.44)
Model Fit				
Deviance (-2 LL)	3351.00	5318.60	3316.80	5266.10
AIC	3357.00	5324.60	3344.80	5302.10

DEP = Ego-Depletion; RCR = Relative Controlled Regulation

Sample 1 Contrast Codes: Week -1 = 0 Week 2 = 1; Week 1/2 = -1 Week 3 = 2

Sample 2 Contrast Codes: Week 1 = 1 Week 2 = -1; Week 3 = -1 Week 4 = 1; Week 1/2 = -1 Week 3/4 = 1

*p < .05, **p <.01

Table 12.

Hypothesis 2: Accounting for Gender (DV = Self-Control Failure)

	Unconditional Model		Gender Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	-.42** (.04)	-.36** (.04)	-.42** (.05)	-.36** (.05)
Gender			-.02 (.13)	-.01 (.09)
DEP			.10** (.03)	.01 (.02)
RCR			-.03 (.04)	-.03 (.03)
Interaction Effects				
Gender * DEP			-.28** (.09)	-.01 (.05)
Gender * RCR			.35** (.03)	-.02 (.07)
DEP * RCR			-.02 (.03)	.01 (.03)
Gender * DEP * RCR			.22 (.13)	-.13 (.07)
Random Effects				
Level 1 Variance (σ^2)	.87 (.93)	.87 (.76)	1.46 (1.21)	.76 (.87)
Random Intercept (u_{0i})	.16 (.40)	.20 (.45)	.14 (.38)	.19 (.44)
Model Fit				
Deviance (-2 LL)	3351.00	5318.60	3297.50	5252.70
AIC	3357.00	5324.60	3317.50	5272.70

DEP = Ego-Depletion; RCR = Relative Controlled Regulation

[a]Female = 0 Male = 1; one participant in each sample was removed due to non-identification with male or female Gender categories

*p < .05, **p <.01

Table 13.

Hypothesis 2: Accounting for Age (DV = Self-Control Failure)

	Unconditional Model		Age Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	-.42** (.04)	-.36** (.04)	-.44** (.05)	-.33** (.07)
Age			.01 (.01)	-.01 (.02)
DEP			.09** (.03)	.01 (.04)
RCR			.03 (.04)	-.07 (.04)
Interaction Effects				
Age * DEP			.00 (.01)	.00 (.01)
Age * RCR			-.01 (.01)	.02 (.01)
DEP * RCR			-.01 (.04)	.03 (.04)
Age * DEP * RCR			.00 (.01)	-.01 (.01)
Random Effects				
Level 1 Variance (σ^2)	.87 (.93)	.87 (.76)	.87 (.93)	.76 (.87)
Random Intercept (u_{0i})	.16 (.40)	.20 (.45)	.16 (.39)	.19 (.44)
Model Fit				
Deviance (-2 LL)	3351.00	5318.60	3317.80	5276.30
AIC	3357.00	5324.60	3337.80	5296.30

DEP = Ego-Depletion; RCR = Relative Controlled Regulation

[a]centered at the youngest Age in each sample (18 years old) to increase interpretability of the intercept and reduce multicollinearity; *p < .05, **p <.01

Table 14.

Post-Hoc Model 1: Direct and Indirect Effects Models (DV = Self-Control Failure)

	Direct Effects Model		Indirect Effects Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Fixed Effects				
(Intercept)	-.40** (.04)	-.37** (.04)	-.43** (.04)	-.37** (.04)
Thu vs. Sun	.04 (.04)	-.01 (.03)	.01 (.03)	-.05* (.02)
Fri vs. Sat	-.01 (.04)	.03 (.03)	.01 (.04)	.00 (.03)
Thu/Sun vs. Fri/Sat	-.12** (.03)	-.13** (.02)	.04 (.03)	-.02 (.02)
Drinking Limits			-.31** (.02)	-.33** (.02)
Random Effects				
Level 1 Variance (σ^2)	.85 (.92)	.74 (.86)	.72 (.85)	.61 (.78)
Random Intercept (u_{0i})	.16 (.40)	.20 (.45)	.18 (.42)	.21 (.45)
Model Fit				
Deviance (-2 LL)	3329.70	5273.10	3148.60	4932.30
AIC	3341.70	5285.10	3162.60	4946.30

Contrast Codes: Thu = 0 Sun = 1; Fri = 0 Sat = 1; Thu/Sun = 0 Fri/Sat = 1
*p < .05, **p <.01

Table 15.

Post-Hoc Model 2: Direct and Indirect Effects Models (DV = Self-Control Failure)

	Direct Effects Model			Indirect Effects Model		
	Sample 1 Total β (*SE*)	Sample 1 Females β (*SE*)	Sample 2 β (*SE*)	Sample 1 Total β (*SE*)	Sample 1 Females β (*SE*)	Sample 2 β (*SE*)
Fixed Effects						
(Intercept)	-.43** (.04)	-.42** (.05)	-.36** (.04)	-.43** (.04)	-.42** (.04)	-.37** (.04)
Thu vs. Sun	.04 (.04)	.03 (.04)	-.01 (.03)	.01 (.03)	.00 (.03)	-.05* (.02)
Fri vs. Sat	-.01 (.04)	.00 (.04)	.03 (.03)	.01 (.04)	.02 (.04)	.00 (.03)
Thu/Sun vs. Fri/Sat	-.12** (.03)	-.10** (.03)	-.13** (.02)	.04 (.03)	.04 (.02)	-.02 (.02)
Ego-Depletion	.05* (.03)	.08** (03)	.00 (.02)	-.01 (.03)	.02 (.02)	-.04* (.02)
Drinking Limits				-.32** (.02)	-.30** (.02)	-.33** (.02)
Random Effects						
Level 1 Variance (σ^2)	.85 (.92)	.72 (.85)	.74 (.86)	.71 (.85)	.61 (.78)	.61 (.78)
Random Intercept (u_{0i})	.16 (.41)	.18 (.42)	.20 (.45)	.18 (.42)	.19 (.43)	.21 (.45)
Model Fit						
Deviance (-2 LL)	3322.00	2795.00	5271.30	3145.10	2652.90	4926.60
AIC	3336.00	2809.00	5285.30	3161.10	2668.90	4942.60

Contrast Codes: Thu = 0 Sun = 1; Fri = 0 Sat = 1; Thu/Sun = 0 Fri/Sat = 1

*p < .05, **p <.01

Table 16.

Post-Hoc Model 3: Accounting for Day of the Week (DV = Drinking Limits)

	Unconditional Model		Moderation Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	1.49** (.10)	1.48** (.10)	1.47** (.10)	1.48** (.10)
Thu vs. Sun			-.07 (.06)	-.09 (.05)
Fri vs. Sat			.10 (.06)	-.05 (.05)
Thu/Sun vs. Fri/Sat			.55** (.04)	.43** (.04)
DEP			-.23** (.04)	-.15** (.04)
RCR			.22** (.05)	.24** (.04)
Interaction Effects				
Thu vs. Sun * DEP			-.06 (.06)	-.02 (.72)
Fri vs. Sat * DEP			-.02 (.06)	.00 (.97)
Thu/Sun vs. Fri/Sat * DEP			-.10* (.04)	-.01 (.04)
Thu vs. Sun * RCR			.16* (.08)	.09 (.06)
Fri vs. Sat * RCR			.09 (.08)	-.15* (.06)
Thu/Sun vs. Fri/Sat * RCR			.14* (.06)	-.02 (.05)
DEP * RCR			.01 (.05)	.02 (.04)
Thu vs. Sun * DEP * RCR			-.01 (.07)	-.05 (.06)
Fri vs. Sat * DEP * RCR			-.01 (.07)	.14* (.06)
Thu/Sun vs. Fri/Sat * DEP * RCR			-.01 (.05)	.04 (.04)
Random Effects				
Level 1 Variance (σ^2)	3.23 (1.80)	3.32 (1.82)	2.68 (1.64)	2.99 (1.73)
Random Intercept (u_{0i})	1.13 (1.07)	1.54 (1.24)	1.20 (1.09)	1.53 (1.24)
Model Fit				
Deviance (-2 LL)	6354.20	10455.90	6028.90	10131.70
AIC	6360.20	10461.90	6064.90	10167.70

DEP = Ego-Depletion; RCR = Relative Controlled Regulation
Contrast Codes: Thu = 0 Sun = 1; Fri = 0 Sat = 1; Thu/Sun = 0 Fri/Sat = 1
*p < .05, **p <.01

Table 17.

Post-Hoc Model 3: Accounting for Week of Assessment (DV = Drinking Limits)

	Unconditional Model		Moderation Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	1.49** (.10)	1.48** (.10)	1.50** (.10)	1.49** (.10)
Week 1 vs. 2			-.29** (.06)	-.05 (.05)
Week 3 vs. 4				.09 (.05)
Week 1/2 vs. 3			.02 (.03)	
Week 1/2 vs. 3/4				.18** (.04)
DEP			-.32** (.04)	-.17** (.04)
RCR			.29** (.06)	.27** (.05)
Interaction Effects				
Week 1 vs. 2 * DEP			.17** (.06)	-.01 (.05)
Week 3 vs. 4 * DEP				.10 (.06)
Week 1/2 vs. 3 * DEP			.01 (.03)	
Week 1/2 vs. 3/4 * DEP				-.07 (.04)
Week 1 vs. 2 * RCR			-.13 (.07)	-.08 (.07)
Week 3 vs. 4 * RCR				-.15* (.07)
Week 1/2 vs. 3 * RCR			-.05 (.04)	
Week 1/2 vs. 3/4 * RCR				.00 (.05)
DEP * RCR			-.02 (.06)	.00 (.04)
Week 1 vs. 2 * DEP * RCR			.04 (.07)	.06 (.06)
Week 3 vs. 4 * DEP * RCR				-.03 (.06)
Week 1/2 vs. 3 * DEP * RCR			.01 (.04)	
Week 1/2 vs. 3/4 * DEP * RCR				-.03 (.04)
Random Effects				
Level 1 Variance (σ^2)	3.23 (1.80)	3.32 (1.82)	2.95 (1.72)	3.17 (1.78)
Random Intercept (u_{0i})	1.13 (1.07)	1.54 (1.24)	1.17 (1.08)	1.52 (1.23)
Model Fit				
Deviance (-2 LL)	6354.20	10455.90	6160.60	10264.00
AIC	6360.20	10461.90	6188.60	20300.00

DEP = Ego-Depletion; RCR = Relative Controlled Regulation

Sample 1 Contrast Codes: Week -1 = 0 Week 2 = 1; Week 1/2 = -1 Week 3 = 2

Sample 2 Contrast Codes: Week 1 = 1 Week 2 = -1; Week 3 = -1 Week 4 = 1; Week 1/2 = -1 Week 3/4 = 1

*p < .05, **p <.01

Table 18.

Post-Hoc Model 3: Accounting for Gender (DV = Drinking Limits)

	Unconditional Model		Moderation Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	1.49** (.10)	1.48** (.10)	1.33** (.09)	1.37** (.11)
Gender			.97** (.25)	.44 (.22)
DEP			-.34** (.05)	-.14** (.04)
RCR			.31** (.06)	.25** (.05)
Interaction Effects				
Gender * DEP			.07 (.14)	-.18* (.09)
Gender * RCR			.04 (.19)	.15 (.13)
DEP * RCR			-.08 (.06)	.02 (.05)
Gender * DEP * RCR			.24 (.21)	-.02 (.11)
Random Effects				
Level 1 Variance (σ^2)	3.23 (1.80)	3.32 (1.82)	3.02 (1.74)	3.23 (1.80)
Random Intercept (u_{0i})	1.13 (1.07)	1.54 (1.24)	.92 (.96)	1.49 (1.22)
Model Fit				
Deviance (-2 LL)	6354.20	10455.90	6129.00	10247.30
AIC	6360.20	10461.90	6149.00	10267.30

DEP = Ego-Depletion; RCR = Relative Controlled Regulation

[a]Female = 0 Male = 1; one participant in each sample was removed due to non-identification with male or female Gender categories

*p < .05, **p <.01

Table 19.

Post-Hoc Model 3: Accounting for Age (DV = Drinking Limits)

	Unconditional Model		Moderation Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	1.49** (.10)	1.48** (.10)	1.49** (.11)	1.02** (.16)
Age[a]			.00 (.02)	.17** (.05)
DEP			-.32** (.05)	-.10 (.07)
RCR			.29** (.07)	.21** (.08)
Interaction Effects				
Age * DEP			.00 (.01)	-.03 (.02)
Age * RCR			.01 (.01)	.03 (.03)
DEP * RCR			-.02 (.07)	.07 (.07)
Age * DEP * RCR			-.01 (.01)	-.02 (.02)
Random Effects				
Level 1 Variance (σ^2)	3.23 (1.80)	3.32 (1.82)	3.05 (1.75)	3.22 (1.79)
Random Intercept (u_{0i})	1.13 (1.07)	1.54 (1.24)	1.16 (1.08)	1.42 (1.19)
Model Fit				
Deviance (-2 LL)	6354.20	10455.90	6204.00	10289.60
AIC	6360.20	10461.90	6224.00	10309.60

DEP = Ego-Depletion; RCR = Relative Controlled Regulation

[a]centered at the youngest Age in each sample (18 years old) to increase interpretability of the intercept and reduce multicollinearity; *p < .05, **p <.01

Table 20.

Post-Hoc Model 4: Accounting for Day of the Week (DV = Self-Control Failure)

	Unconditional Model		Moderation Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	-.42** (.04)	-.36** (.04)	-.50** (.05)	-.38** (.04)
Thu vs. Sun			-.02 (.04)	-.07* (.03)
Fri vs. Sat			-.01 (.04)	.01 (.03)
Thu/Sun vs. Fri/Sat			.06* (.03)	-.01 (.02)
LIM			-.37** (.03)	-.33** (.02)
RCR			.04 (.04)	.01 (.02)
Interaction Effects				
Thu vs. Sun * LIM			-.03 (.04)	-.03 (.03)
Fri vs. Sat * LIM			.04 (.03)	-.03 (.02)
Thu/Sun vs. Fri/Sat * LIM			.14** (.03)	.03 (.02)
Thu vs. Sun * RCR			-.01 (.06)	-.02 (.04)
Fri vs. Sat * RCR			.09 (.05)	.00 (.03)
Thu/Sun vs. Fri/Sat * RCR			.05 (.04)	.05 (.02)
LIM * RCR			-.02 (.03)	-.06** (.02)
Thu vs. Sun * LIM * RCR			-.06 (.06)	-.03 (.04)
Fri vs. Sat * LIM * RCR			-.07* (.03)	.02 (.03)
Thu/Sun vs. Fri/Sat * LIM * RCR			.02 (.03)	.01 (.02)
Random Effects				
Level 1 Variance (σ^2)	.87 (.93)	.87 (.76)	.68 (.83)	.61 (.78)
Random Intercept (u_{0i})	.16 (.40)	.20 (.45)	.20 (.45)	.20 (.45)
Model Fit				
Deviance (-2 LL)	3351.00	5318.60	3099.00	4888.70
AIC	3357.00	5324.60	3135.00	4924.70

LIM = Drinking Limit; RCR = Relative Controlled Regulation
Contrast Codes: Thu = 0 Sun = 1; Fri = 0 Sat = 1; Thu/Sun = 0 Fri/Sat = 1
*p < .05, **p <.01

Table 21.

Post-Hoc Model 4: Accounting for Week of Assessment (DV = Self-Control Failure)

	Unconditional Model		Moderation Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	-.42** (.04)	-.36** (.04)	-.45** (.04)	-.36** (.04)
Week 1 vs. 2			-.08* (.03)	-.01 (.02)
Week 3 vs. 4				-.03 (.03)
Week 1/2 vs. 3			-.02 (.02)	
Week 1/2 vs. 3/4				-.03 (.02)
LIM			-.34** (.02)	-.33** (.02)
RCR			.04 (.03)	.01 (.02)
Interaction Effects				
Week 1 vs. 2 * LIM			-.10** (.03)	-.04 (.02)
Week 3 vs. 4 * LIM				-.05 (.02)
Week 1/2 vs. 3 * LIM			-.02 (.02)	
Week 1/2 vs. 3/4 * LIM				-.08** (.02)
Week 1 vs. 2 * RCR			.01 (.04)	.02 (.03)
Week 3 vs. 4 * RCR				-.05 (.03)
Week 1/2 vs. 3 * RCR			-.04 (.02)	
Week 1/2 vs. 3/4 * RCR				.03 (.02)
LIM * RCR			.03 (.03)	-.05** (.02)
Week 1 vs. 2 * LIM * RCR			.06 (.04)	.01 (.03)
Week 3 vs. 4 * LIM * RCR				-.10** (.03)
Week 1/2 vs. 3 * LIM * RCR			-.04* (.02)	
Week 1/2 vs. 3/4 * LIM * RCR				.00 (.02)
Random Effects				
Level 1 Variance (σ^2)	.87 (.93)	.87 (.76)	.70 (.84)	.60 (.78)
Random Intercept (u_{0i})	.16 (.40)	.20 (.45)	.18 (.42)	.19 (.44)
Model Fit				
Deviance (-2 LL)	3351.00	5318.60	3103.30	4850.10
AIC	3357.00	5324.60	3131.30	4886.10

LIM = Drinking Limit; RCR = Relative Controlled Regulation
Sample 1 Contrast Codes: Week -1 = 0 Week 2 = 1; Week 1/2 = -1 Week 3 = 2
Sample 2 Contrast Codes: Week 1 = 1 Week 2 = -1; Week 3 = -1 Week 4 = 1; Week 1/2 = -1 Week 3/4 = 1
*p < .05, **p <.01

Table 22.

Post-Hoc Model 4: Accounting for Gender (DV = Self-Control Failure)

	Unconditional Model		Moderation Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	-.42** (.04)	-.36** (.04)	-.43** (.05)	-.36** (.04)
Gender			-.03 (.01)	-.01 (.09)
LIM			-.28** (.03)	-.33** (.02)
RCR			.01 (.03)	.02 (.02)
Interaction Effects				
Gender * LIM			-.10 (.05)	.02 (.04)
Gender * RCR			.32** (.01)	-.04 (.06)
LIM * RCR			.00 (.03)	-.02 (.02)
Gender * LIM * RCR			.21** (.08)	-.10* (.05)
Random Effects				
Level 1 Variance (σ^2)	.87 (.93)	.87 (.76)	.71 (.84)	.62 (.79)
Random Intercept (u_{0i})	.16 (.40)	.20 (.45)	.18 (.43)	.20 (.45)
Model Fit				
Deviance (-2 LL)	3351.00	5318.60	3111.00	4879.80
AIC	3357.00	5324.60	3131.00	4899.80

LIM = Drinking Limit; RCR = Relative Controlled Regulation

[a]Female = 0 Male = 1; one participant in each sample was removed due to non-identification with male or female Gender categories

*p < .05, **p <.01

Table 23.

Post-Hoc Model 4: Accounting for Age (DV = Self-Control Failure)

	Unconditional Model		Moderation Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	-.42** (.04)	-.36** (.04)	-.45** (.05)	-.34** (.07)
Age			.01 (.01)	-.01 (.02)
LIM			-.31** (.02)	-.33** (.03)
RCR			.07 (.04)	.01 (.04)
Interaction Effects				
Age * LIM			.00 (.01)	.00 (.01)
Age * RCR			-.01 (.01)	.00 (.01)
LIM * RCR			.04 (.03)	.01 (.03)
Age * LIM * RCR			-.01 (.01)	-.02* (.01)
Random Effects				
Level 1 Variance (σ^2)	.87 (.93)	.87 (.76)	.72 (.85)	.62 (.78)
Random Intercept (u_{0i})	.16 (.40)	.20 (.45)	.18 (.42)	.20 (.45)
Model Fit				
Deviance (-2 LL)	3351.00	5318.60	3129.50	4897.80
AIC	3357.00	5324.60	3149.50	4917.80

LIM = Drinking Limit; RCR = Relative Controlled Regulation

[a]centered at the youngest Age in each sample (18 years old) to increase interpretability of the intercept and reduce multicollinearity; *p < .05, **p <.01

Table 24.

