A longitudinal investigation of depression, anxiety, and stress as moderators of the coupled relationship between negative urgency and disordered eating frequency in first-year undergraduates

by

Nicole Legg
Bachelor of Science (Honours), University of British Columbia Okanagan, 2016

A Thesis Submitted in Partial Fulfillment
of the Requirements for the Degree of

MASTER OF SCIENCE

in the Department of Psychology

© Nicole Legg, 2019
University of Victoria

All rights reserved. This thesis may not be reproduced in whole or in part, by photocopy or other means, without the permission of the author.
A longitudinal investigation of depression, anxiety, and stress as moderators of the coupled relationship between negative urgency and disordered eating frequency in first-year undergraduates

by

Nicole Legg
Bachelor of Science (Honours), University of British Columbia Okanagan, 2016

Supervisory Committee

Dr. Brianna Turner, Supervisor
Department of Psychology

Dr. Bonnie Leadbeater, Departmental Member
Department of Psychology
Abstract

Evidence suggests that the transition to postsecondary may be an important period of risk for engagement in disordered eating (DE). DE has been demonstrated to fluctuate and change course over time, however, very little research has examined factors that underlie these changes in DE. Higher negative urgency has been associated with elevated DE frequency, and preliminary evidence suggests that negative urgency may change concurrently with DE symptoms. Moreover, symptoms of depression, anxiety, and stress (DAS), are all associated with DE engagement, implicating an important role for negative affect in DE engagement. Despite this evidence, there is a paucity of literature examining the association between negative urgency and DE frequency over time, and how acute negative emotional states may moderate this relationship. The current study aimed to address this research gap by examining the relationship between negative urgency and DE frequency over time, and if symptoms of DAS moderate this relationship. It was hypothesized that DE frequency and negative urgency would share a significantly coupled relationship, and that symptoms of DAS would significantly moderate this relationship. Specifically, negative urgency would be more strongly coupled with DE frequency when DAS symptoms were high, as compared to when DAS symptoms were low. Two cohorts of first year undergraduate students (N = 645) completed monthly self-reports of negative urgency, symptoms of DAS, and DE frequency over their first two semesters of post-secondary study (7 months total). Multilevel Models revealed that indeed negative urgency and DE frequency share a statistically significant coupled relationship over time ($p < .001$), and that depressive symptoms moderate this relationship ($p < .001$) such that the coupled association between negative urgency and
DE frequency was strengthened by depression. The current study is the first to examine how negative urgency and DE frequency co-vary over time and how negative affect moderates this association. The results illuminate the importance of considering interactions between established risk factors and negative emotional states in the engagement and frequency of DE behaviours, and offers preliminary insight into correlates of change in DE frequency over time.
# Table of Contents

Supervisory Committee ........................................................................................................... ii
Table of Contents ...................................................................................................................... v
List of Tables ................................................................................................................................. vi
List of Figures ................................................................................................................................. vii
Acknowledgments ......................................................................................................................... viii
Introduction ........................................................................................................................................ 1
  Theoretical Models of DE .................................................................................................................. 3
  Negative Urgency and DE ................................................................................................................ 5
  Negative Affect and DE .................................................................................................................... 9
The Current Study ............................................................................................................................. 14
Methods ............................................................................................................................................. 17
  Participants ....................................................................................................................................... 17
  Procedures ....................................................................................................................................... 18
  Measures ......................................................................................................................................... 19
  Data Cleaning ................................................................................................................................. 23
  Planned Analyses ........................................................................................................................... 24
Results ............................................................................................................................................... 29
  Preliminary Analyses .................................................................................................................... 29
    Nested structure of the data .......................................................................................................... 31
    Missing data ............................................................................................................................... 34
  Main Analyses ............................................................................................................................... 38
    Study Aim 1 ................................................................................................................................. 38
    Study Aim 2 ................................................................................................................................. 45
Discussion .......................................................................................................................................... 53
Limitations .......................................................................................................................................... 64
Future Directions ............................................................................................................................. 66
References ......................................................................................................................................... 68
List of Tables

Table 1. Descriptive statistics for measures of DE, Negative Urgency, and DAS .......... 30

Table 2. Correlations of all variables included in the study .................................. 30

Table 3. Random effects and ICC’s of null multilevel models .................................. 33

Table 4. Descriptives of each cohort and full sample of the current study ..................... 35

Table 5. T-test results comparing those that dropped out after baseline to those who completed one or more follow-up surveys ......................................................... 36

Table 6. Response rates of participants across seven monthly follow-ups .................... 37

Table 7. Number of monthly follow ups completed by participants .............................. 37

Table 8. Number of months that participants engaged in at least one episode of DE ...... 39

Table 9. MLM results for the null, time only, and coupled model between negative urgency and DE severity ........................................................................................................ 47

Table 10. MLM results for the moderating effects of DAS on the association between negative urgency and DE severity ........................................................................... 51
List of Figures

**Figure 1.** Level-1 and Level-2 equations for the coupled MLM examining if negative urgency shares a coupled relationship with DE frequency when assessed frequency across seven points. .................................................................................................................. 26

**Figure 2.** Level-1 and Level-2 equations for the MLM examining if depression moderates the coupled association between negative urgency and DE frequency when assessed frequency across seven points. ........................................................................................................... 27

**Figure 3.** Level-1 and Level-2 equations for the MLM examining if anxiety moderates the coupled association between negative urgency and DE frequency when assessed frequency across seven points. ........................................................................................................... 27

**Figure 4.** Level-1 and Level-2 equations for the MLM examining if stress moderates the coupled association between negative urgency and DE frequency when assessed frequency across seven points. ........................................................................................................... 28