Post-Hoc Model 5 (DV = Self-Control Failure)

	Unconditional Model		Moderation Model	
	Sample 1 β (*SE*)	Sample 2 β (*SE*)	Sample 1 β (*SE*)	Sample 2 β (*SE*)
Main Effects				
(Intercept)	-.42** (.04)	-.36** (.04)	-.43** (.04)	-.37** (.04)
DEP			.05 (.03)	-.02 (.02)
RCR			.02 (.04)	-.01 (.02)
INT			.11** (.03)	.12** (.02)
Interaction Effects				
DEP * RCR			-.01 (.04)	.01 (.02)
DEP * INT			.02 (.03)	.02 (.02)
RCR * INT			.02 (.04)	-.01 (.03)
DEP * RCR * INT			-.01 (.03)	-.03 (.02)
Random Effects				
Level 1 Variance (σ^2)	.87 (.93)	.87 (.76)	.85 (.92)	.71 (.85)
Random Intercept (u_{0i})	.16 (.40)	.20 (.45)	.15 (.39)	.20 (.44)
Model Fit				
Deviance (-2 LL)	3351.00	5318.60	3242.10	5063.40
AIC	3357.00	5324.60	3262.10	5083.40

DEP = Ego-Depletion; INT = Intention to Limit; RCR = Relative Controlled Regulation
*p < .05, **p <.01

Table 25.

Sample Comparison and Summary of Findings

	Sample 1	Sample 2	Comparison[a]
Demographics			
Males (Proportion)	14%	23%	$z = 2.00$*
Females (Proportion)	85%	77%	$z = 2.20$*
Age (Mean)	20.68	20.72	$t = -1.11$
Methodology and Descriptives			
% Missing Data	27%	23%	$z = 8.80$**
Morning Assessment Window	6–11am	6am–1pm	
Academic Term	Fall (Mid)	Spring (End)	
Number of Weeks	3	4	
Number of Days	12	16	
Person-Level Variables			
Self-Control Demands	4.48 (1.48)	4.22 (1.63)	$t = 1.63$
Need Satisfaction	4.58 (.62)	4.66 (.68)	$t = -1.20$
Ego-Depletion	4.15 (.92)	3.98 (.96)	$t = 1.75$
Relative Controlled Regulation	-1.89 (1.45)	-1.95 (1.61)	$t = .38$
Alcohol Consumption	.72 (.40)	.60 (.54)	$t = 2.48$*
Drinking Limit	1.49 (1.07)	1.48 (1.24)	$t = .08$
Summary of Findings: Hypothesis 1			
Main Effect of SCD on Ego-Depletion?	✓	✓	Congruent
Moderated by Need Satisfaction?			
Main Interaction	X	X	Congruent
Conditional on Day of the Week	✓	✓	Congruent
Conditional on Week of Assessment	✓	✓	Congruent
Conditional on Gender	X	X	Congruent
Conditional on Age	X	X	Congruent
Summary of Findings: Hypothesis 2			
Main Effect of Ego-Depletion on Self-Control Failure?	✓	X	Mixed
Moderated by RCR?	X	X	Congruent
Conditional on Day of the Week	X	X	Congruent
Conditional on Week of Assessment	X	X	Congruent
Conditional on Gender	X	X	Congruent
Conditional on Age	X	X	Congruent

[a]A two-sample *z*-test was used to compare gender and missing data proportions between samples Age and person-level variables were compared using independent samples *t*-tests

Appendix B

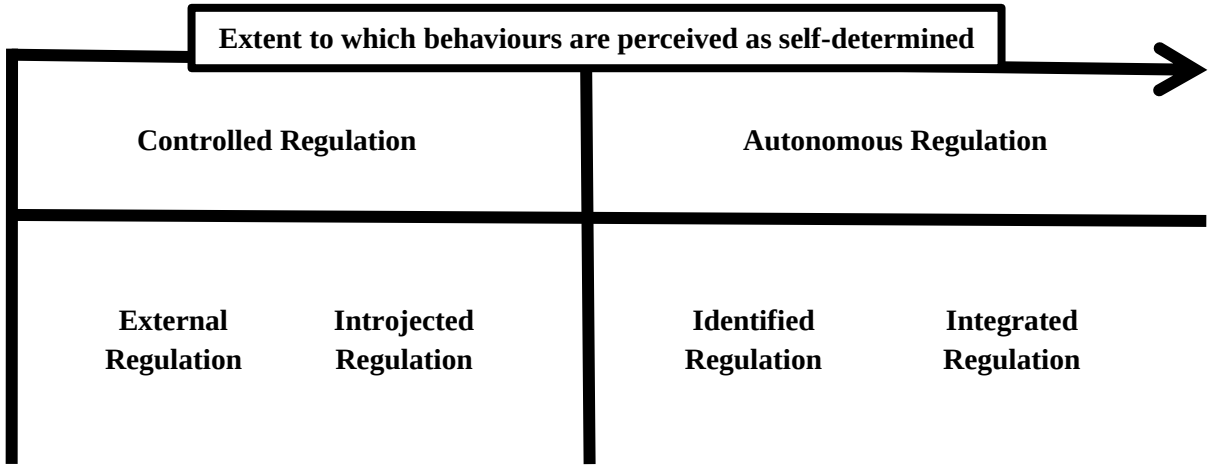


Figure 1. Four different self-regulatory styles placed along the self-determination continuum. Adapted from "The 'What' and the 'Why' of Goal Pursuits: Human Needs and the Self-Determination of Behaviour," by E. L. Deci, & R. M. Ryan, 2000. *Psychological Inquiry, 11*, p. 23

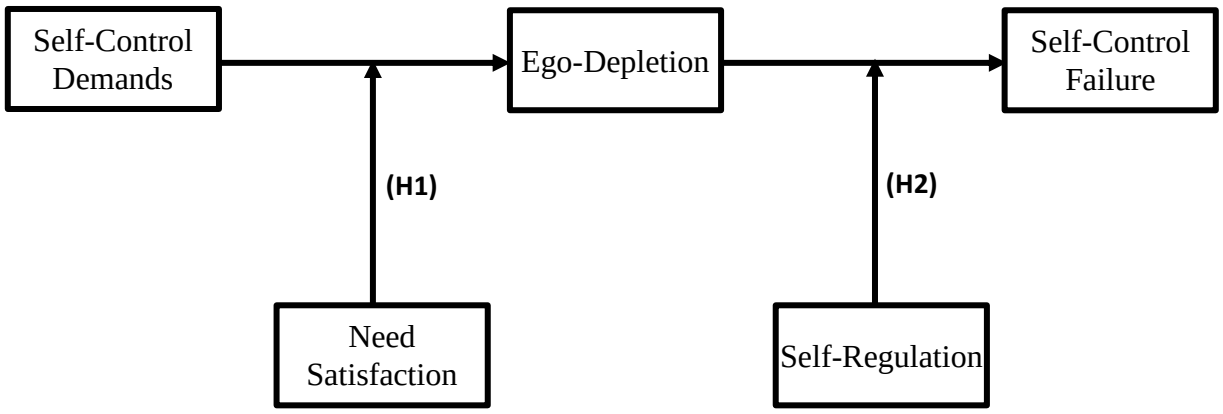
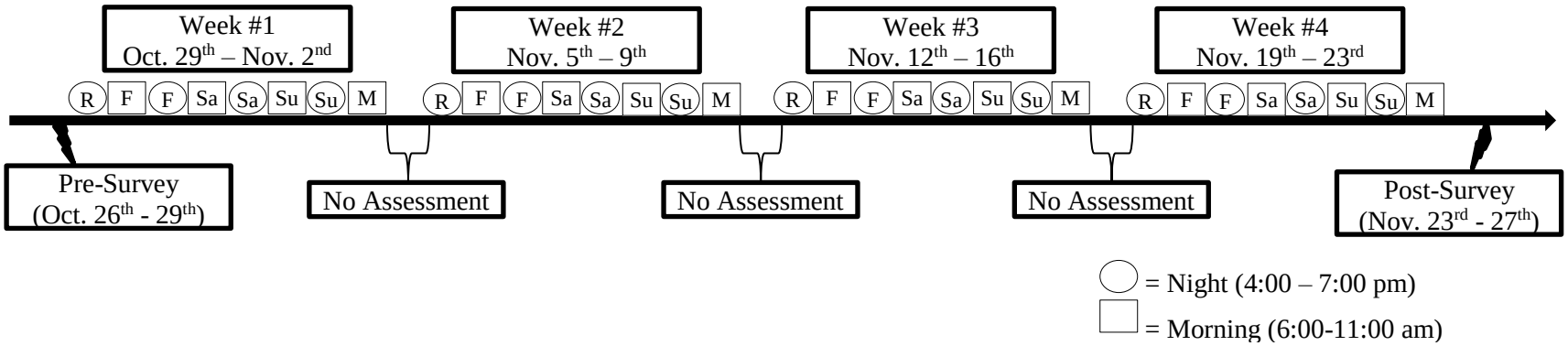


Figure 2. Theoretical model of Ego-Depletion, Self-Regulation, and Self-Control Failure

Fall, 2015 (Sample 1)



Spring, 2016 (Sample 2)

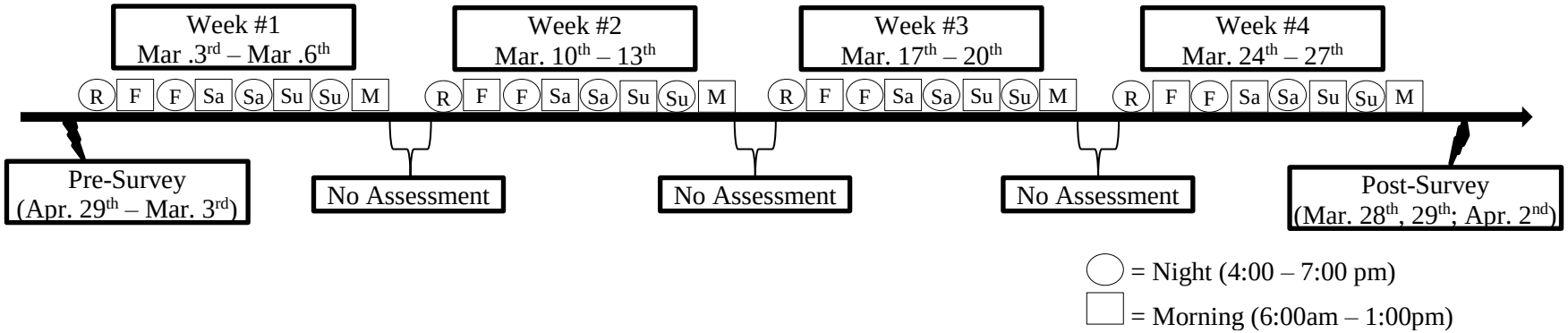


Figure 3. Research design for Fall, 2015 and Spring 2106 diary studies.

Note: There was a technical problem with the online system during the final week of the Fall, 2015 study. As a result, only data collected during the first three weeks were analyzed for Sample 1.

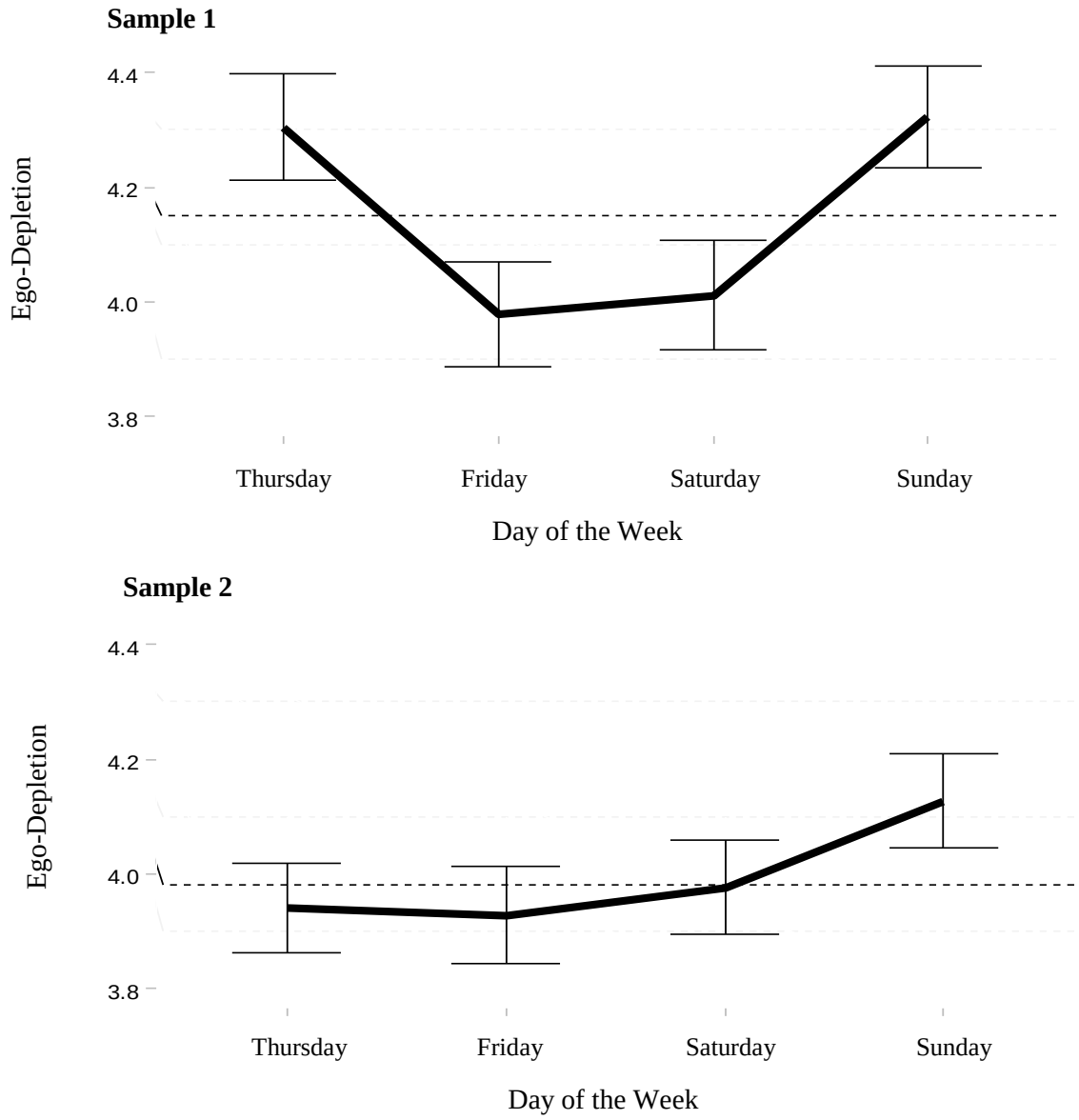


Figure 4. Variation in Ego-Depletion by Day of the Week.

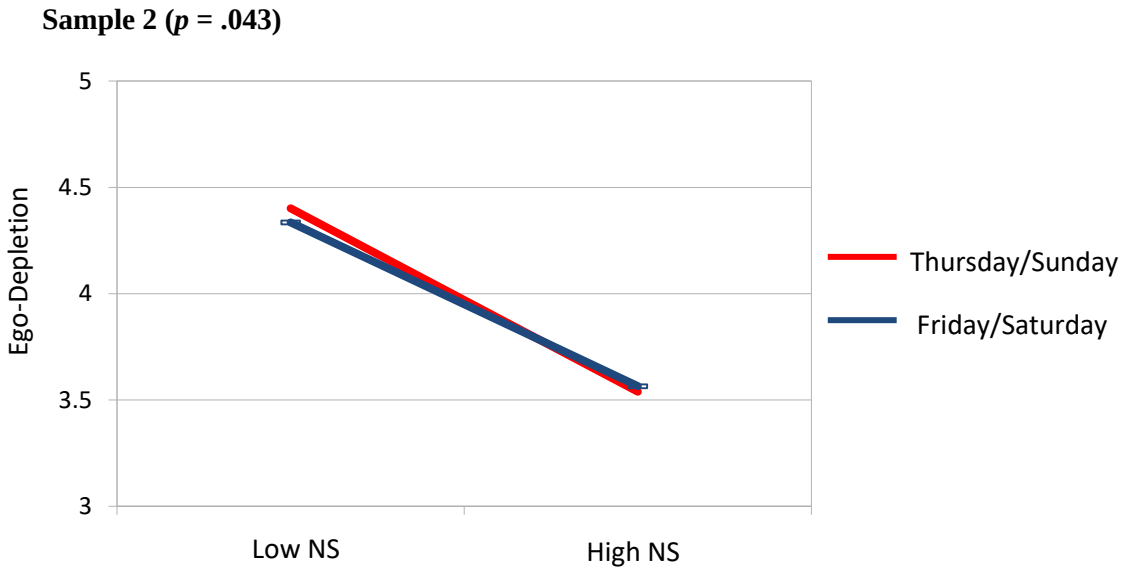
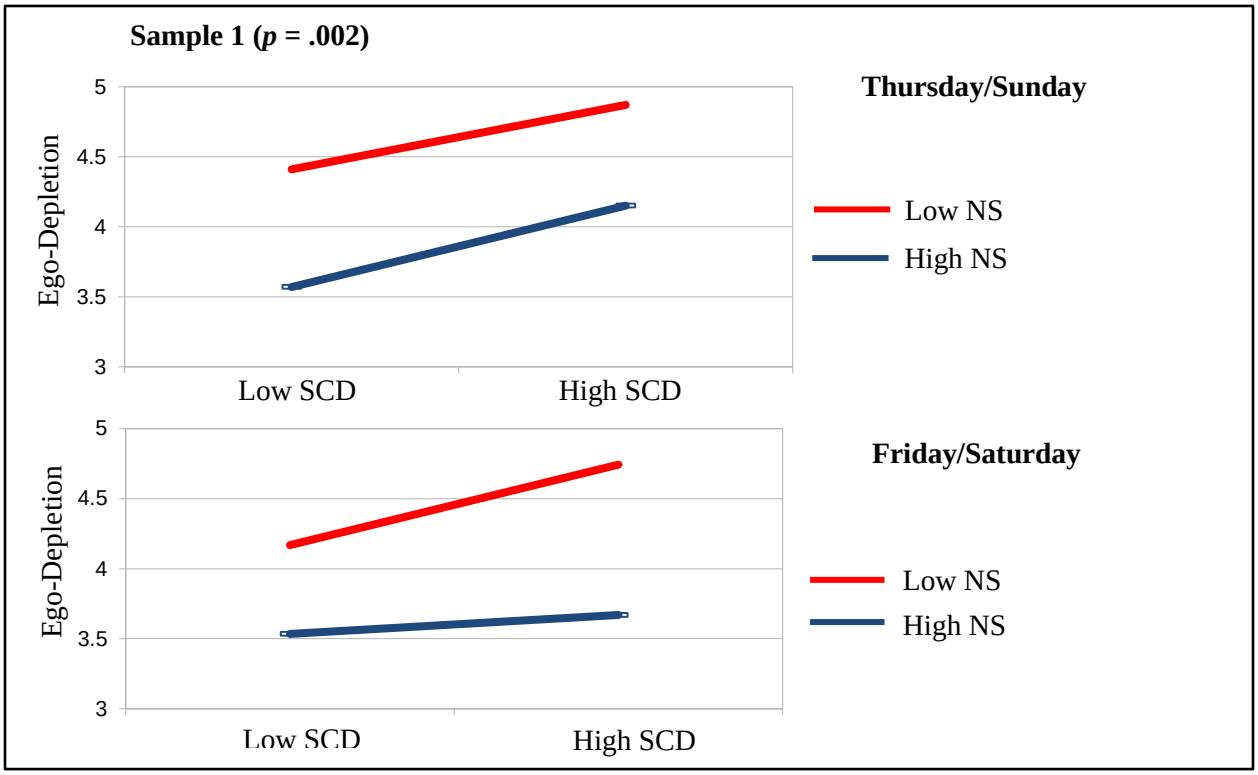


Figure 5. Interaction between Need Satisfaction (NS) and Day of the Week on Ego-Depletion



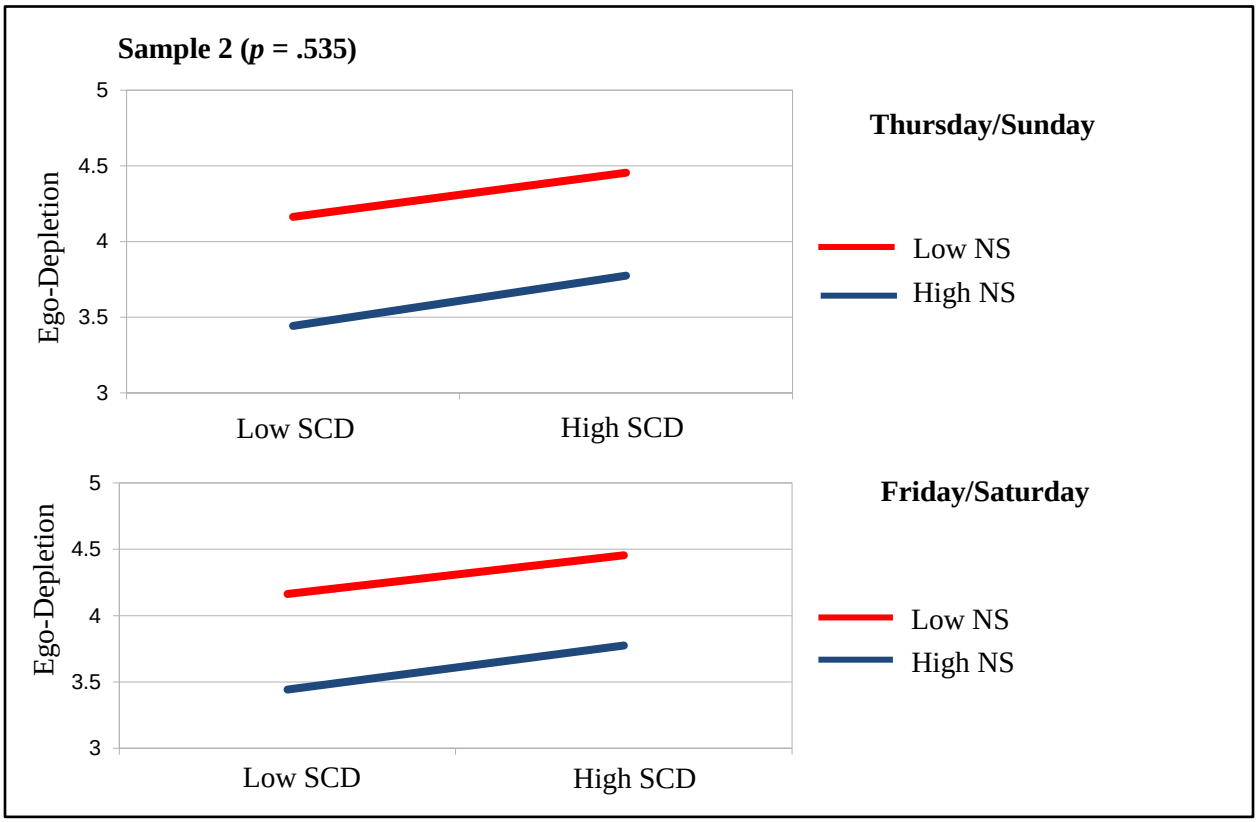


Figure 6. Interaction between Self-Control Demands (SCD) and Need Satisfaction (NS) on Ego-Depletion for Thursday/Sunday vs. Friday/Saturday

Sample 2 (p = .009)

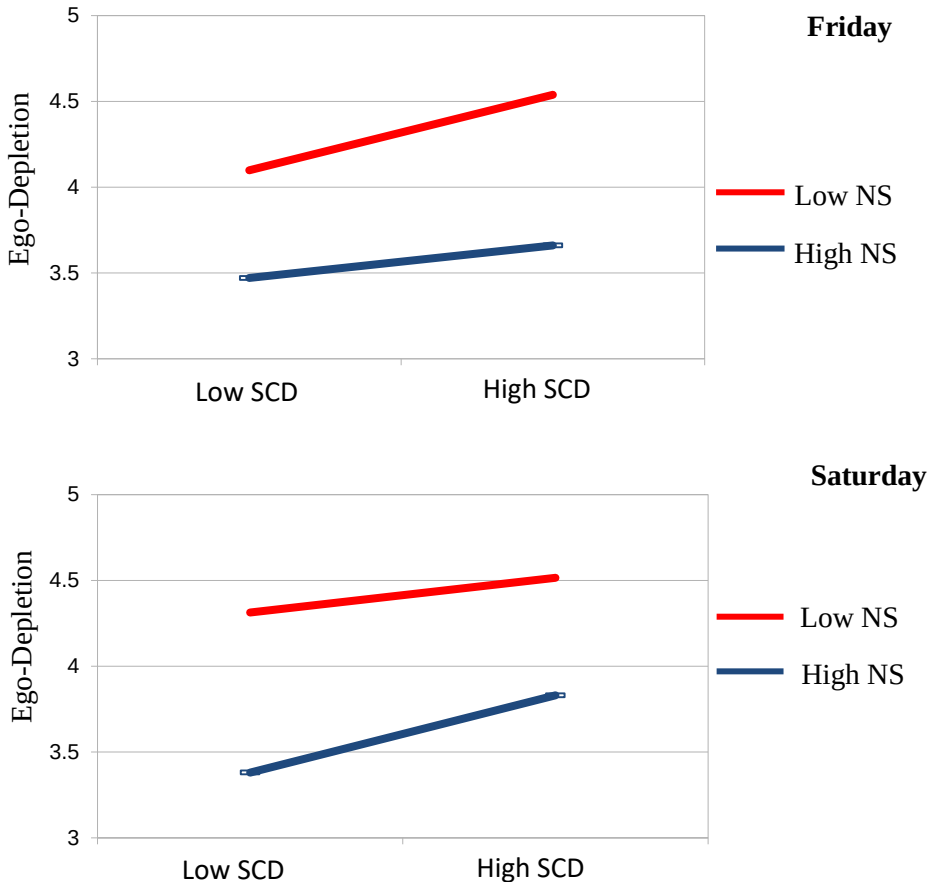


Figure 7. Interaction between Self-Control Demands (SCD) and Need Satisfaction (NS) on Ego-Depletion for Friday vs. Saturday

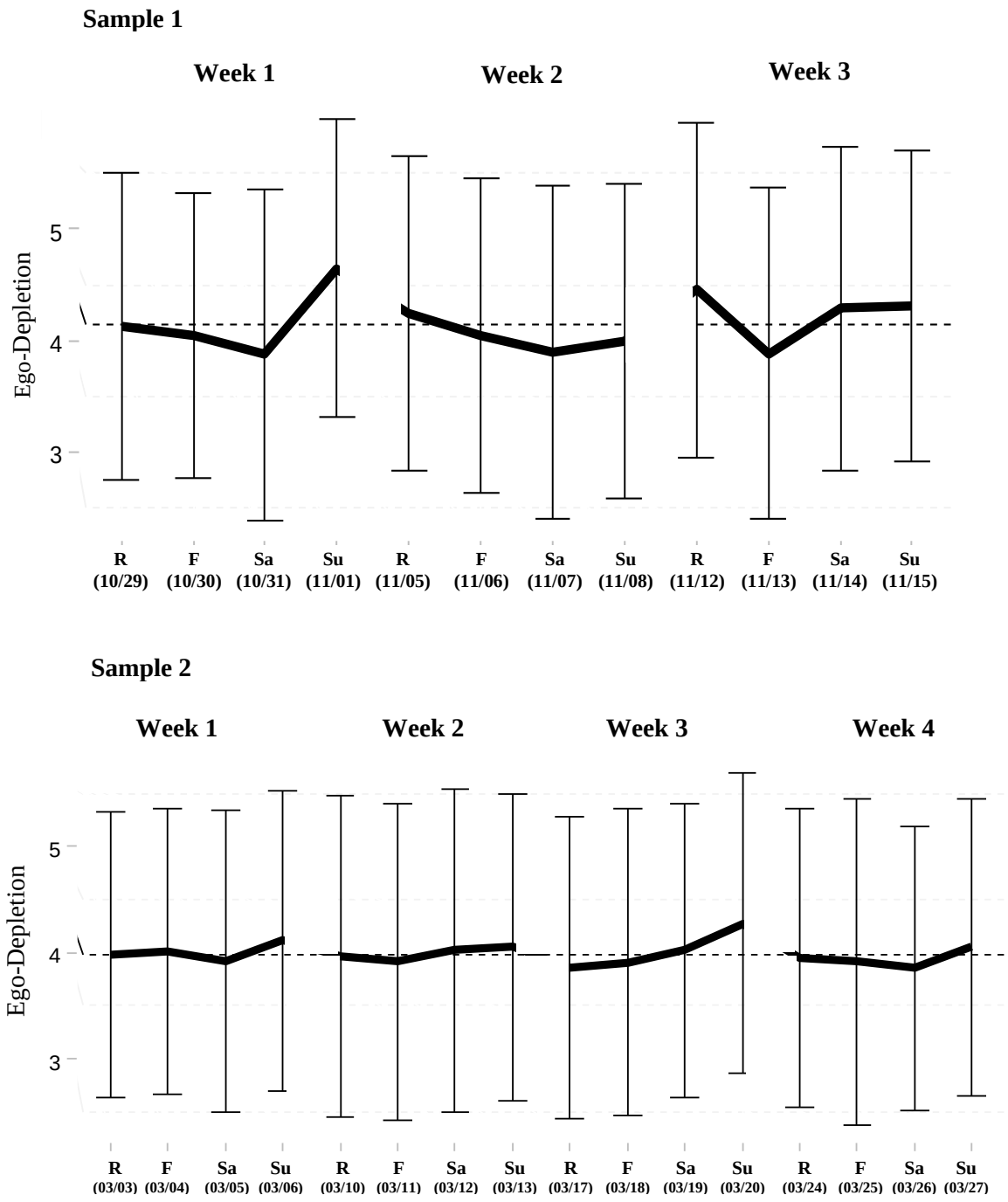


Figure 8. Variation in Ego-Depletion by measurement occasion and Week of Assessment

Sample 1 (*p* = .022)

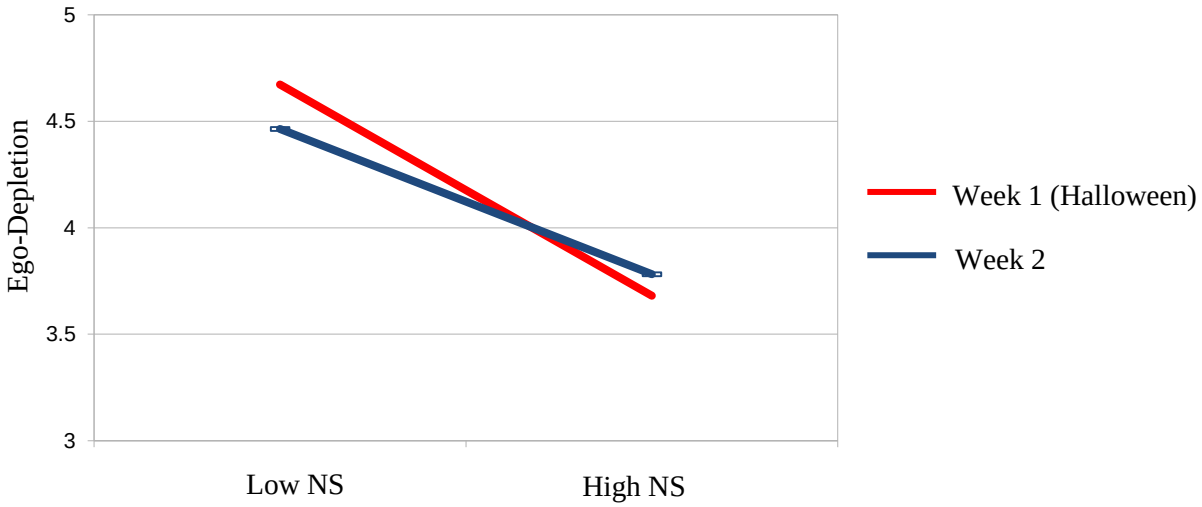


Figure 9. Interaction between Need Satisfaction (NS) and Week of Assessment on Ego-Depletion

Sample 2 (*p* = .001)

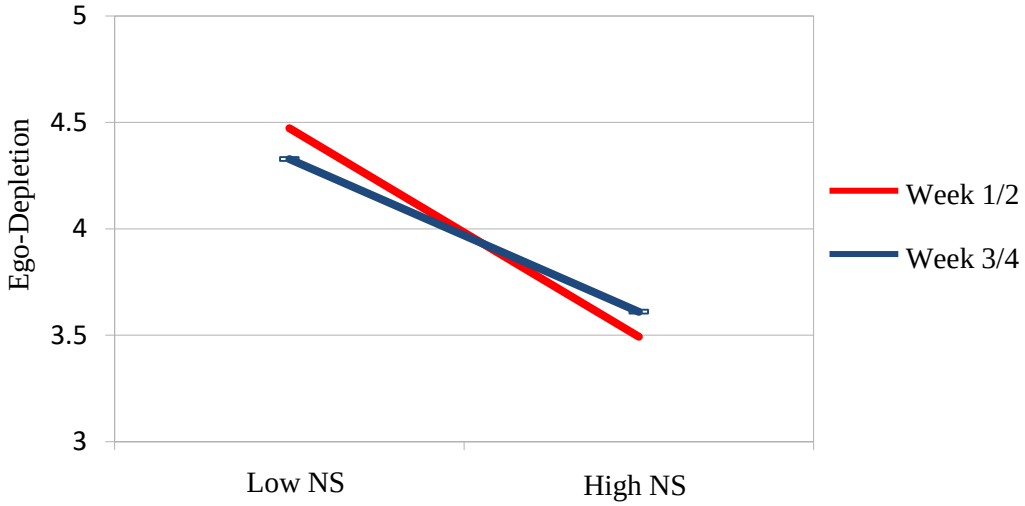


Figure 10. Interaction between Need Satisfaction and Week of Assessment on Ego-Depletion

Sample 1 (p = .003)

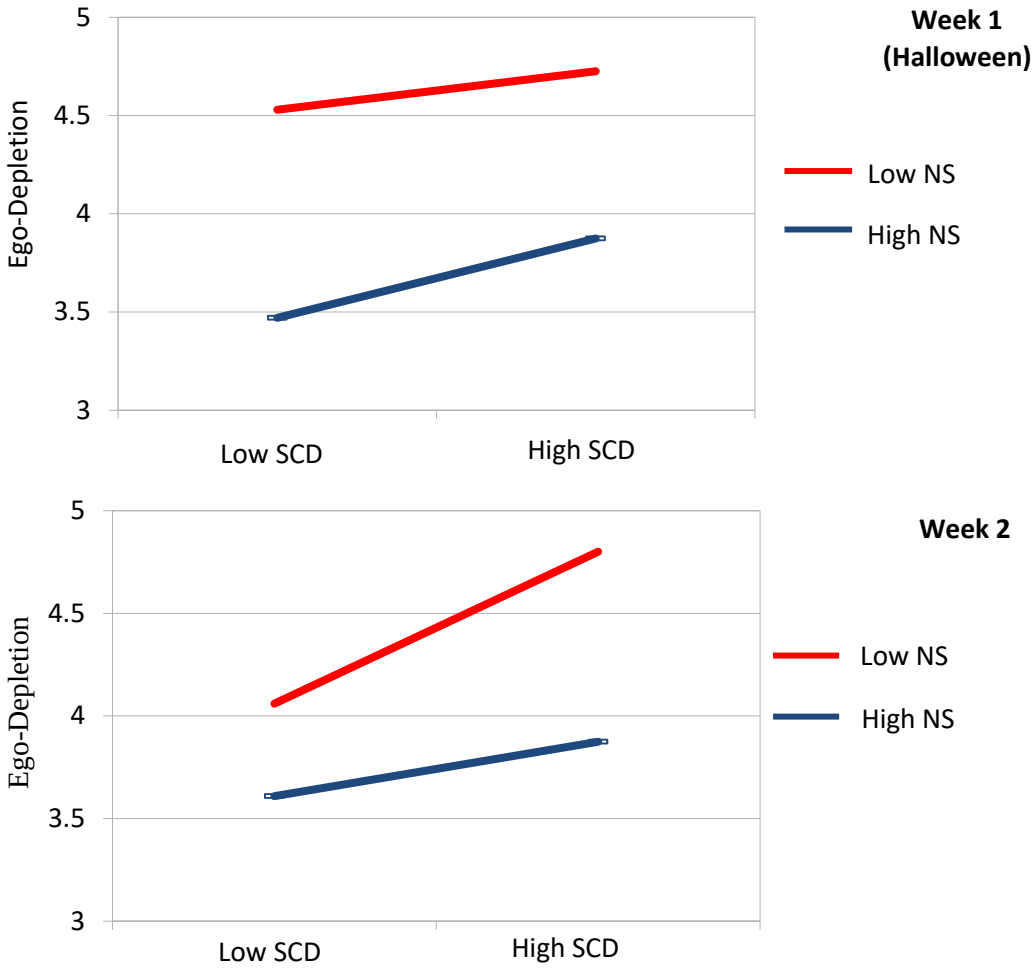


Figure 11. Interaction between Self-Control Demands (SCD) and Need Satisfaction (NS) on Ego-Depletion for Week 1 vs. Week 2

Sample 2 (p = .005)