**Figure 5.** Plot illustrating variance in ten participants’ negative urgency scores, in relation to their own personal mean, over time. The plot demonstrates the pure within-person variance in negative urgency over time. .................................................................................................................. 33

**Figure 6.** Prevalence rates of DE engagement among first year undergraduates within a given month, further broken down by the type of DE behaviour. ................................................................. 40

**Figure 7.** The percentage of first year undergraduates who endorsed no DE, and various levels of DE frequency........................................................................................................................................... 41

**Figure 8.** Number of reports of each type of DE behaviour, further broken down by the number of endorsements for each frequency level of DE........................................................................................................ 42

**Figure 9.** Number of cases across seven months wherein various DE behaviours occurred alone, or in combination, within a given month. ................................................................. 43

**Figure 10.** Group average scores of depression, anxiety, and stress symptoms, and group average negative urgency scores across the academic year................................................................. 44
Acknowledgments

First and foremost, I would like to thank my supervisor, Dr. Brianna Turner, for her support, expertise, and patience in helping me craft this thesis (and its may edits). Thank you, Bri, for guiding and inspiring me throughout my Masters degree. Moreover, I would like to thank my parents for always encouraging me to pursue what I am passionate about, with endless support, optimism, and encouragement.

I would like to thank Drs. Bonnie Leadbeater and Shannon Zaitsoff for the time and expertise that they contributed to this project, as well as the other members of the Department of Psychology at the University of Victoria who have advised, supported, mentored, and taught me throughout my Masters degree. Finally, I would like to acknowledge the Canadian Institutes for Health Research Council for funding this project through a Canadian Graduate Studies - Masters Award.
A longitudinal investigation of depression, anxiety, and stress as moderators of the coupled relationship between negative urgency and disordered eating frequency in first-year undergraduates

Disordered eating (DE) is described as engagement in maladaptive and subclinical eating disorder symptoms including binge eating, fasting, and extreme compensatory behaviours such as self-induced vomiting, laxative or diuretic abuse, and compulsive exercise (Perryman, Barnard, & Reysen, 2018). The transition from high school to postsecondary education may be a period of increased risk for engagement in DE behaviours as high rates of body dissatisfaction, anxiety about weight gain, and poor body image are frequently reported by university freshmen, particularly among women (Barker & Galambos, 2007; Delinsky & Wilson, 2008; Freeman & Gil, 2004; Lowery et al., 2005; Sassaroli & Ruggerio, 2005). Moreover, the stress associated with new academic, social, and occupational demands of university may further increase this risk (Freeman & Gil, 2004; Wolff, Crosby, Roberts, & Wittrock, 2000). Between 10-44% of college students engage in DE (Celio et al., 2006; Eisenberg, Nicklett, Roeder, & Kirz, 2011; Hoerr, Bokram, Lugo, Bivins, & Keast, 2002; Luce, Crowther, & Pole, 2008; Prouty, Protinsky, & Canady, 2002), and although rates of DE are typically higher in women than men (Neumark-Sztainer, Wall, Larson, Eisenberg, & Loth, 2011), men demonstrate comparable rates of vomiting, laxative and diuretic use, and compulsive exercise to women (Lipson & Sonneville, 2017). DE is associated with multiple negative outcomes including body dissatisfaction, lowered self-esteem, appearance anxiety, and negative affect, as well as cardiovascular, gastrointestinal, and endocrine complications (Brechan & Kvalem, 2015; Brown & Mehler, 2013; Ferreiro, Wichström, Seoane,
Senra, 2014; Mehler & Anderson, 2010; Slater & Tiggemann, 2010). Moreover, DE is a robust risk factor for the development of a clinical Eating Disorder, which carries severe physical consequences, as well as high morbidity, mortality, and relapse rates (Arcelus, Mitchell, Wales, & Nielsen, 2011). Despite the saliency of DE in postsecondary populations, it remains unclear why DE behaviours fluctuate or change course during the transition to adulthood.

Prospective studies demonstrate that DE symptoms may worsen or remain stable in some individuals, while attenuating in others over time (Ackard, Fulkerson, & Neumark-Sztainer, 2011; Hautala et al., 2008). In a large sample of male and females, Ackard and colleagues (2011) found evidence for exacerbated, stable, and attenuated trajectories of DE symptoms across a five-year period spanning adolescence to young adulthood. Similarly, Hautala and colleagues (2008) found evidence of sustained and attenuated trajectories among mid-adolescent males and females who were reassessed one year later. Among a sample of college-aged women, approximately half of the participants shifted from their latent class of DE symptomatology across a four-year period, and many of these shifts were into a less severe DE class (Cain, Epler, Steinley, & Sher, 2010). Within a shorter temporal period, Boone and colleagues (2012) examined day-to-day fluctuations in DE across a seven-day period using a daily diary. The researchers found that 15%, 44%, and 10% of the variance in drive for thinness, binge eating, and body dissatisfaction was at the within-person level, demonstrating that DE symptoms and cognitions often fluctuate day to day. Moreover, the researchers found that daily fluctuations in perfectionism were positively associated with daily fluctuations in binge eating, indicating that perfectionism and DE symptoms co-vary, despite
perfectionism being historically conceptualized as a stable, trait-like characteristic (e.g., Hewitt & Flett, 1991). The authors highlighted a need for more research to investigate shorter-term fluctuations in DE and to identify additional factors that may influence fluctuations in DE, including variability in trait-like characteristics that are strongly correlated with DE such as perfectionism, neuroticism, and impulsivity (Forbush, Heatherton, & Keel, 2007; MacLaren & Best, 2009; Waxman, 2009). Variables that dynamically interact with these substantiated risk factors of DE may help further explain fluctuations in DE (Lavender & Mitchell, 2015; Lester, Keel, Lipson, 2003; Liechty & Lee, 2013). Better understanding DE symptom fluctuations, and the etiological foundations and mechanisms that underpin them, is crucial to the implementation of effective prevention and intervention efforts for DE.

**Theoretical Models of DE**

Current etiological models of DE underscore the importance of both predisposing risk factors, as well as acute risk states such as negative emotions, in driving engagement of DE. The diathesis-stress model postulates that individuals often have diatheses that predispose them to the manifestation of psychopathology, such as genetic risk factors or traits that increase vulnerability to negative affect, and when these vulnerabilities interact with stressors, such as difficult life events, they trigger the onset or exacerbation of mental health symptoms (Slavik & Croake, 2006). In support of this model, researchers have found that perfectionism served as a diathesis for bulimic symptoms among women who perceived themselves as overweight, but not for those who did not perceive themselves as overweight (Joiner, Heatherton, Rudd, & Schmidt, 1997). Moreover, the diathesis-stress model is in line with recent calls in the literature to consider interactions
between established risk factors and mediating or moderating variables, in the engagement and fluctuations of DE (e.g., Boone et al., 2012; Ferrier-Auerbach & Martens, 2009). The diathesis-stress model provides a conceptualization framework that considers interactions between both well-established vulnerabilities and stressors in the manifestation of DE.

Additionally, emotion regulation models implicate negative emotional states in having a central role in the onset and maintenance of DE. The emotion regulation model of DE suggest that negative affect often serves as an important trigger for DE, and that negative affect is temporarily reduced after a DE episode (Heatherton & Baumeister, 1991; Gupta, Rosenthal, Mancini, Cheavens, & Lynch, 2008). Thus, DE may help individuals cope with negative affect by providing comfort, distraction and escape from their negative internal state, thereby perpetuating future engagement in DE through negative reinforcement (Hawkins & Clement 1984; McCarthy 1990; as cited in Blodgett Salafia & Lemer, 2012). In support of this model, self-report and daily diary studies have demonstrated that increased negative affect precedes engagement in DE (e.g., Kjelsas, Borsting, & Gudde, 2004; Waters, Hill, & Waller, 2001), and an ecological momentary assessment study found subsequent decreases in negative affect following both binge and vomiting episodes among a clinical sample (Smyth et al., 2007). An intensive self-monitoring study among a sample of university women found evidence for increased negative affect before a binge episode, reduced negative affect during the episode, and a return to higher negative affect after the episode when assessed every two minutes for thirty-five minutes (Deaver, Miltenberger, Smyth, Meidinger, & Crosby, 2003). These results suggest that although negative affect may be temporarily reduced during DE
episodes, the short-lived nature of these reductions, followed by a return or exacerbation of negative mood, may paradoxically serve to reinforce DE over time. Although a fuller discussion of the emotion regulation model (Heatherton & Baumeister, 1991) provides some information about risk factors that render an individual more susceptible to engaging in this regulatory cycle, the model does not consider dynamic interactions that may more fully explain why only some individuals who experience elevated negative affect also engage in DE. An integrated model of DE that draws on elements from both the diathesis-stress and emotion regulation models may more comprehensively explain the fluctuating pattern that is often observed in DE behaviour. Specifically, integrating these perspectives suggests that small changes in trait-like DE risk factors, exacerbate DE when they occur in conjunction with acute risk states such as negative emotions. Put another way, negative emotional states are the stressor within the diathesis-stress interaction, which interact with more stable diatheses to change propensities for DE engagement over time.

**Negative Urgency and DE**

Various personality characteristics have been associated with DE pathology, including perfectionism, neuroticism, and impulsivity (see Farstad, McGeown, & von Ranson, 2016 and Waxman, 2009 for reviews). These personality traits are theorized to function as vulnerabilities for DE (MacNeil, Esposito-Smythers, Mehlenbeck, & Weismoor, 2012). A recent systematic review found that impulsivity, defined as an individual’s (in)ability to inhibit urges and participate in adequate forethought before engaging in problematic behaviours (Whiteside & Lynam, 2001), is higher among individuals who engage in DE compared to controls, particularly among those who
engage in DE that is primarily characterized by bingeing and purging behaviours (see Waxman, 2009 for review). There is pervasive agreement among researchers that impulsivity is a multifaceted construct, however, conceptualizations of the various facets that comprise impulsivity vary widely (e.g., Patton, Stanford, & Barratt, 1995; Carver, Johnson, Joormann, Kim, & Nam, 2011; Lynam, Whiteside, Smith, & Cyders, 2006; Whiteside & Lynam, 2001). According to the UPPS-P model of impulsivity (Lynam et al., 2006; Whiteside & Lynam, 2001), impulsivity is comprised of the following five facets: negative urgency (i.e., the tendency to engage in impulsive behaviour when experiencing strong negative emotions); positive urgency (i.e., the tendency to engage in impulsive behaviour when experiencing strong positive emotions); lack of planning (i.e., the inadequate ability to consider the consequences of one's behaviour); sensation seeking (i.e., the desire for and pursuit of thrills and excitement); and, difficulty persisting on tasks (i.e., inadequate perseverance when bored and/or fatigued). Negative urgency has emerged as a uniquely robust predictor of DE, over and above other facets of impulsivity (Fischer, Smith & Cyders, 2008; Miller, Flory, Lynam, & Leukefeld, 2003; Smith et al., 2007). This robust association aligns with emotion regulation models of DE, such that a poorer ability to regulate behaviour under negative affect may make a person especially vulnerable to the short-term emotion regulatory benefits of DE (e.g., Ferriter & Ray, 2011; Racine & Wildes, 2013).