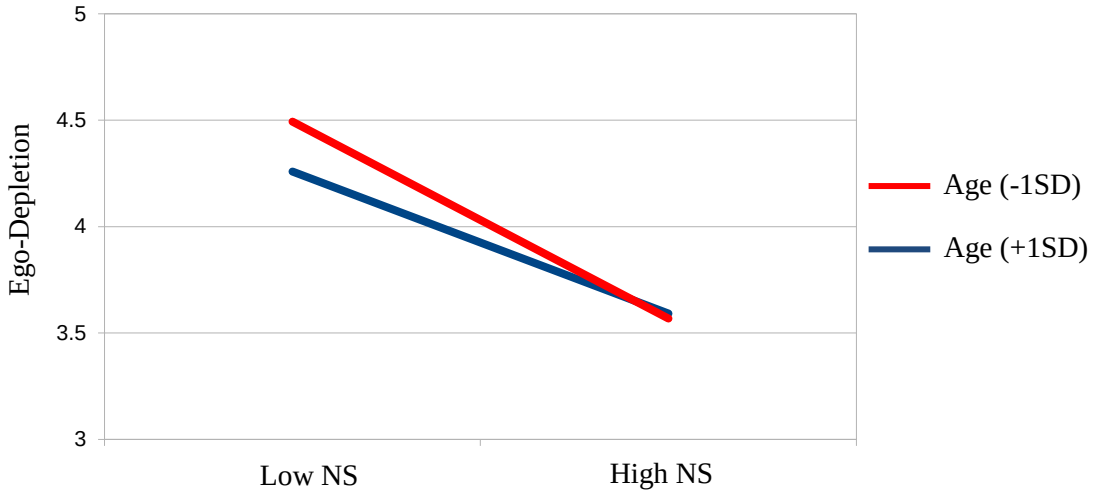


Figure 12. Interaction between Need Satisfaction (NS) and Age on Ego-Depletion

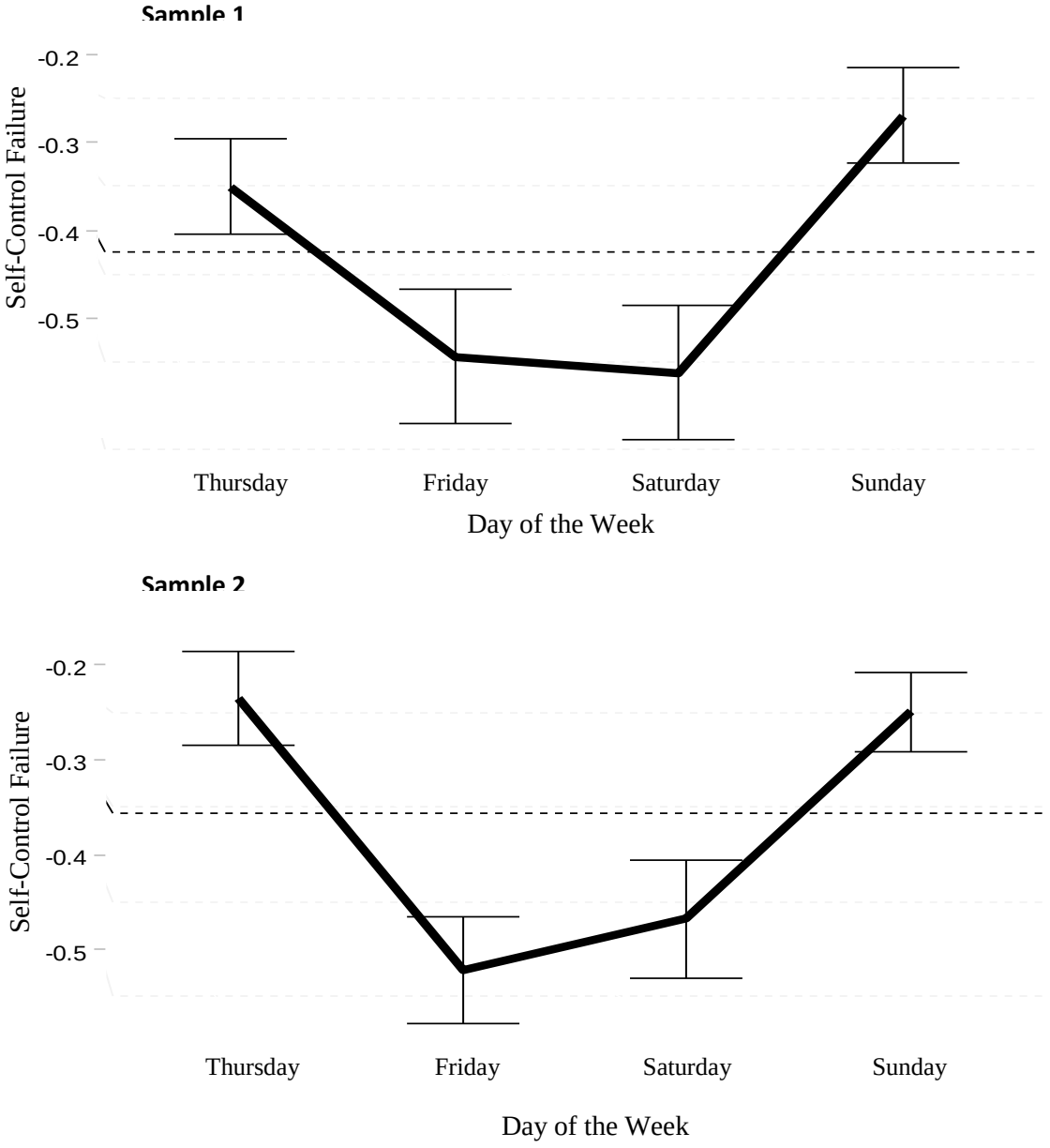


Figure 13. Variation in Self-Control Failure by Day of the Week.

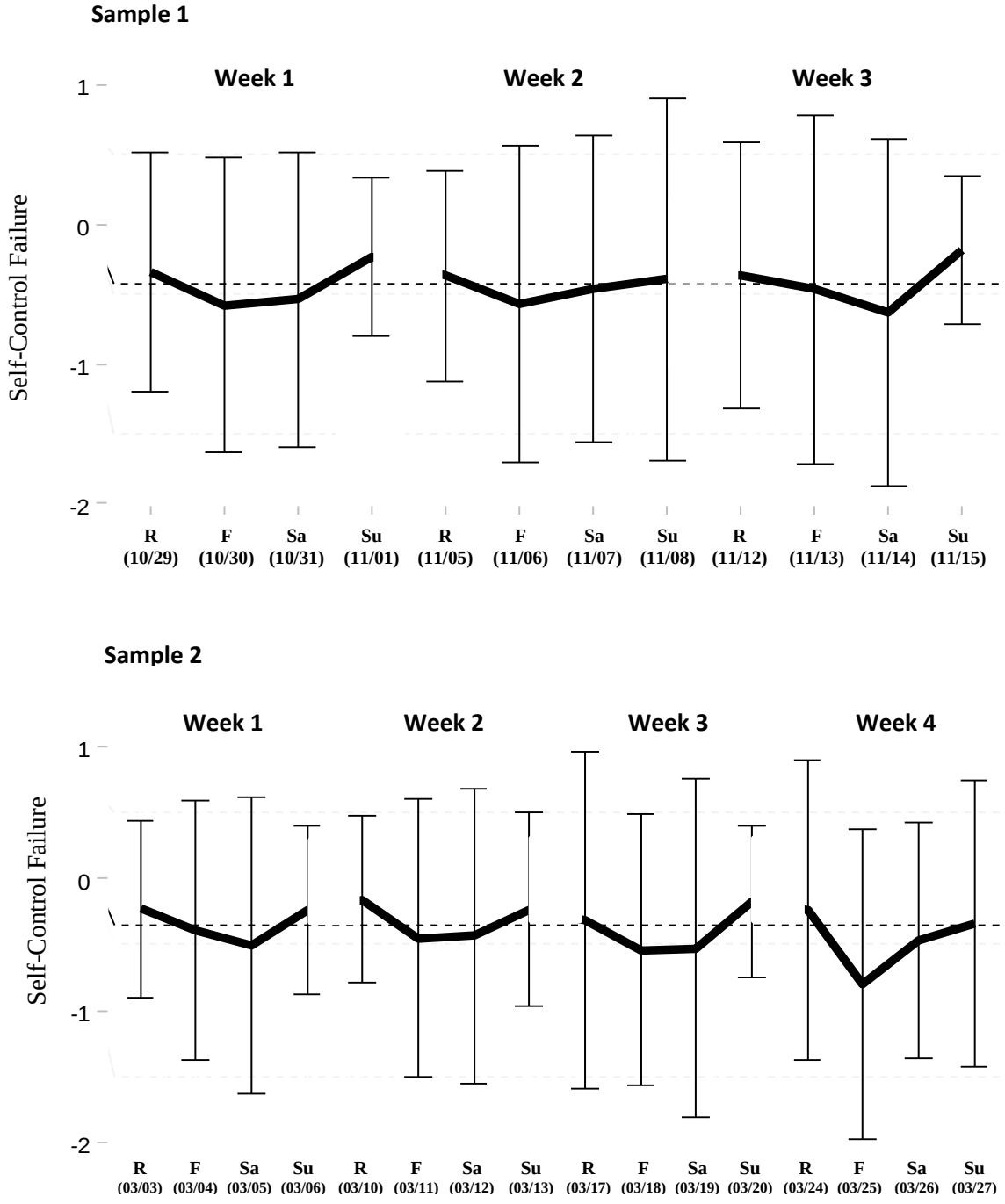


Figure 14. Variation in Self-Control Failure by measurement occasion and Week of Assessment

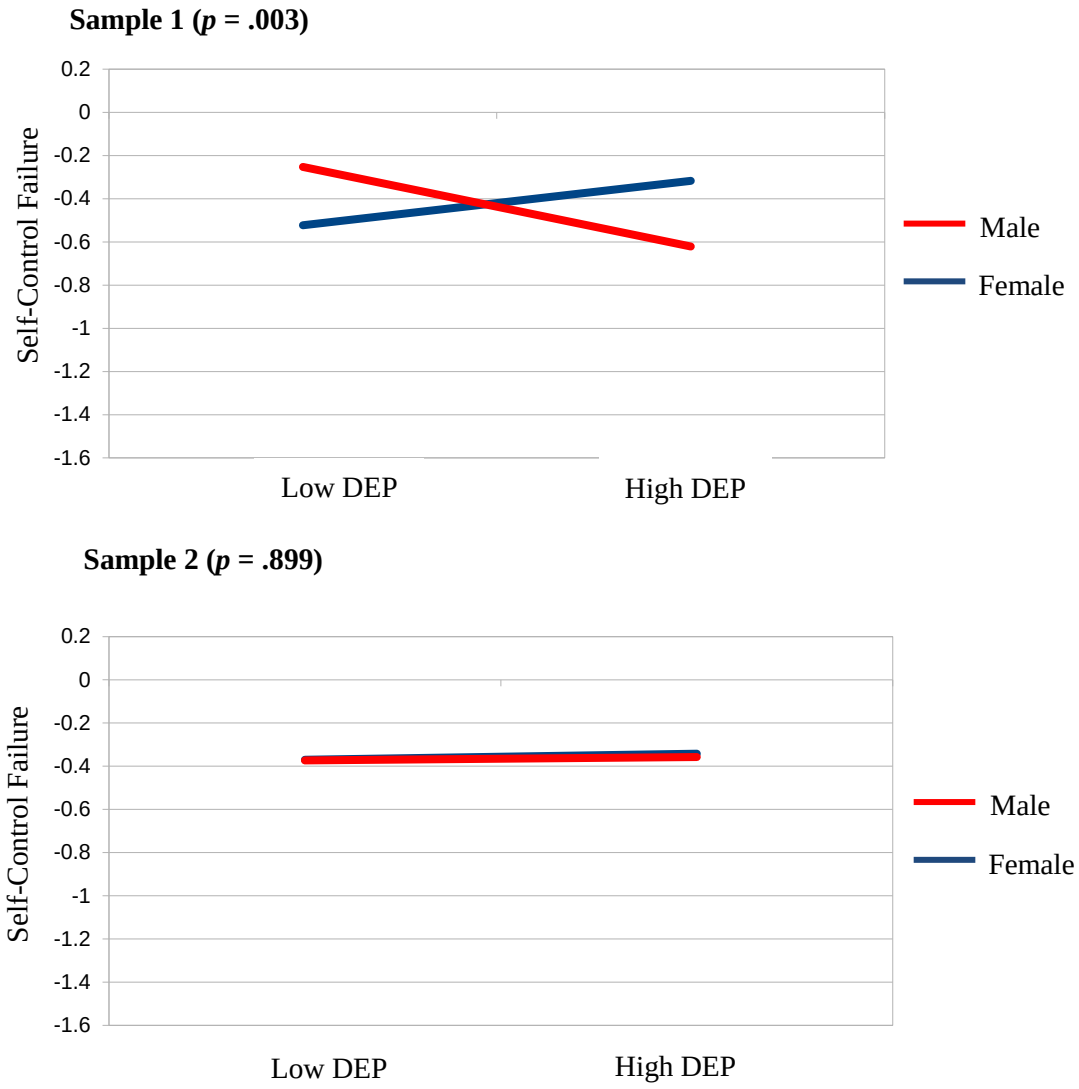


Figure 15. Interaction between Ego-Depletion and Gender on Self-Control Failure

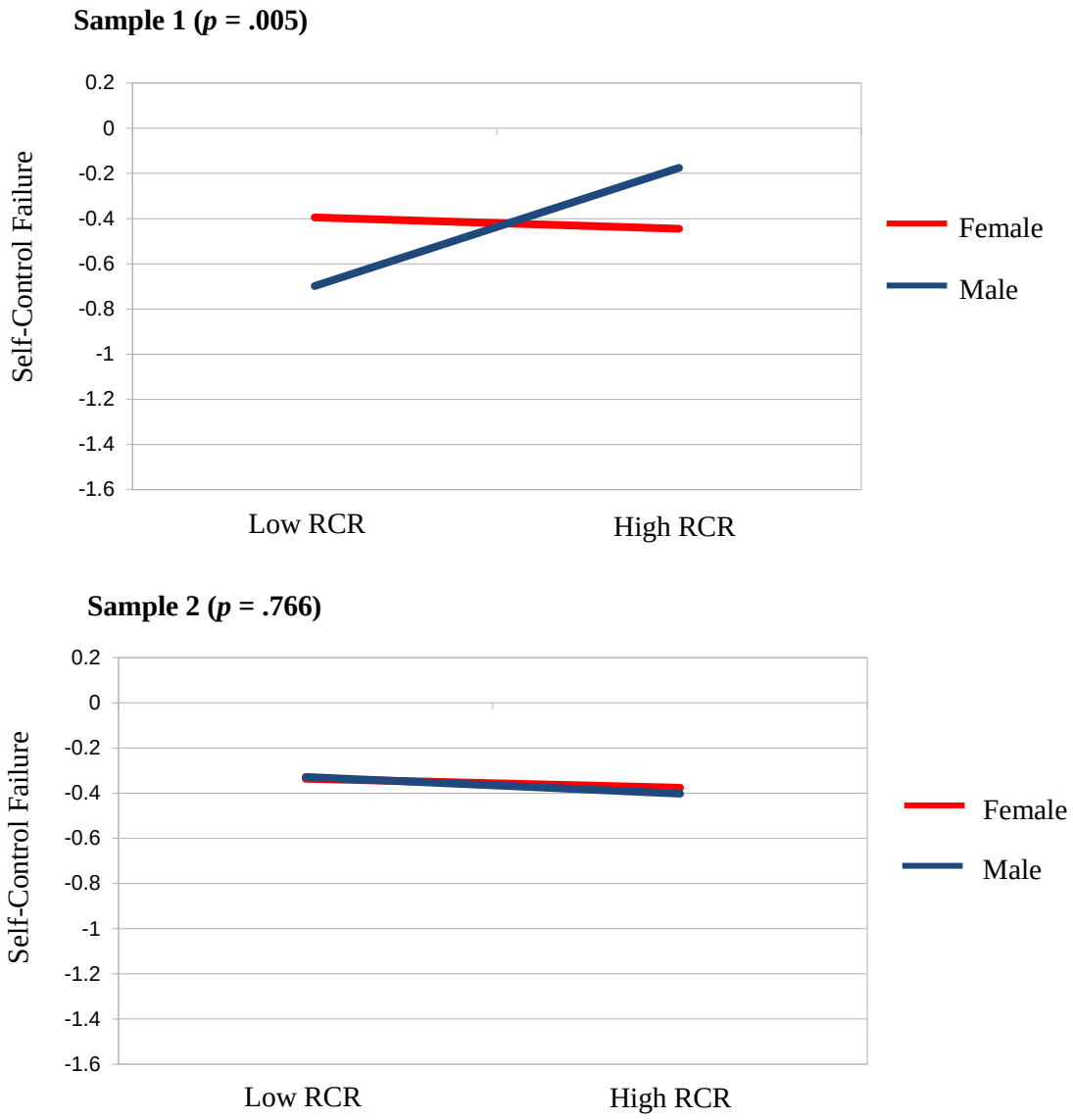


Figure 16. Interaction between Relative Controlled Regulation and Gender on Self-Control Failure

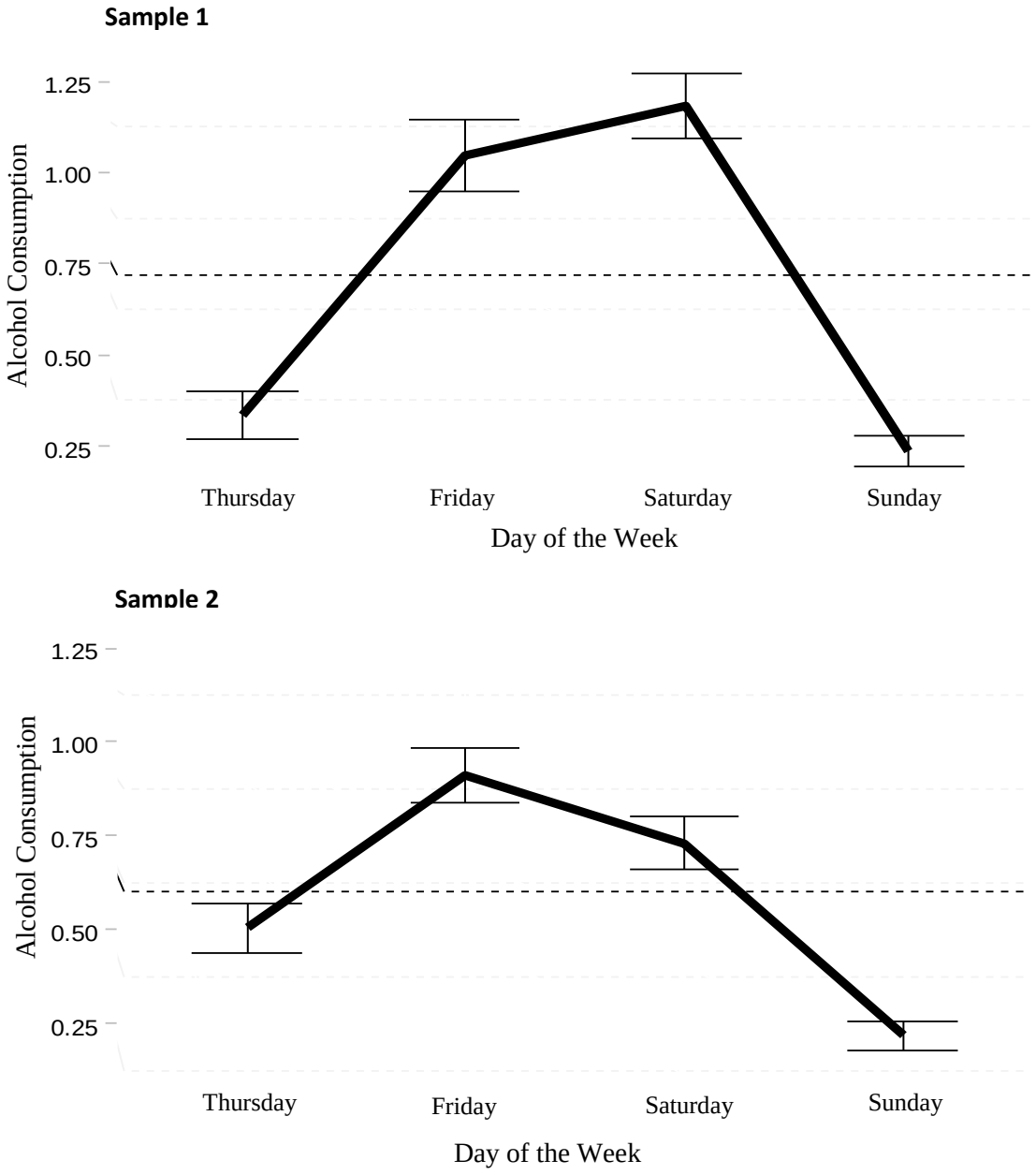


Figure 17. Variation in Alcohol Consumption by Day of the Week.