Research has established negative urgency as an important cross-sectional correlate and prospective predictor of DE pathology (e.g., Davis & Fischer, 2013; Davis-Becker, Peterson, Fischer, 2014; Fischer et al., 2008; Miller et al., 2003; Pearson, Zapolski, & Smith, 2015; Smith et al., 2007), over and above the effects of negative
affect (Racine et al., 2013). Moreover, negative urgency reliably differentiates those with and without DE pathology (Fischer, Settles, Collins, Gun, & Smith, 2012; Pearson & Smith, 2015). More recently, research has begun to examine the role that negative urgency holds in the severity and frequency DE. Researchers found that among female undergraduate students, higher scores of negative urgency are associated with greater severity and frequency of loss of control eating (Espel, Muratore, & Lowe, 2017). Moreover, the researchers found that the association between negative urgency and severity of loss of control eating was significantly moderated by higher response inhibition. When response inhibition was high, lower negative urgency was somewhat protective of loss of control eating and higher negative urgency was more strongly associated with loss of control eating. Davis-Becker and colleagues (2014) found significant associations between negative urgency and global severity of DE pathology scores (defined as a combination of DE symptoms and DE behavioural frequencies) for female, but not male undergraduates. Moreover, they found a significant association between negative urgency and binge eating frequency for both genders. Finally, a cluster analysis of women with clinical and subclinical binge eating found that individuals with a Dietary-Negative Affect subtype of binge eating reported higher levels of negative urgency, higher frequencies of objective binge episodes, and more severe eating disorder symptoms compared to individuals with a Pure-Dietary binge eating subtype (Carrard, Crépin, Ceschi, Golay, & Van der Linden, 2012), suggesting that elevated negative urgency co-occurs with higher binge eating frequencies among individuals who are vulnerable to DE when they are distressed, compared to those who engage in DE without the context of negative affect (Carrard, Crépin, Ceschi, Golay, & Van der Linden, 2012).
These results point to an important interaction between negative urgency, negative emotional states, and elevated DE behavioural frequencies. When considered prospectively, Davis and Fischer (2013) found that baseline negative urgency uniquely predicted increases in global frequency binge eating and compensatory behaviours 3 months later in undergraduate females, when controlling for baseline symptoms of DE, trait anger and anxiety. The aforementioned literature suggests that higher negative urgency is associated with greater DE severity and frequency, and that considering moderators in the association is an important research aim.

Despite relatively strong evidence regarding the role of negative urgency as a prospective predictor of DE, the temporal role of negative urgency in DE, and impulsivity more broadly, remains unclear. One proposed theory, discussed by Lavender and Mitchell (2015), postulates that impulsivity (and therefore negative urgency) may have a non-prospective relationship with DE pathology. Indeed, Anestis, Selby, and Joiner (2007) found that changes in negative urgency positively corresponded with changes in bulimic symptoms among undergraduate students, when assessed three to four weeks later. The authors note that despite their moderate to large effect sizes of these concordant changes, these results should be interpreted with caution due to the limited capabilities of change scores to delineate true change from error. However, the study provides preliminary evidence suggesting that we would expect negative urgency to positively co-vary with DE symptoms, similar to past findings that demonstrated a concurrent association between perfectionism and DE behaviours (Boone et al., 2012). Positive concurrent changes between broad impulsivity and severity of maladaptive behaviour symptoms have also been demonstrated in the substance use literature among
adolescents and young adults (e.g., Blonigen, Timko, Finney, Moos, & Moos, 2011; King, Fleming, Monahan, & Catalano, 2011; Littlefield, Sher, & Wood, 2009).

Examining if, and how, substantive risk factors of DE are related to fluctuations in frequency or severity of DE symptoms may illuminate mechanisms that underpin short term changes in DE. Longitudinal studies that employ multiple follow-ups and utilize more advanced statistical techniques to examine within-person change of negative urgency and DE are needed.

**Negative Affect and DE**

Negative emotional states are by definition, integral to the construct of negative urgency, and are suggested to hold an important role in DE. Symptoms of depression, anxiety, and stress (DAS) are pervasive negative emotional concerns among university students: 44.4% of Canadian undergraduates reported that they felt “so depressed it was difficult to function”, 64.5% reported “overwhelming anxiety”, and 14.4% reported “tremendous stress” (ACHA-NCHA II, 2016). Moreover, these negative emotional states are particularly salient among students who are undergoing the developmental challenges of transitioning to post-secondary (e.g., new social roles, increased responsibilities, loss of social support, and autonomy), and frequently co-occur (Kessler et al., 2012; Mahmoud, Staten, Hall, & Lennie, 2012). Research suggests that symptoms of DAS hold several important roles in the onset and maintenance of DE (Bennett & Cooper, 1999; Grant et al., 2003). Indeed, depression, anxiety and stress are all positively associated with DE (e.g., Ball & Lee 2000; Crowther, Sanftner, Bonifazi, & Shepherd, 2001; Gan, Mohd Nasir, & Hazizi, 2011; Tuschen-Caffier & Vogele, 1999; Wolff et al., 2000) and women who engage in DE report higher rates of stress, as well as comorbid anxiety and
mood disturbances, compared to women who do not engage in DE (Ball & Lee 2000; Crowther et al., 2001; Johnson, Cohen, Kasen, & Brook, 2002; Gitimu et al., 2016). The emotion regulation model of DE conceptualizes the co-occurrence of DAS symptoms and DE such that we expect more frequent DE when symptoms of DAS are high within a given individual, as DE provides relief from these negative emotional states. Given that negative emotional states appear to hold a central role in DE, and underpin negative urgency, it is surprising that, to my knowledge, no studies have formally tested the interaction between negative urgency and negative emotional states such as DAS symptoms in DE engagement.

Research has illuminated an association between perceived stress and DE, particularly among first year female undergraduates (Beukes, Walker, & Esterhuyse, 2010; Wolff et al. 2000; Freeman & Gil, 2004). Evidence suggests that there may be both psychosocial and psychobiological pathways within this relationship. For example, women who engage in DE tend to report more stressful life events, and perceive stressors as being more intense and emotionally disruptive, compared to women who do not engage in DE (e.g., Ball & Lee 2000; Crowther et al., 2001; Wolff et al., 2000). Similarly, undergraduate women who engage in high levels of binge or compensatory DE report higher perceived impacts of stressors, and demonstrate altered physiological responses to stressors including increased blood pressure, heart rate reactivity, 24-hour urinary cortisol, and decreased 24-hour urinary norepinephrine, compared to women who had low or no DE (Koo-Loeb, Costello, Light, & Girdler, 2000). Laboratory studies have demonstrated that induced interpersonal stress is linked to increased urges to binge eat among women with Bulimia Nervosa (e.g. Tuschen-Caffier & Vogele, 1999), and
naturalistic daily observation studies demonstrate that greater psychological distress is associated with same-day binge eating (e.g. Freeman & Gil, 2004; Wolff et al., 2000). These results suggest that individuals who engage in DE may be more psychologically and physically susceptible to experiencing acute stress. Given the positive contemporaneous and prospective associations between heightened stress and DE, research would benefit from examining how stress interacts with risk factors such as negative urgency to render an individual at a particularly elevated risk of engaging in DE.

Similar to stress, evidence suggests that generalized anxiety, social anxiety and appearance anxiety are positively related to DE (e.g. Fitzsimmons-Craft, Harney, Brownstone, Higgins, & Bardone-Cone, 2014; Puccio et al., 2017; Turel et al., 2018). A nationally representative sample of U.S. adolescents found that clinical anxiety disorders were diagnosed in 60% of adolescents who engaged in subclinical DE, and within 66% of adolescents who had a clinical Eating Disorder (Swanson, Crow, Le Grange, Swendsen, & Merikangas, 2011). Similar to stress, studies suggest that anxiety holds significant contemporaneous, as well as prospective relationships to DE (Fitzsimmons-Craft et al., 2014; Lee, & Vaillancourt, 2019; Pallister & Waller, 2008; Puccio et al., 2017; Sala & Levinson, 2016; Turel et al., 2018). In concordance with emotion regulation models of DE, it is suggested that anxiety may hold an etiological role in the development of DE, as DE might be used as an attempt to reduce negative internal mood states, or exist as a repercussion of anxiety associated with sociocultural pressures and thin idealizations (Bulik, Sullivan, Fear, & Joyce, 1997; as cited in Puccio et al., 2017). Research is needed to test these hypotheses, further delineate the mechanisms that contribute to the striking
comorbidity rates between anxiety and DE, and examine the specific role that anxiety holds in propensities for DE engagement.

Depression and eating difficulties are also highly comorbid; a nationally representative sample of U.S. adolescents showed that major depression was diagnosed in up to 28% of those with subclinical DE, and to 35% of those with a clinical Eating Disorder (Swanson et al., 2011). When examined cross-sectionally, evidence suggests that DE attitudes and behaviours are positively associated with depressive symptoms (Prefit & Szentagotai-Tatar, 2018; Santos, Richards, Bleckley 2007), and undergraduate women who are at-risk for acquiring an eating disorder report more depressive symptoms compared to those who are not at-risk (Gitimu et al., 2016). Moreover, emotion regulation difficulties, which may hold parallels with negative urgency, significantly mediated the relationship between depression and DE, indicating that there may be important pathways between emotion regulation, negative affect and DE engagement (Prefit & Szentagotai-Tatar, 2018). Similar to the emotion regulation function of DE as it applies to anxiety (Bulik et al., 1997), we might expect that when depressive symptoms are elevated, individuals engage in DE more often to alleviate their negative internal state. Moreover, considering interaction variables such as emotion regulation, or behavioural regulation under negative affect (i.e., negative urgency), may further illuminate mechanisms that contribute to the engagement in DE.

Past research suggests that stress, anxiety and depressive symptoms tend to be elevated when DE occurs; however, more research is needed to understand if these negative emotional states are reliable concomitants of DE engagement when considered across time. In efforts to illuminate why only some individuals who experience elevated
symptoms of DAS also engage in DE, some studies have investigated how symptoms of DAS moderate associations between established risk factors for DE and DE engagement. A study conducted by Juarasico, Perone, and Timko (2011) found that anxiety, depression, and dieting significantly moderated the relationship between body dissatisfaction and DE behaviours and symptoms within college women, whereas impulsivity did not. Another study revealed that anxiety significantly moderated the relationship between body image dissatisfaction and restrained eating in female undergraduates, but depression and stress did not (Doumit, Zeeni, Sanchez Ruiz, & Khazen, 2016). Taken together, these results suggest that anxiety may be an important moderator between body dissatisfaction and DE. Among a sample of treatment seeking young adults, researchers found that depression moderated the relationship between lack of emotional clarity and DE, while anxiety did not (Sloan, O'Donnell, Bianchi, Simpson, Cox, & Hall, 2018). Although limited in number and breadth, the aforementioned studies suggest that negative emotional states may moderate relationships between risk factors for DE and DE engagement. Some studies have found that variables such as response inhibition, body dissatisfaction, appearance pressures, and thin-ideal internalization moderate the relationships between negative urgency and dysregulated eating, as well as negative urgency and binge eating (e.g., Espel et al., 2017; Racine & Martin, 2016; Racine et al., 2017), demonstrating that dynamic variables do indeed moderate the association between negative urgency and DE. However, to my knowledge no studies have specifically examined the moderating role of negative emotional states on this relationship. Given the robust association between negative urgency and DE, and centrality of negative emotional states in emotion regulation models of DE and the
construct of negative urgency itself, examining symptoms of DAS as moderators of the relationship between negative urgency and DE frequency seems to be a logical and critical step in DE research.