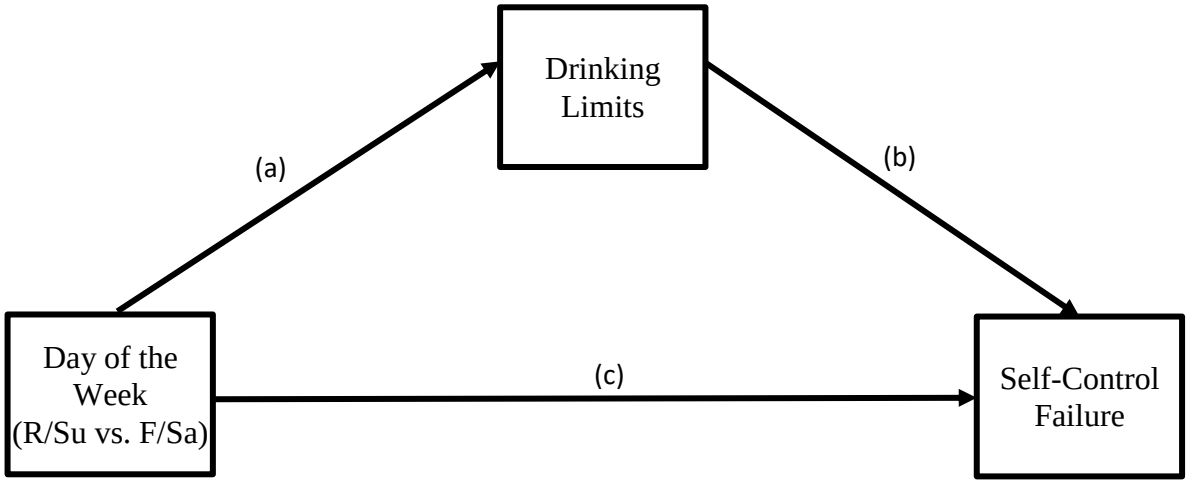


Figure 18. Post-Hoc Model 1: Testing a mediational relationship linking Day of the Week to Self-Control Failure by way of changes to student Drinking Limits

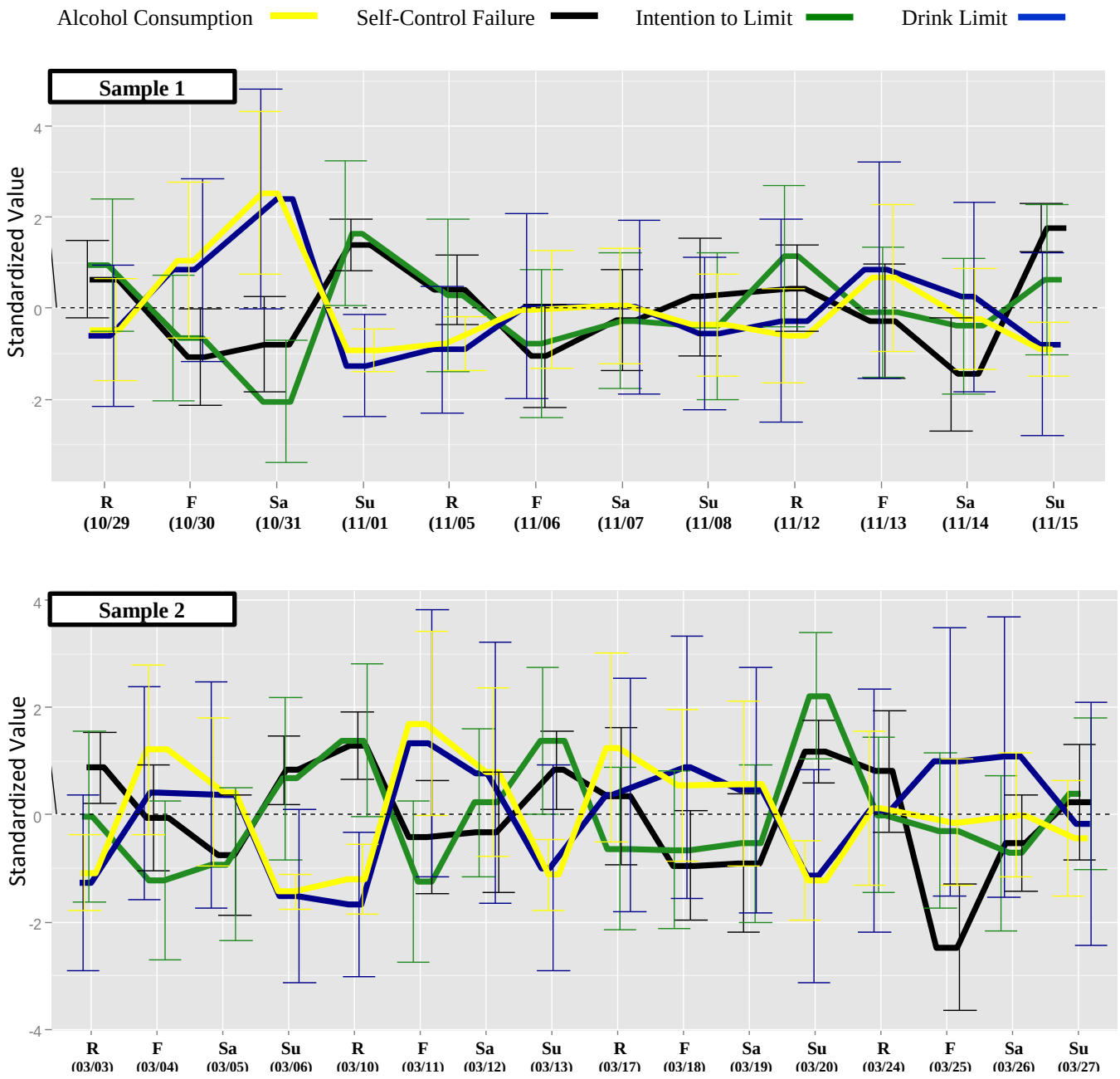


Figure 19. Variation in drinking-related variables across each diary study.

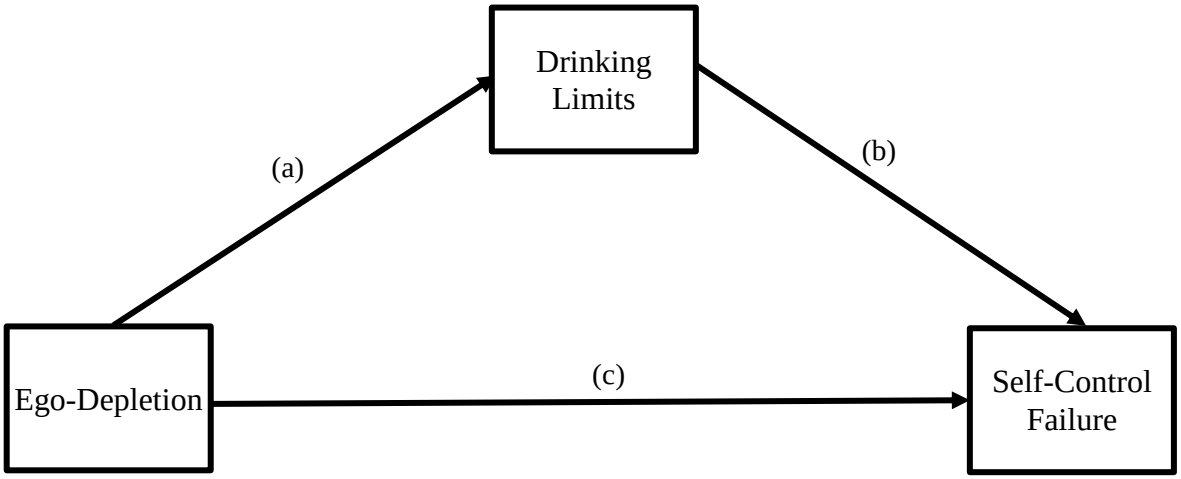


Figure 20. Post-Hoc Model 2: Testing a mediational relationship linking Ego-Depletion to Self-Control Failure by way of changes to student Drinking Limits

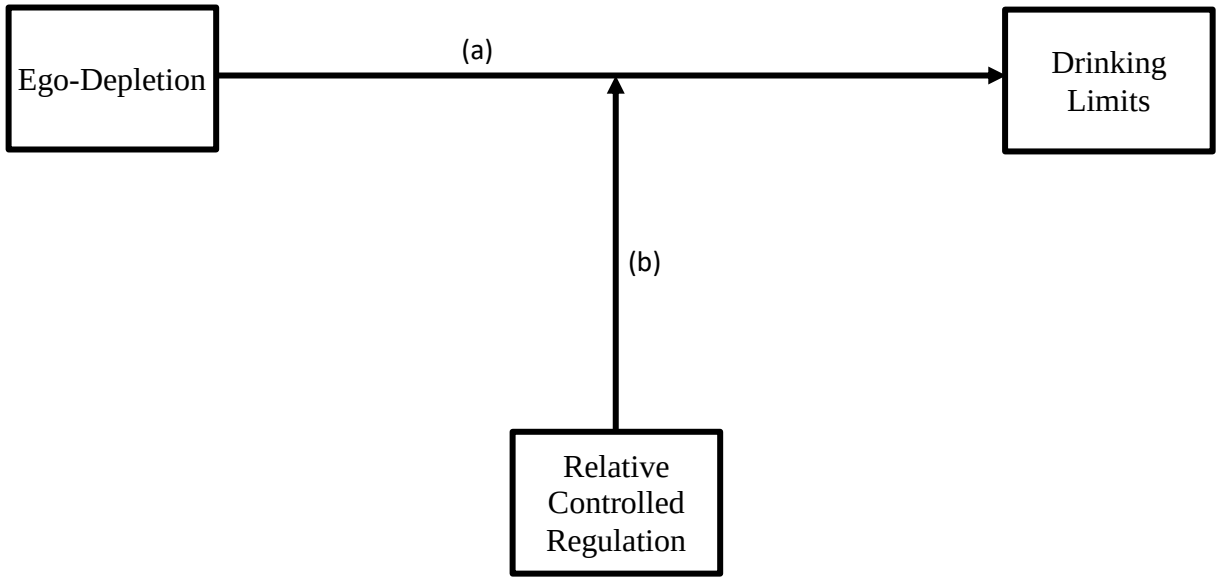
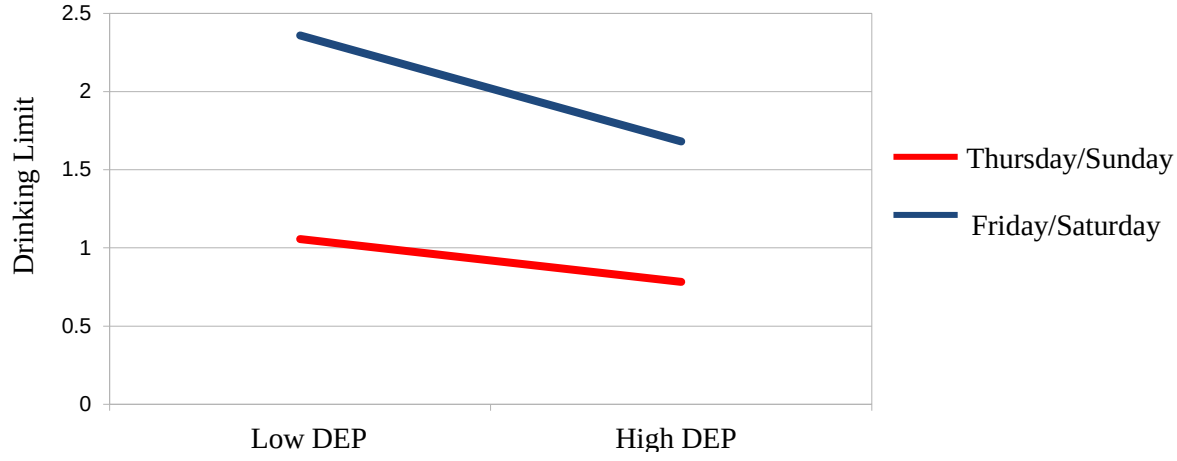


Figure 21. Post-Hoc Model 3: Testing the interaction between Ego-Depletion and Relative Controlled Regulation on student Drinking Limits

Sample 1 (*p* = .028)



Sample 2 (*p* = .701)

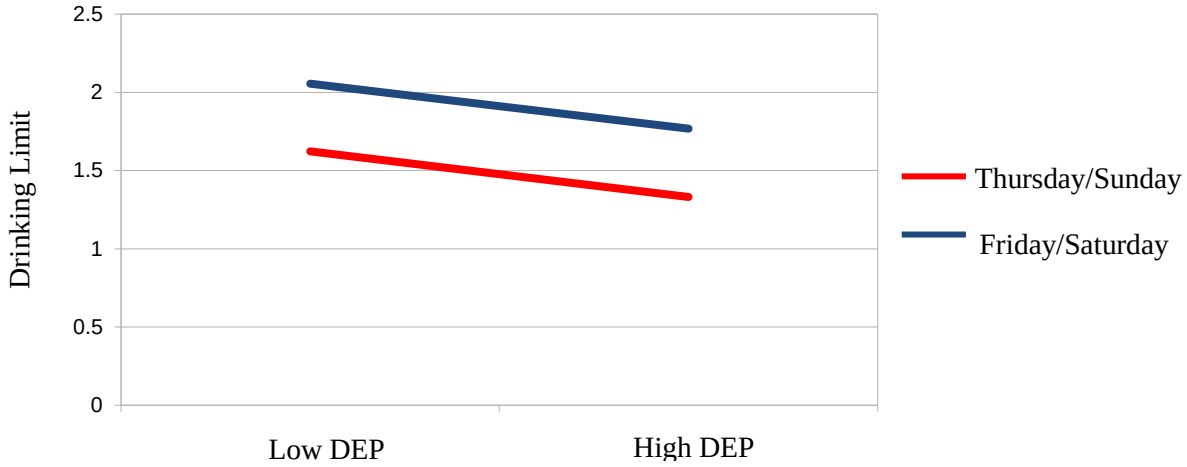


Figure 22. Interaction between Depletion (DEP) and Day of the Week on Drinking Limits

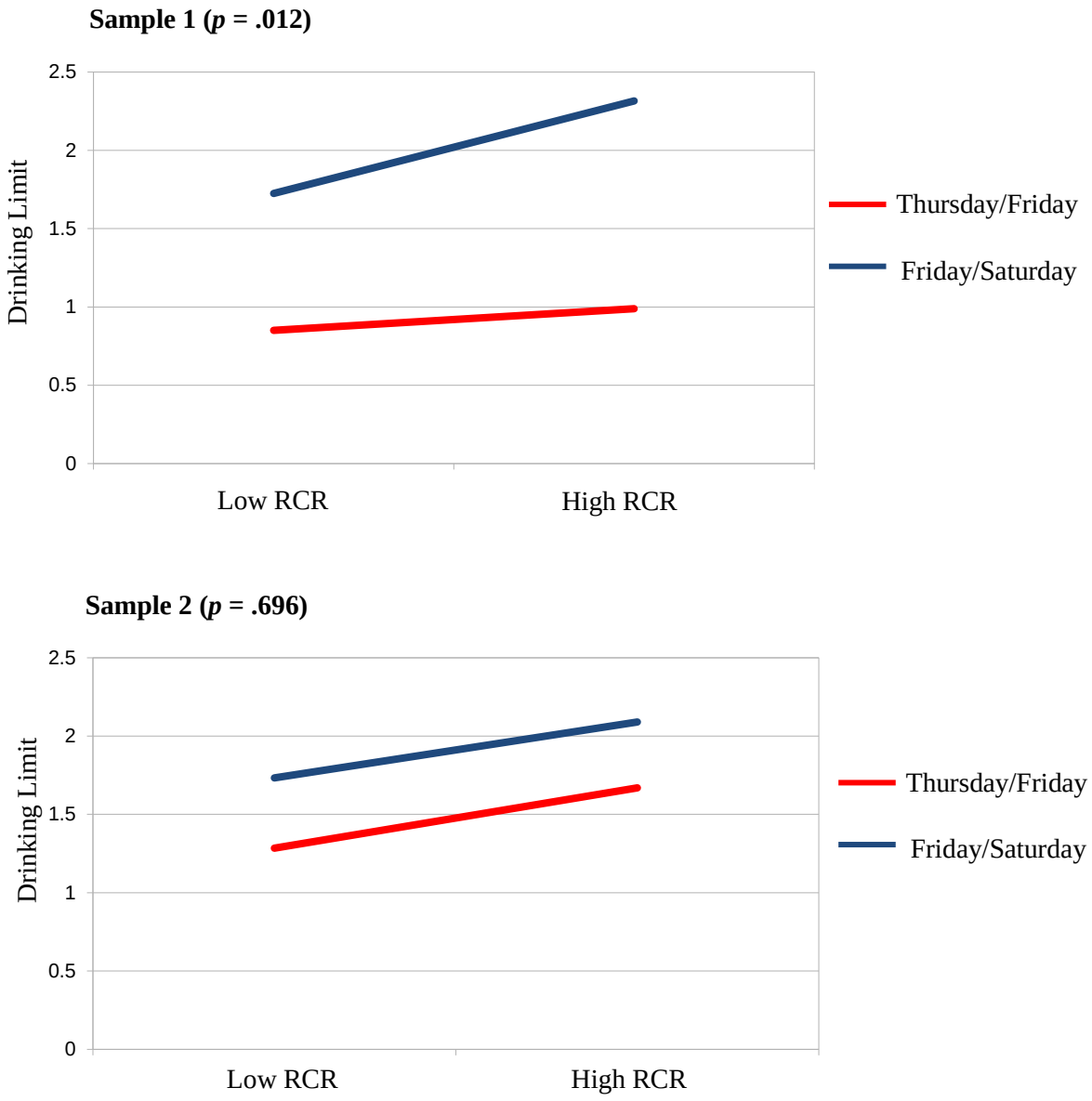


Figure 23. Interaction between Relative Controlled Regulation (RCR) and Day of the Week on Drinking Limits

Sample 2 (p = .026)

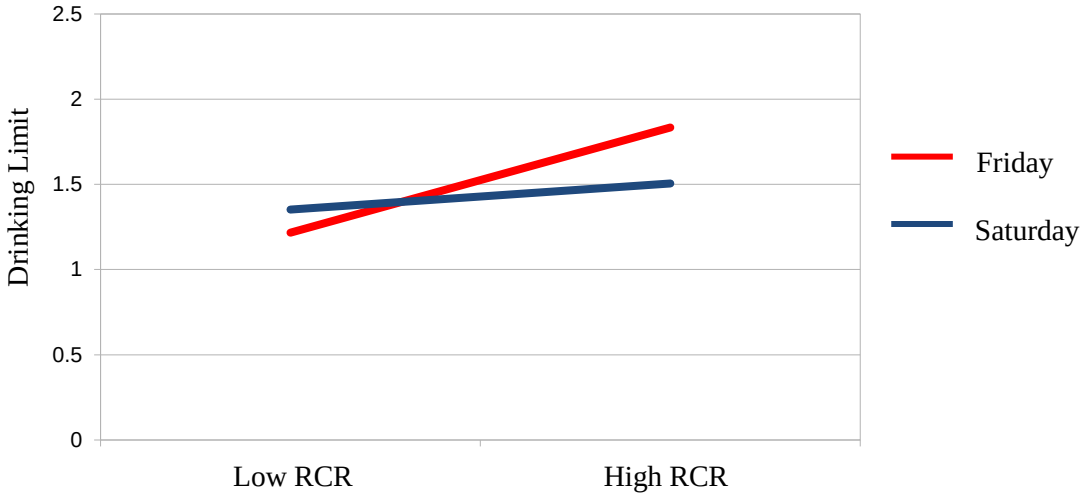


Figure 24. Interaction between Relative Controlled Regulation (RCR) and Day of the Week on Drinking Limits