**The Current Study**

Although symptoms of DAS and negative urgency are positively associated with DE, there is a paucity of research examining how these variables may interact to influence frequencies of DE engagement over time. This is surprising given evidence establishing that: 1) negative urgency is a uniquely robust correlate of frequency and severity of DE (Davis-Becker et al., 2014; Espel et al., 2017; Fischer et al., 2008); 2) negative urgency may change concurrently with DE symptom severity (Anestis et al., 2007); 3) the association between negative urgency and DE is theoretically and empirically prone to moderation effects (Espel et al., 2017; Racine & Martin, 2016; Racine et al., 2017); and 4) negative emotional states hold a central role in DE and negative urgency, and significantly moderate relationships between substantiated DE risk factors and DE engagement (e.g., Doumit et al., 2016; Jurasasico et al., 2011; Sloan et al., 2018). Moreover, given that the transition to university often entails a period that young adults are often newly and uniquely responsible for their own food, nutrition, and caloric choices, this temporal period is particularly critical. The current study aims to address the paucity of literature investigating associations and interactions between negative urgency, symptoms of DAS, and DE frequency over time by investigating the strength of the concurrent, time-varying association between negative urgency and DE frequency across seven months, and whether symptoms of DAS moderate this relationship. Specifically, the aims of this study were to: 1) examine the prevalence and frequency of various DE
behaviours (i.e., binge eating, fasting, and compensatory behaviours [purging, laxative/diuretic use, excessive exercise to counteract caloric intake]) within male and female first-year undergraduate students over seven months, 2) examine the strength of the contemporaneous, coupled relationship between negative urgency and DE frequency across seven months, and 3) test the moderating roles of depression, anxiety and stress in the coupled relationship between negative urgency and DE frequency. The overarching goal of this study was to further contextualize DE engagement among first-year undergraduates and provide a theoretically based model to conceptualize monthly changes in DE symptoms across the academic year.

Given past results indicating that higher negative urgency is associated with greater frequencies of DE (e.g., Davis-Becker et al., 2014; Espel et al., 2017), and fluctuations or changes in negative urgency positively correspond with changes in maladaptive behaviours, including DE (e.g., Anestis et al. 2007; Blonigen et al., 2011; King et al., 2011; Littlefield et al., 2009), Hypothesis 1 was that there would be a positive contemporaneous (i.e., coupled) association between negative urgency and DE frequency. In other words, at times when negative urgency is higher than usual within a given individual, DE frequency is also high, and vice versa. Next, given that heightened symptoms of DAS tend to be positively associated with DE engagement (e.g., Beukes, Walker, & Esterhuyse, 2010; Wolff et al. 2000; Freeman & Gil, 2004, Puccio et al., 2017) and the theoretical implications of the diathesis-stress and emotion regulation models of DE, Hypothesis 2 was that symptoms of DAS would significantly moderate the association between negative urgency and DE frequency. Specifically, it was hypothesized that negative urgency would be a stronger or more salient correlate of DE
when DAS scores are also elevated, while the strength of the relationship between negative urgency and DE frequency would be more attenuated when DAS scores are low. In other words, it is hypothesized that tendencies to engage in impulsive behaviours when experiencing negative affect (i.e., negative urgency) are stronger when negative affect (DAS) is higher than usual. Examining the relationship between negative urgency and DE frequency over time, and testing symptoms of DAS as moderators this relationship, allows for the dynamic interplay of acute risk states and substantiated risk factors in DE frequency which may help improve our understanding of DE symptom fluctuations and trajectories, and subsequently inform substantive factors to target during intervention.
Methods

Participants

Participants were two cohorts of male and female first-year undergraduate students at the University of Victoria who were enrolled in a longitudinal study of risk-taking behaviour during their first two semesters of academic study (N = 704). Participants were enrolled in the study in September, and completed monthly online surveys from October through April. The present analyses included only those participants completed at least one follow-up survey, and thus contributed at least one observation for frequency of disordered eating behaviour during the academic year, as it was not assessed at baseline (n = 645). Data from the first cohort was collected over the 2017-18 academic year (n = 325), and data from the second cohort were collected over the 2018-19 academic year (n = 320). Participants were recruited through the University’s online psychology research participation portal, flyers around campus, online advertisements, and in-person canvassing by undergraduate research assistants. Eligible participants were: (a) enrolled in a minimum of 3.0 academic units per semester at the University of Victoria, (b) between the ages of 17-25 years old, (c) in their first semester of post-secondary study when they enrolled in the study, and (d) willing and able to participate in a two-hour September baseline assessment session. Exclusionary criteria included: students who were solely enrolled in Distance Education or Continuing Studies programs, or who had completed previous post-secondary studies at another institution.
Procedures

This thesis was part of a larger study that assessed social and emotional functioning, coping, mental health and engagement in various risk-taking behaviours across students’ first year of post-secondary study. Interested students completed a brief screening questionnaire to confirm their eligibility for the study (e.g., “Are you currently a student at the University of Victoria?”, “What year of study are you in?”). Eligible participants then signed up for a baseline September testing session via the online Psychology Research portal or using an online survey. During the baseline session, undergraduate research assistants explained the purposes and procedures of the study and obtained informed consent for the baseline and follow-up portions of the study. Although not analyzed, the baseline testing session assessed risk-taking, decision-making, engagement in various risky behaviours, mood, social functioning, personality traits, and lifestyle through computerized behavioural tasks and self-report surveys. Baseline testing sessions were held in shared computer spaces on campus, while follow-up surveys were completed online and from any location, provided the participant retained an active internet connection.