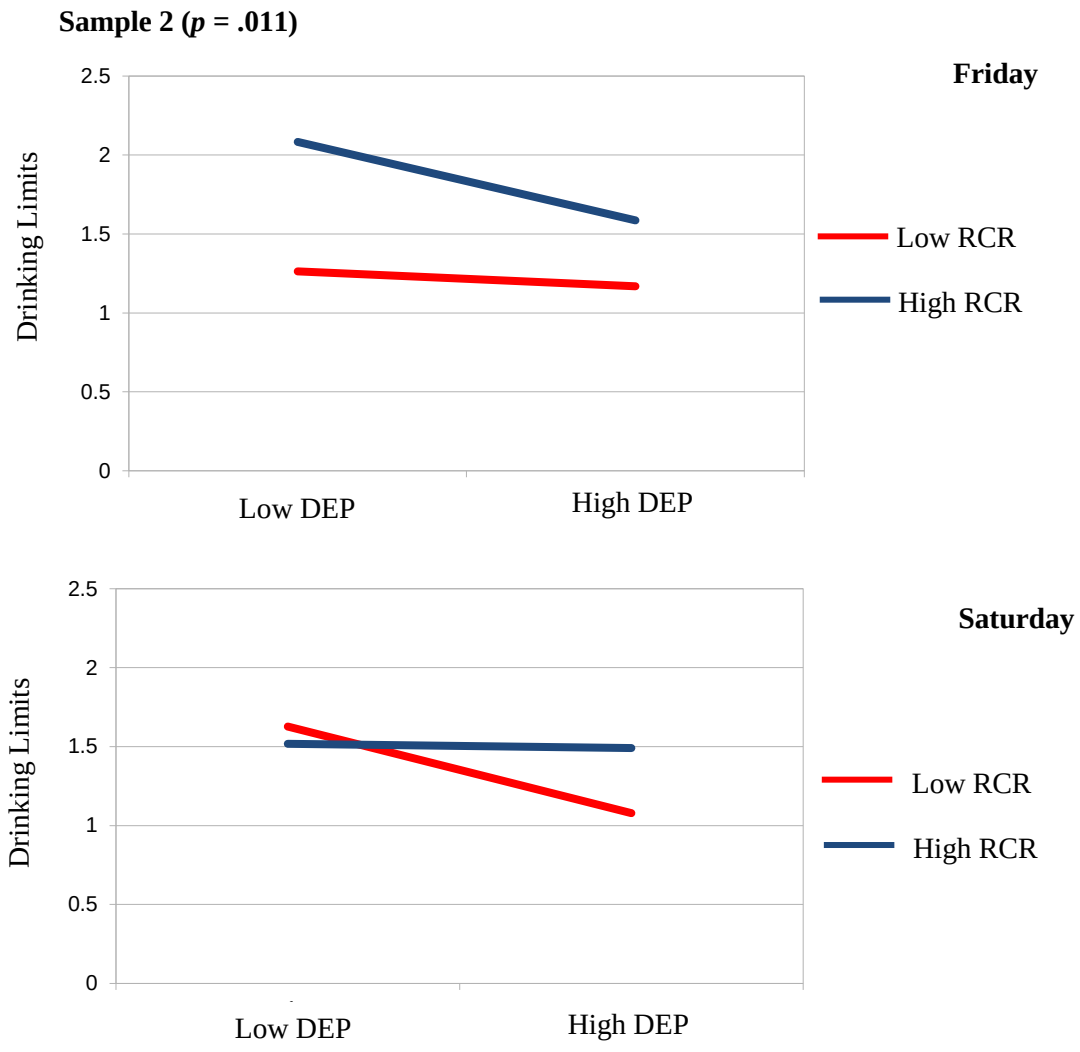


Figure 25. Interaction between Depletion (DEP) and Relative Controlled Regulation (RCR) on Drinking Limits on Friday versus Saturday

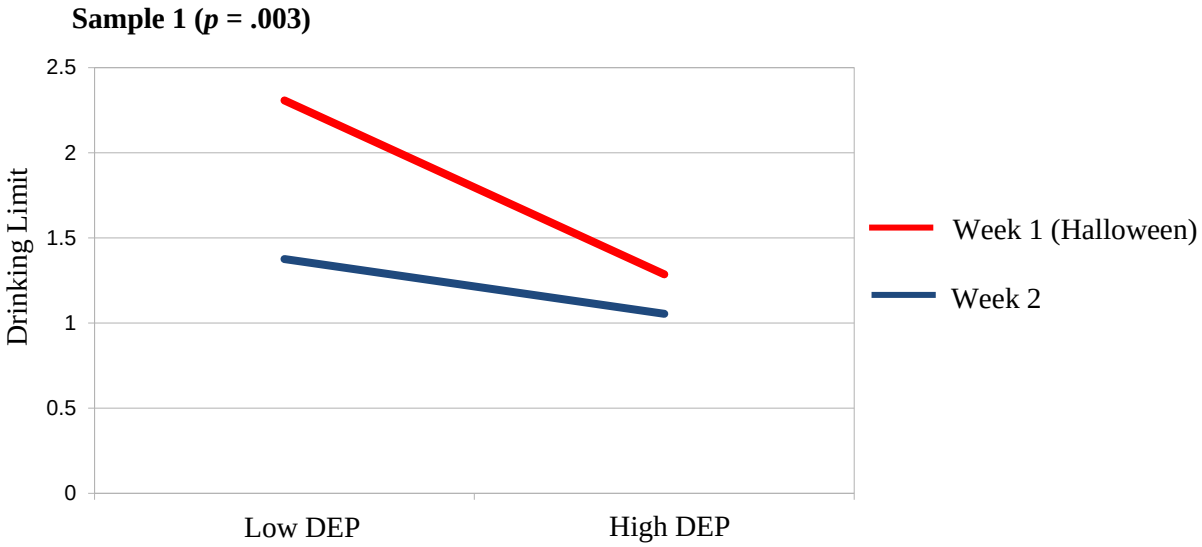


Figure 26. Interaction between Depletion (DEP) and Week of Assessment on Drinking Limits

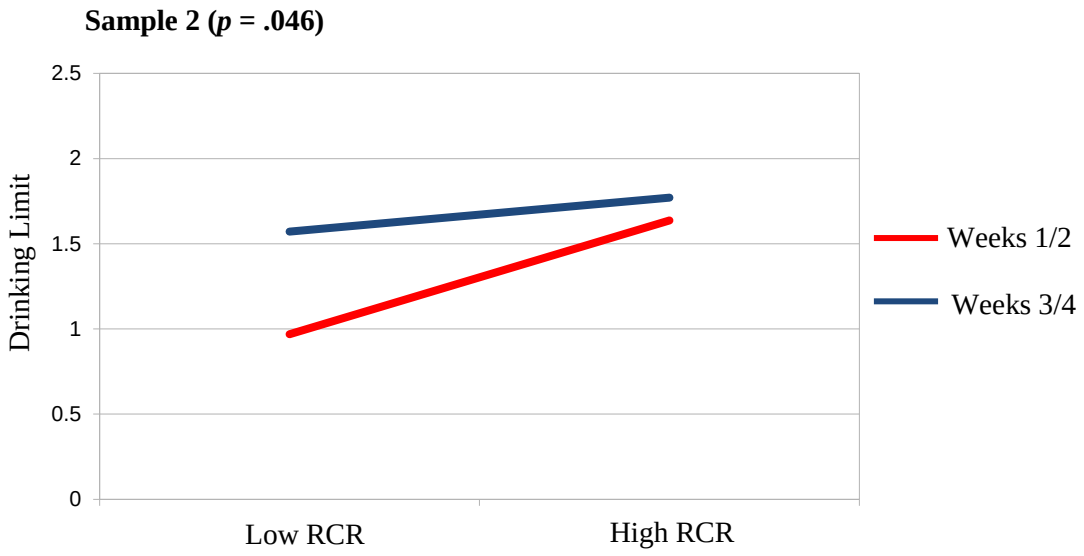


Figure 27. Interaction between Relative Controlled Regulation (RCR) and Week of Assessment on Drinking Limits. Week 4 = Easter weekend/final exams

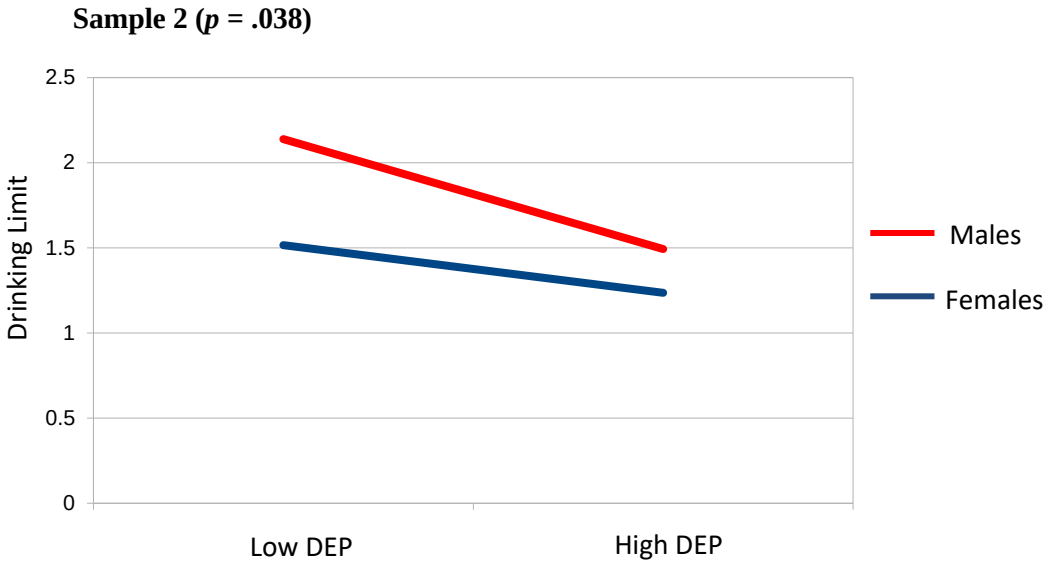


Figure 28. Interaction between Depletion (DEP) and Gender on Drinking Limits

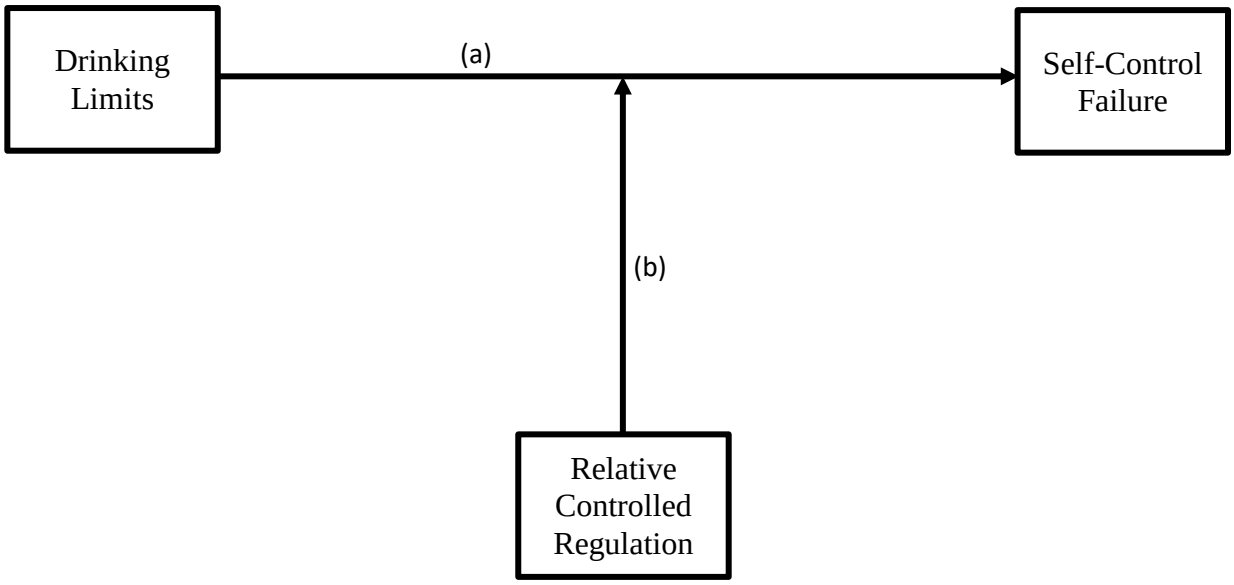


Figure 29. Post-Hoc Model 4: Testing the interaction between Drinking Limits and Relative Controlled Regulation on Self-Control Failure

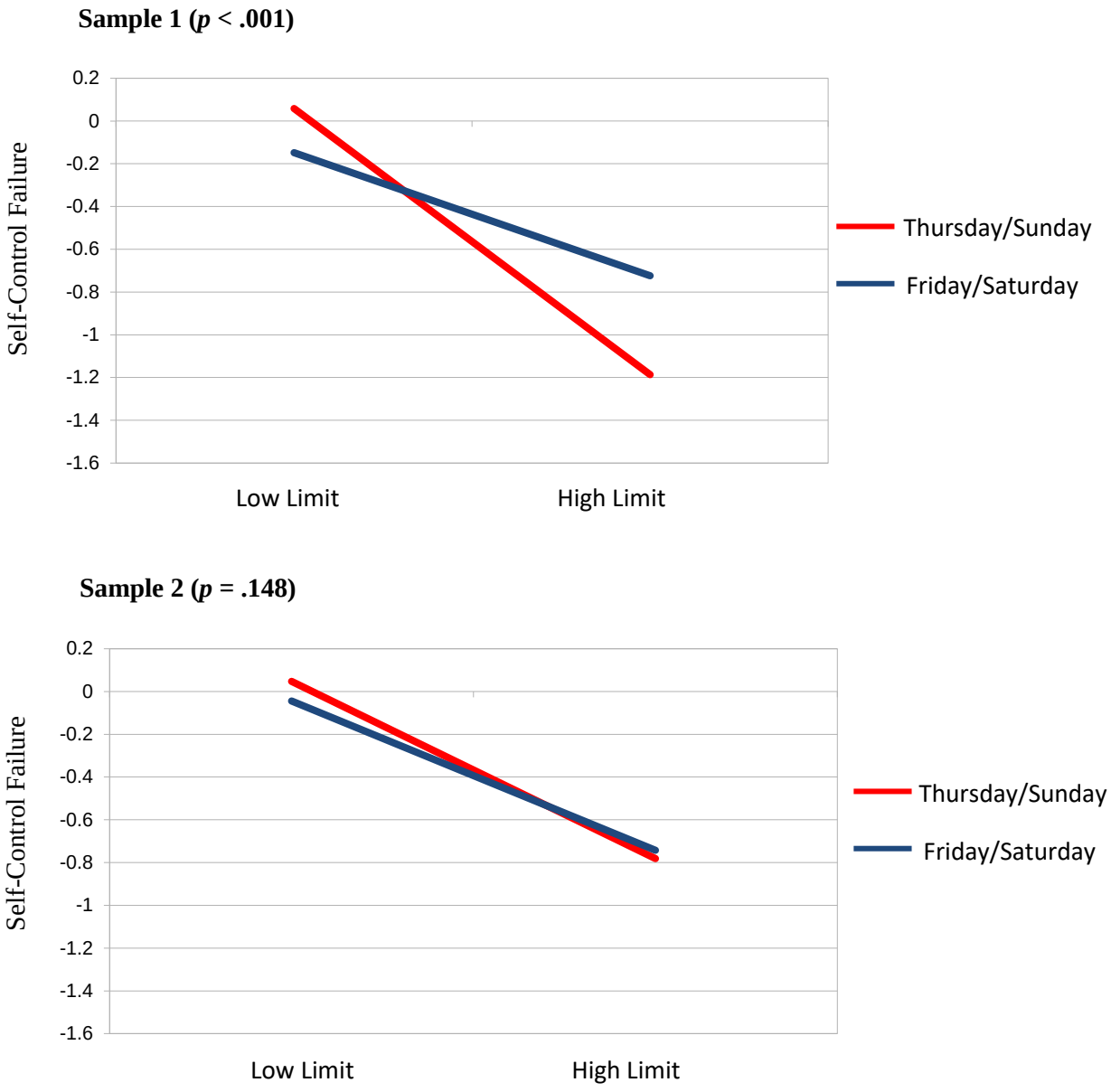


Figure 30. Interaction between Drinking Limits and Day of the Week on Self-Control Failure

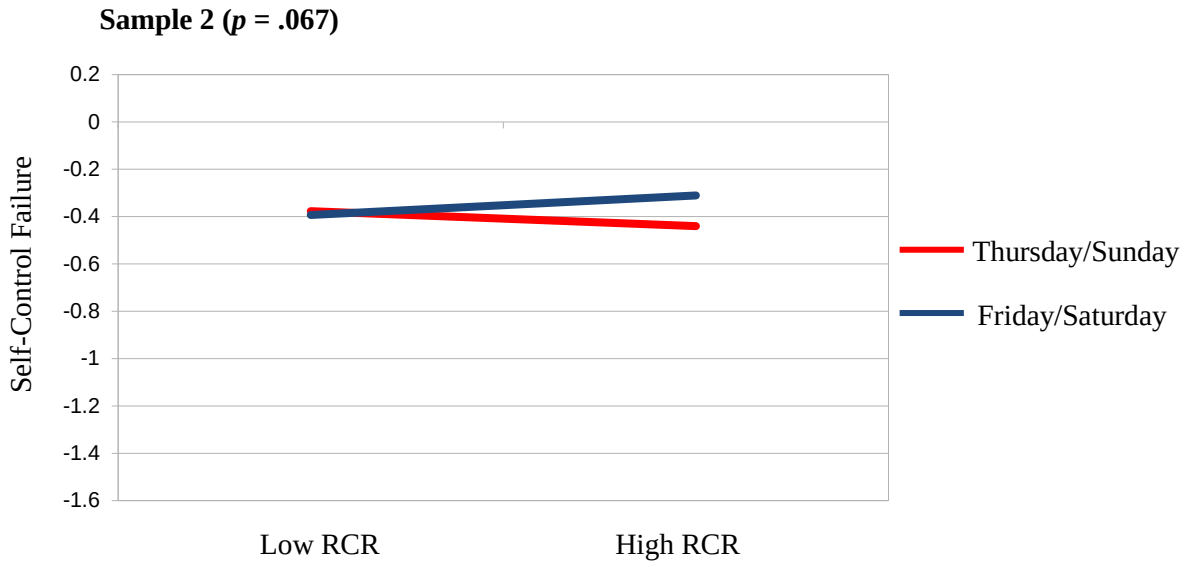


Figure 31. Interaction between Relative Controlled Regulation (RCR) and Day of the Week on Self-Control Failure