Approximately thirty days after the completion of the baseline testing session, participants received an automated email prompting them to complete the first online follow-up assessment. The email contained a link that directed participants to an online Qualtrics portal where they completed a battery of questionnaires assessing their engagement in risky behaviours (including DE), as well as their perceived impulsivity (including negative urgency), mood, stress, and coping within the past thirty days. The same online follow-up protocol was administered to all participants every 30 days.
throughout the academic year, totaling seven follow-up time points spanning from October through April. Due to adjustments of measures administered part way through the study, negative urgency was only measured in the latter four follow-up surveys for Cohort 1 (January to April), and all of the follow-up surveys for Cohort 2 (October to April). The follow-up questionnaires took between 20-60 minutes to complete, depending on participant endorsement of risky behaviours and consequent skip logic of the online survey. Participants could choose to receive either $10 cash or two SONA credits for each follow-up survey completed. Moreover, participants could receive a cash bonus if they completed the majority of the follow-up surveys ($5 for completing five of the seven follow-ups, or $16 in Cohort 1 and $10 in Cohort 2 for completing six of the seven follow-ups, due to payment structure adjustments between cohorts). All study procedures were approved by the University of Victoria Human Research Ethics Board.

**Measures**

**Disordered Eating.** Participants reported how often they had engaged in specific DE behaviours in the past month at each follow-up using questions that were developed for this study. Specifically, the questions were adapted from the Eating Disorders Examination Questionnaire (EDE-Q; Fairburn & Beglin, 2008) to better suit our sample, and asked about engagement in binge eating (i.e., “...eaten an objectively large amount of food in a manner that felt out of control”), fasting (i.e., “…gone for at least 8 waking hours without eating, severely limited your calories [i.e., less than 1000 per day], or skipped 2 or more meals in a row with the goal of changing your shape or weight, not including forgetting to eat or a religiously sanctioned fast”), and compensatory behaviours (i.e., “…made yourself throw up, taken laxative/diuretics, or engaged in very
intense exercise to counteract the effects of eating”). Participants reported their past month frequency for each of the three DE behaviours using a 4-point ordinal scale (i.e., I have done this… “Never”, “Only once”, “2-3 times”, “4 or more times”, with an option to select “Prefer not to say” given the potentially sensitive nature of these items). Follow-up frequency responses were re-coded so that a “Never” response was assigned a value of 0, “Once” was assigned a value of 1, “2-3 times” was assigned a value of 2, “4 or more times” was assigned a value of 3, and “Prefer not to say” was coded as missing.

Previous studies have conceptualized DE frequency as the total number DE episodes experienced, rather than the diversity or number of different DE behaviours engaged in (e.g., Davis-Becker et al., 2014; Gomes, Gonçalves, & Costa, 2015; Taranis & Meyer, 2011). Moreover, past studies have not associated, or weighted, one type of DE as being more severe than another, as they often obtained a total DE frequency count when multiple DE behaviours were individually assessed (e.g., Davis-Becker et al., 2014; Gomes et al., 2015). The DSM-5 diagnostic criteria for various clinical Eating Disorders, such as Bulimia Nervosa and Binge Eating Disorder, require engagement in DE behaviours at specified frequencies in order for the behaviours to be considered clinically significant, indicating that frequency of DE is an important marker of the presence of DE pathology (American Psychiatric Association, 2013). It is likely that the physical consequences and negative outcomes associated with DE are more salient among those who have more frequent DE engagement, compared to those who have lower frequencies of engagement but a higher diversity DE behaviours. Given that the follow-up items employed ordinal responses that included a range of values (i.e. “2-3 times”, “4 or more times”), summing the ordinal items across all three behaviours would conflate number of
DE behaviours and with the frequencies. Given how past studies have conceptualized DE frequency (i.e., considering all DE behaviours as equal), and the ordinal nature of our measures, I used the highest value of frequency that occurred across all three DE behaviours to represent DE frequency within a given month. For example, if a participant engaged in binge eating “Once”, and compensatory behaviours “2-3 times” within a given month, they were assigned a two (i.e., “2-3 times”) to reflect their frequency of DE for that month.

**Negative Urgency.** The UPPS-P Impulsive Behaviour Scale (Lynam, Smith, Whiteside, & Cyders, 2006) is a 59-item self-report scale that assesses five facets of impulsivity: lack of premeditation, lack of perseverance, sensation seeking, positive urgency, and negative urgency. The negative urgency subscale of the UPPS-P is composed of 12 items that assess levels of impulsivity under conditions of negative emotion (e.g., “Sometimes when I feel bad, I cannot stop what I am doing even though it makes me feel worse”). Items are rated on a 4-point Likert scale (1 = “Agree Strongly”, 2 = “Agree Somewhat”, 3 = “Disagree Somewhat”, 4 = “Disagree Strongly”) and were reverse scored where necessary so that higher scores reflect poorer behavioural control under negative emotion. The UPPS-P is a widely used, well validated measure of impulsivity that demonstrates good convergent and construct validity (Fossati et al., 2016; Cyders, 2013; Cyders, Littlefield, Coffey & Karyadi, 2014; Whiteside & Lynam, 2001; Whiteside, Lynam, Miller, & Reynolds, 2005). Additionally, the negative urgency subscale has excellent internal consistency ($\alpha = 0.89$) and demonstrates measurement invariance across genders (Cyders, 2013). The internal consistency ($\alpha$) of the negative urgency subscale ranged from .89-.91 for the current study.
**Depression Anxiety and Stress Scale.** (DASS-21; Lovibond & Lovibond, 1995).