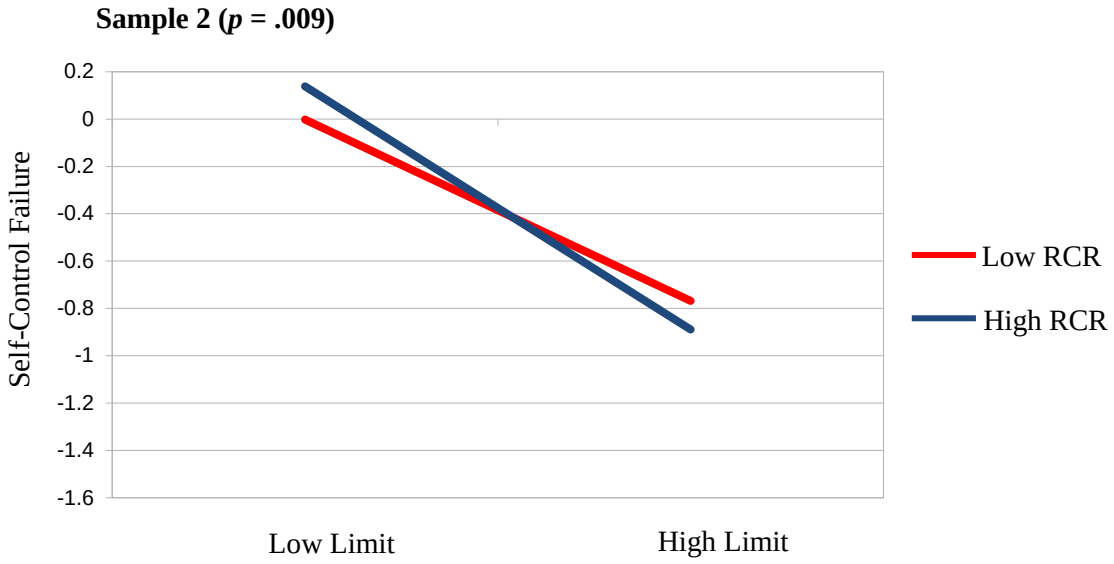
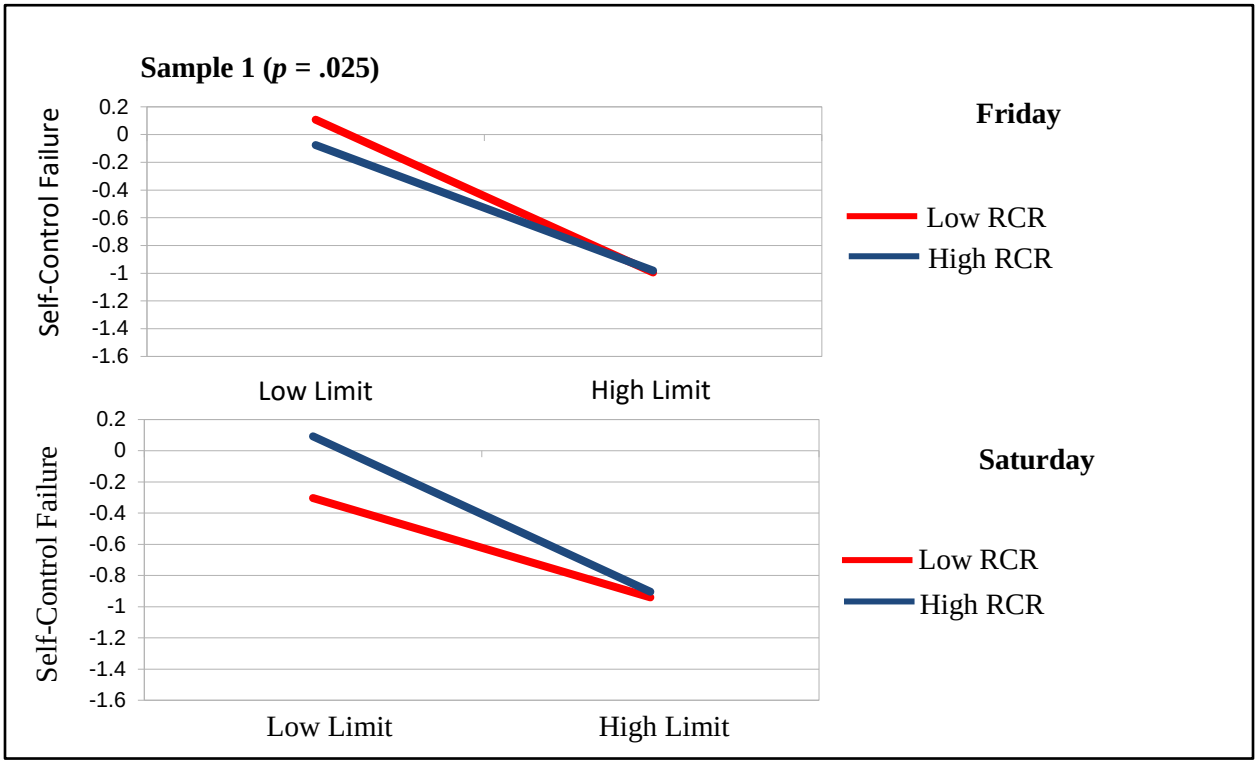


Figure 32. Interaction between Drinking Limits and Relative Controlled Regulation (RCR) on Self-Control Failure



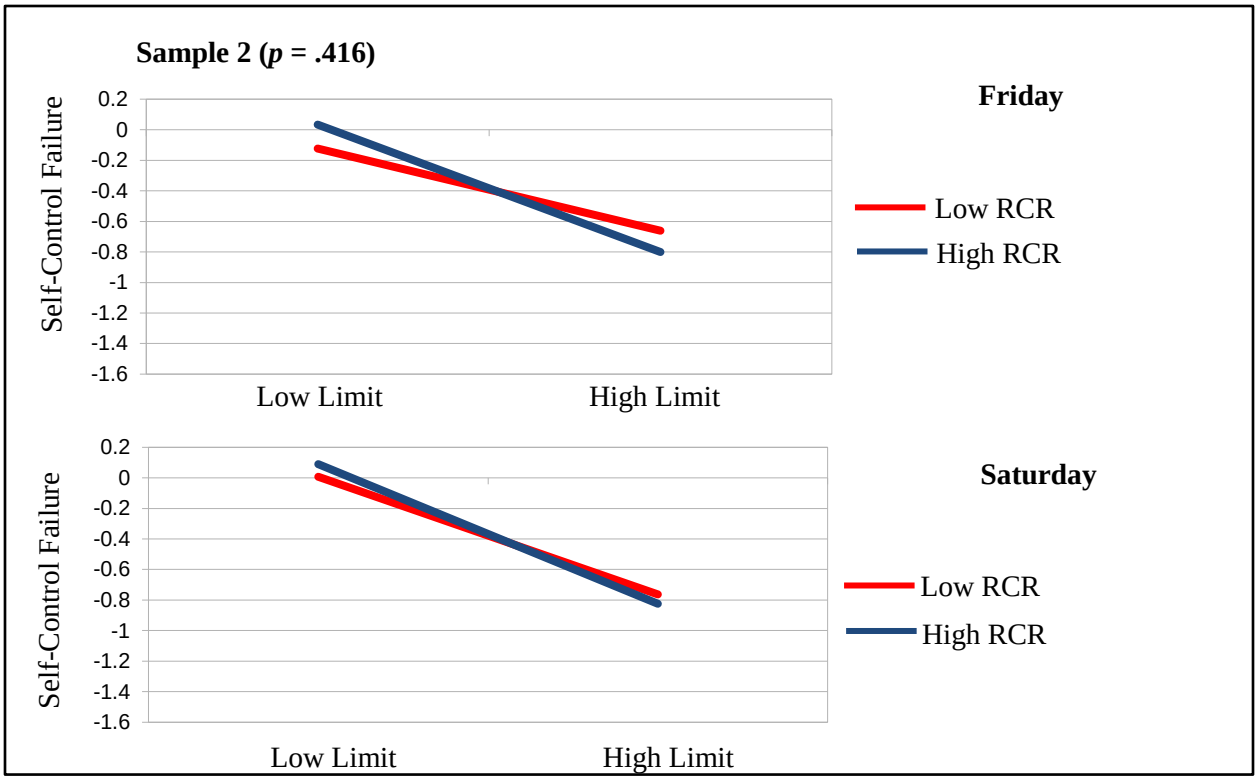


Figure 33. Interaction between Drinking Limits and Relative Controlled Regulation (RCR) on Self-Control Failure for Fridays versus Saturdays

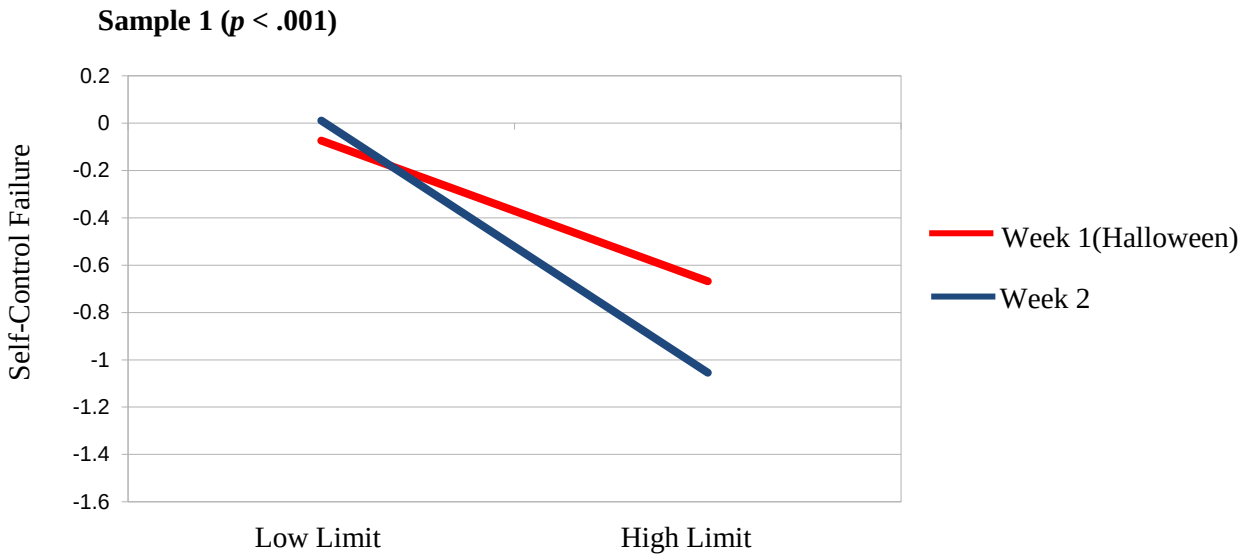


Figure 34. Interaction between Drinking Limits and Week of Assessment on Self-Control Failure

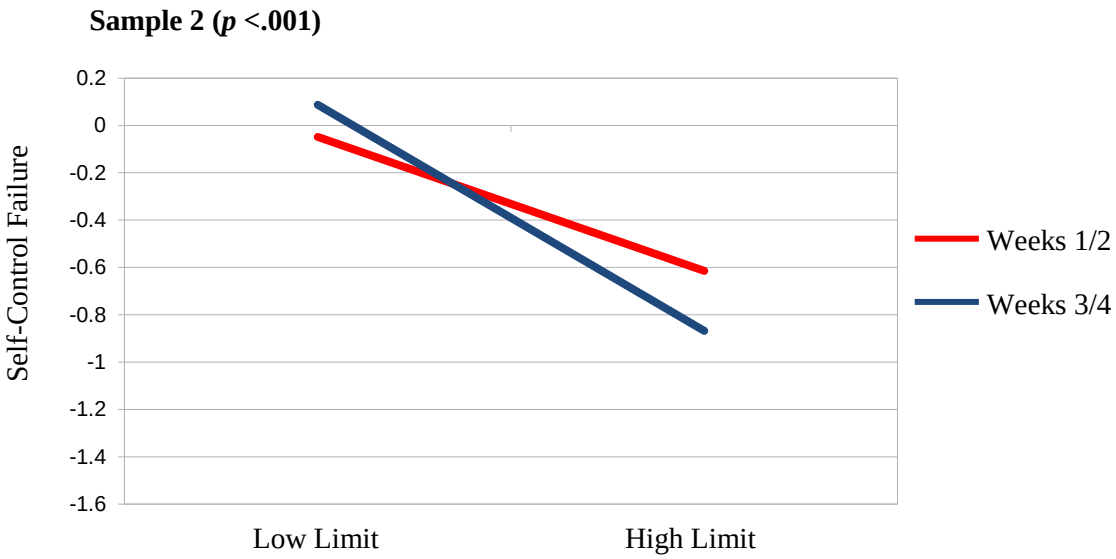


Figure 35. Interaction between Drinking Limits and Week of Assessment on Self-Control Failure. Week 4 = Easter weekend/final exams.

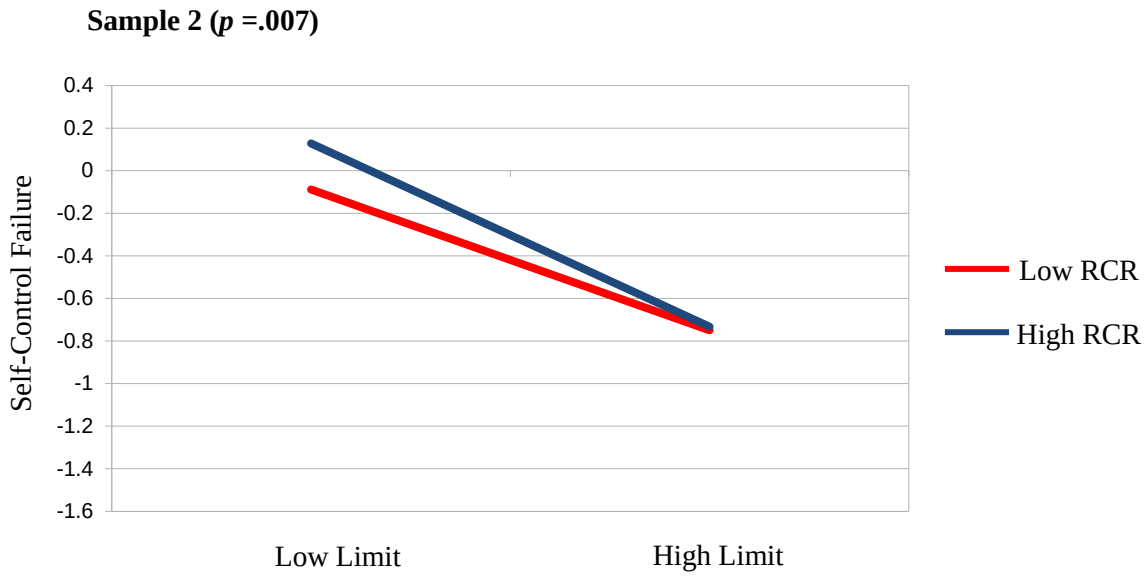


Figure 36. Interaction between Drinking Limits and Relative Controlled Regulation (RCR) on Self-Control Failure

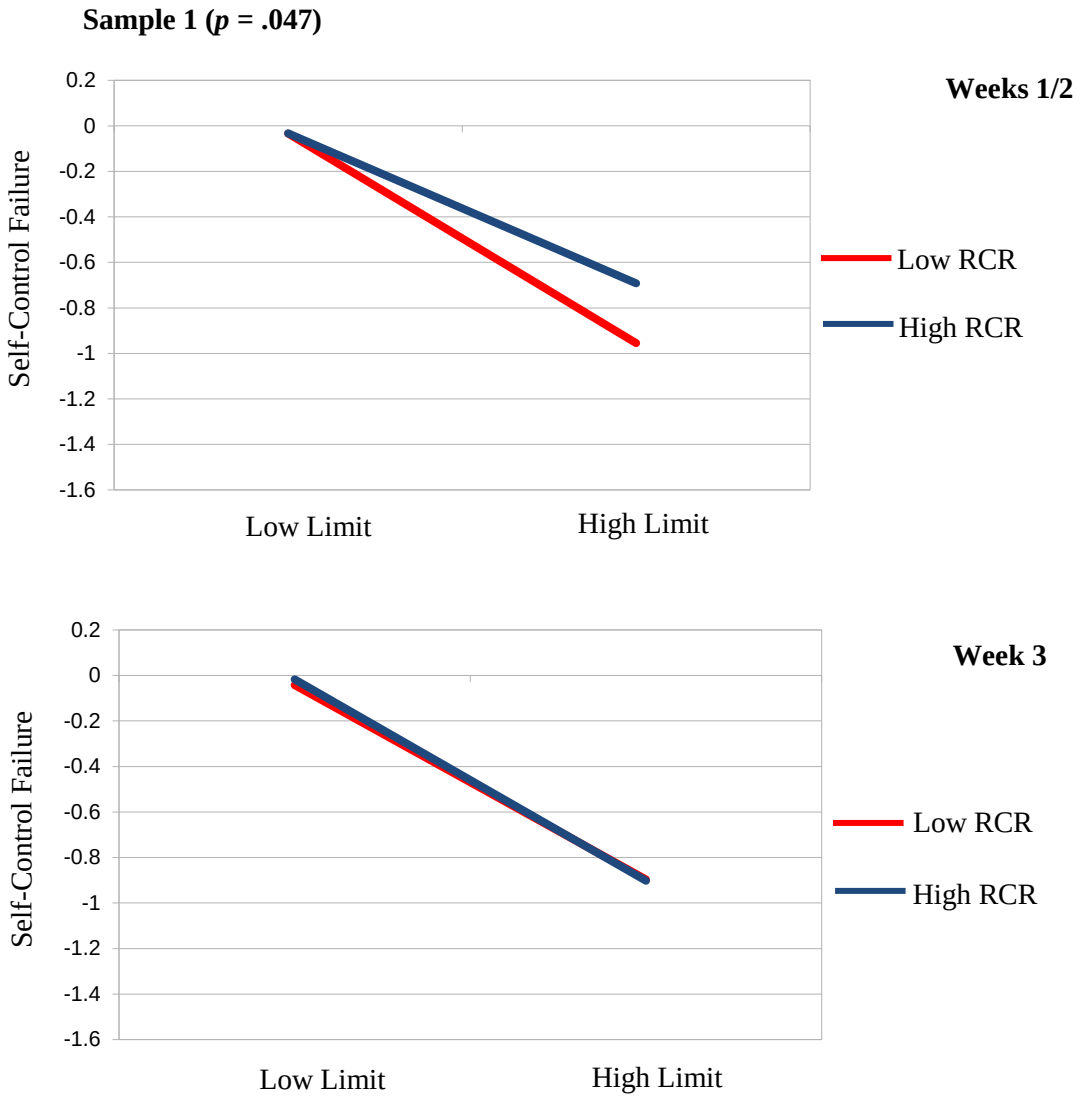


Figure 37. Interaction between Drinking Limits and Relative Controlled Regulation (RCR) on Self-Control Failure on Weeks 1 and 2 versus Week 3. Week 1 = Halloween.

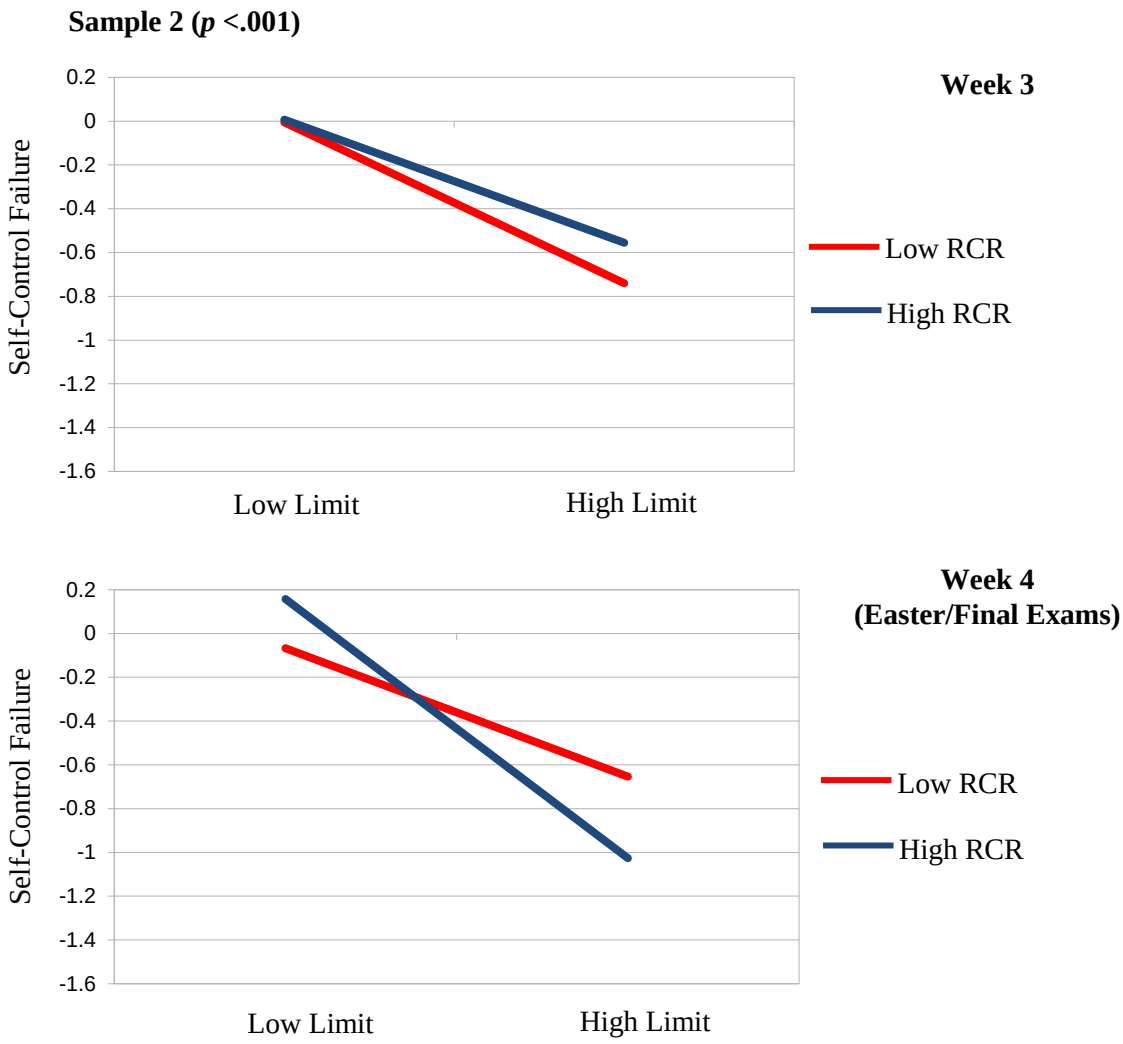


Figure 38. Interaction between Drinking Limits and Relative Controlled Regulation (RCR) on Self-Control Failure on Week 3 versus Week 4

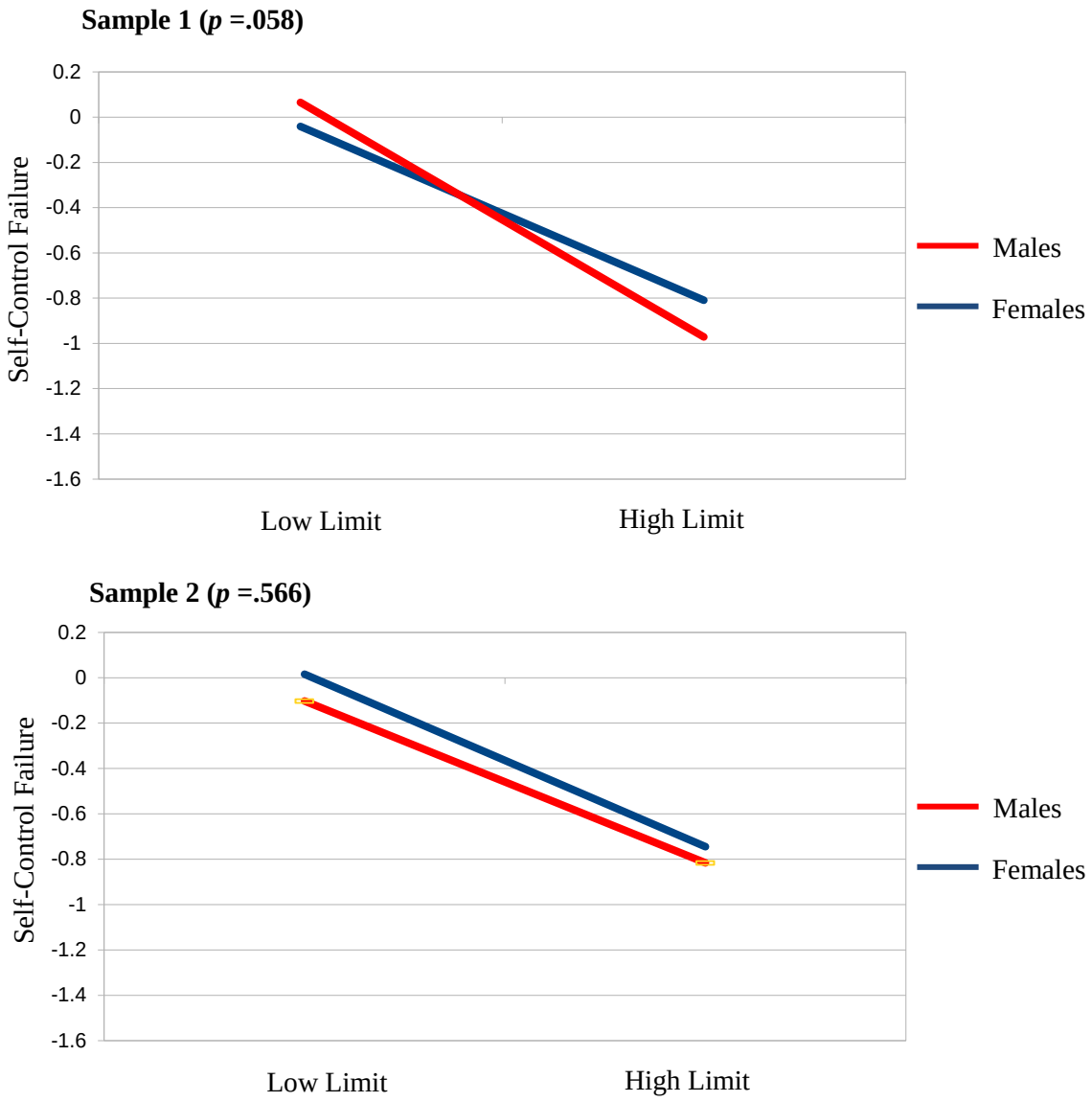
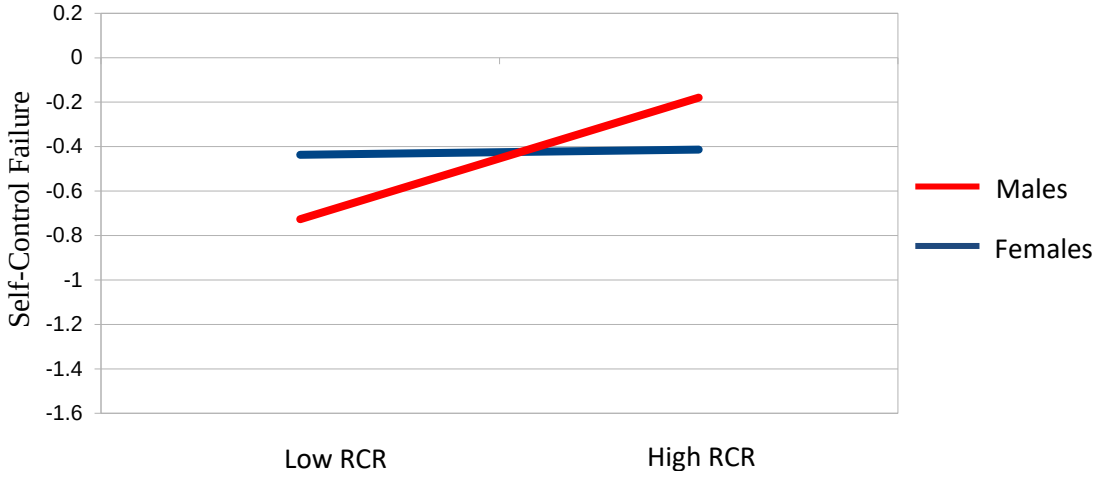


Figure 39. Interaction between Drinking Limits and Gender on Self-Control Failure

Sample 1 (*p* =.005)



Sample 2 (*p* =.529)

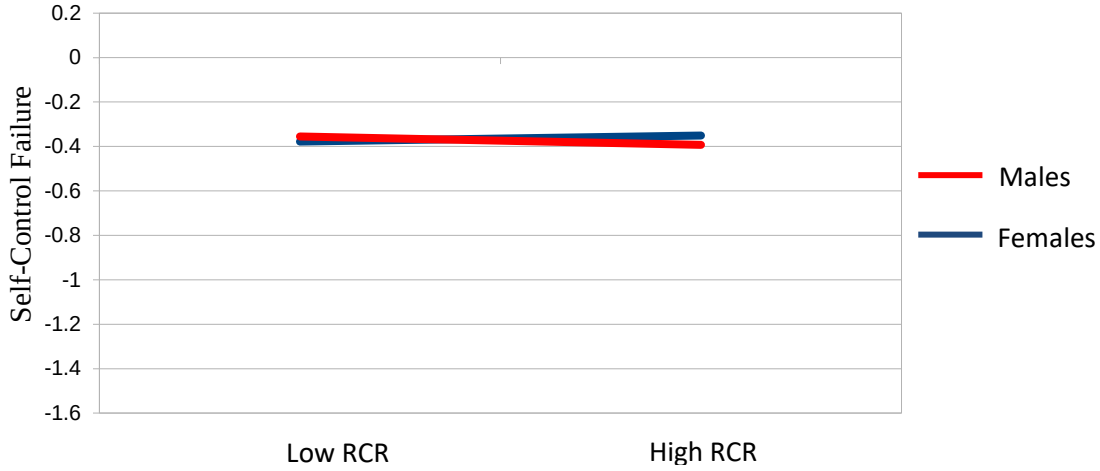


Figure 40. Interaction between Relative Controlled Regulation (RCR) and Gender on Self-Control Failure

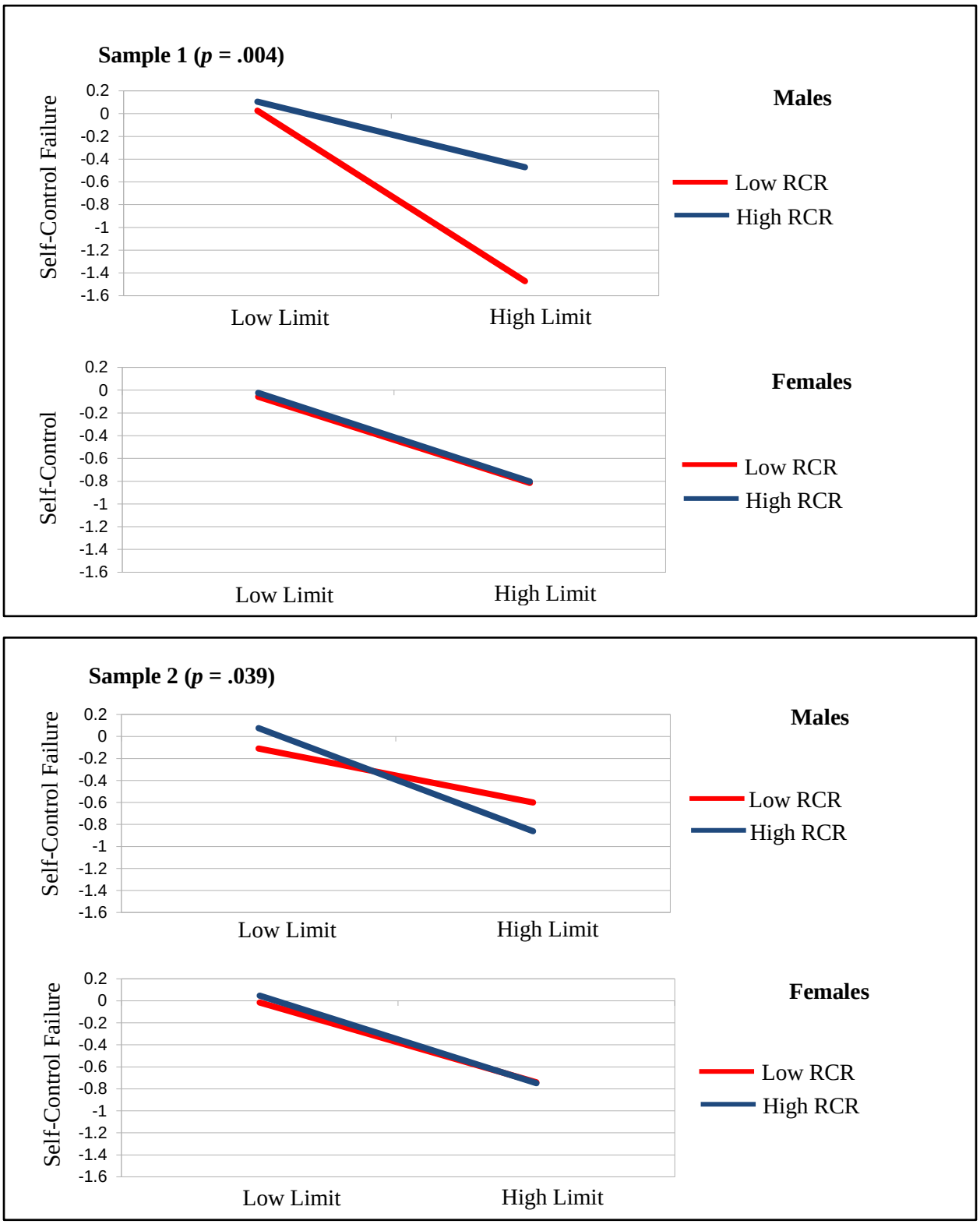


Figure 41. Interaction between Drinking Limits and Relative Controlled Regulation (RCR) on Self-Control Failure for Males versus Females

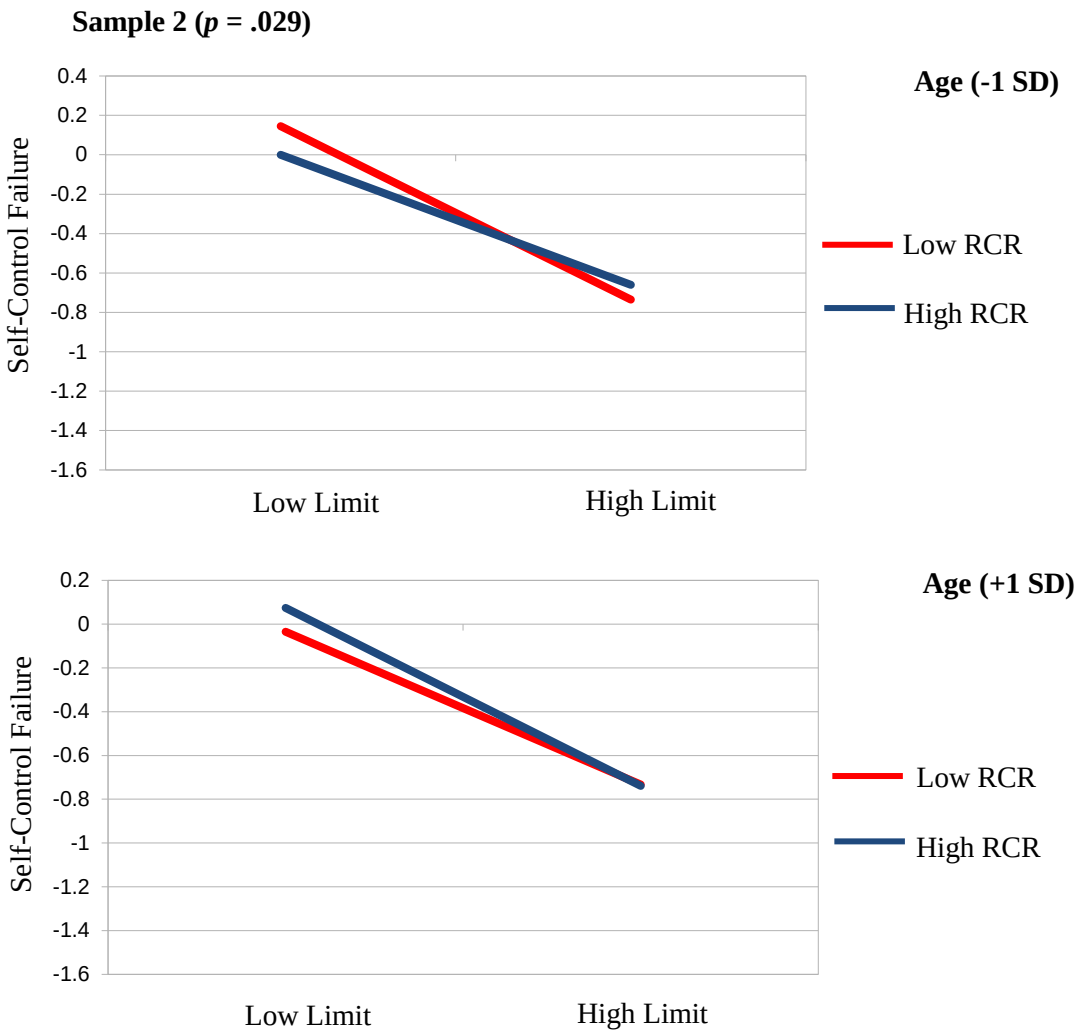


Figure 42. Interaction between Drinking Limits and Relative Controlled Regulation (RCR) on Self-Control Failure for younger versus older students

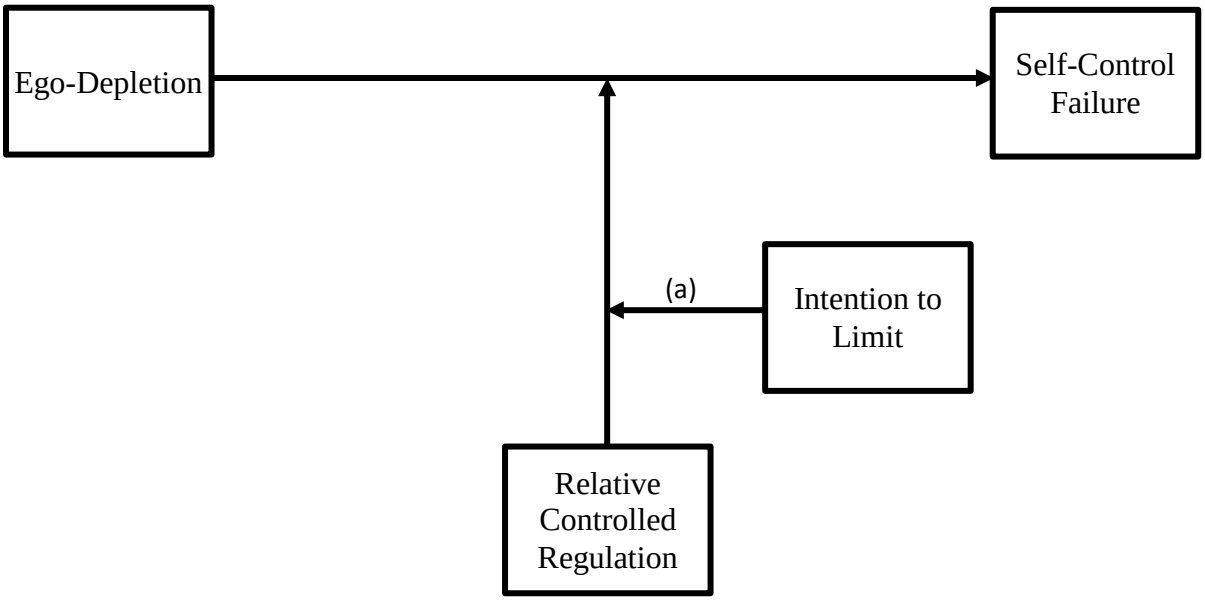


Figure 43. Post-Hoc Model 5: Testing the three-way interaction between Ego-Depletion, Relative Controlled Regulation, and Intention to Limit on Self-Control Failure