The DASS-21 is a shortened version of the original 42-item DASS (Lovibond & Lovibond, 1995), which is comprised of three scales (each containing 7 items) that measure the perceived severity and symptoms of depression, anxiety, and stress, respectively. The Depression scale assesses feelings of worthlessness, hopelessness, self-deprecation, lack of interest/involvement, and anhedonia. The Anxiety scale assesses autonomic arousal, awareness and subjective experience of physiological arousal, nervousness, and situational anxiety. The Stress assesses difficulty relaxing, nervous arousal, irritability and impatience. Participants rated each item on a 4-point Likert scale (0 = “Did not apply to me at all”, 1 = “Applied to me to some degree, or some of the time”, 2 = “Applied to me to a considerable degree, or a good part of the time”, 3 = “Applied to me very much or most of the time”). Items were reversed scored where necessary so that higher scores reflect elevated levels of symptoms of DAS. The DASS-21 has been supported for use in clinical and non-clinical samples, has excellent internal reliability ($\alpha = 0.82-0.97$) and temporal stability, and shows good concurrent validity (Antony, Bieling, Cox, Enns, & Swinson, 1998; Brown, Chorpita, Korotitsch, & Barlow, 1997; Henry & Crawford, 2005). The internal consistencies ($\alpha$) for the current study, across the seven follow-ups, ranged from 0.82-0.88 for the stress subscale, 0.79-87 for the anxiety subscale, and 0.88-0.92 for the depression subscale. Relative to the 42-item version, the DASS-21 has smaller interfactor correlations and a clearer factor structure, with fewer item cross-loadings and higher mean item-factor loadings (Antony et al., 1998). Although studies in undergraduate samples suggest that a general underlying factor (e.g., “negative affect”) might adequately describe the scores (Henry & Crawford,
2005; Osman et al., 2012), the measure developers recommend retaining three subscales and do not provide instructions for obtaining a total score on this measure.

**Data Cleaning**

Although online survey administration provides a convenient way to collect follow-up data from such a large sample, quality control should be considered in preparing a final dataset for analysis. Screening for responders who may not have been attentive to questions is particularly important for self-report data. As such, each month’s follow-up data were cleaned according to the procedures below before being merged together across time points and cohorts. First, I removed participants who did not complete questions up until the last page within the online follow-up survey (questions within the survey were allowed to be skipped), as they would not have been able to choose and receive compensation for their participation, and their responses could not ethically be analyzed. Next, to exclude participants who may not have been closely attending to the survey content, I calculated an average per-item response time for each participant at each follow-up (as the number of items completed can vary widely due to the skip logic of the online surveys). After visually analyzing several possible thresholds, I determined that excluding participants in the fastest 3% of response times would eliminate participants who may have been responding randomly or semi-randomly to the follow-up surveys. Finally, I excluded participants who failed either of two attention-check questions (e.g., “Please choose Strongly Agree for this question”) that were added to each follow-up monthly survey in Cohort 2. Visual inspection of the survey response patterns supported these exclusion criteria (for instance, several participants who were
excluded on the basis of failing attention check questions or fast responding submitted uniform responses across questionnaires).

**Planned Analyses**

Because participants were assessed repeatedly over seven time points, observations are nested within individuals. As such, we cannot assume that our observations meet assumptions of independence. Multilevel modeling (MLM) acknowledges that some variation between time points, within a given participant, will be systematically related to the participant, and does not assume a) that change is the same for all individuals, b) homogeneity of variances across time points, or c) homogeneity of covariance between time points. Accounting for nestedness of the data using MLM reduces the likelihood of Type I errors and biased parameter estimates. Moreover, unlike repeated measures ANOVAs that employ listwise deletion of participants that have missing follow-up data, MLM can employ maximum likelihood techniques to handle missing observations. Maximum likelihood techniques use all available data without participant deletion, and therefore, maximizes the power of the sample. Finally, unlike traditional repeated measures ANOVA and regression techniques that assume change to be the same for each individual, MLM allows for the investigation of intraindividual, or within-person changes. Due to the nestedness of the data, the intraindividual nature of the research question, and because I expected some attrition throughout this prospective study, I employed MLM with full maximum likelihood estimation techniques for the current study.

To address the study’s aims, I used descriptive statistics to assess the prevalence of DE behaviours over seven months and the frequency at which different types of DE
behaviours occur over seven months within first-year undergraduate students. Additionally, I used coupled MLM analyses to assess how DE frequency changes as a function of negative urgency through time, and the moderating effects of depression, anxiety, and stress on the relationship between negative urgency and DE frequency. Coupled MLM investigate if changes in one variable are concurrently associated with changes in another variable, for a given individual over time. Therefore, a coupled model facilitates the investigation of how changes in negative urgency and DE frequency co-vary over time, instead of how DE frequency changes as a function of time, and therefore adopts a process-based versus time-based approach (see Hoffman & Satwski 2009; Sliwinski & Mogel, 2015 for further discussions of coupled MLM). Because the current study aimed to examine this coupling effect at the within-person level, negative urgency and DAS symptom scores were each person-mean centred so that scores reflect variation from a given individual’s own mean. Person-mean centering allows for the delineation of within-person from between-person variation by yielding an unbiased estimate of pure within-person effect, thereby facilitating the interpretability of the results. Time was parameterized by assessment time point (e.g., t = 0 to indicate the October follow-up, which serves as the intercept, t = 1 to indicate the November follow-up, etc.) and was included as a covariate to account for changes in DE frequency as a function of time. To investigate the association between negative urgency and DE frequency, I specified a coupled model in which person-centered negative urgency was specified as the independent variable, time was included as a covariate, and the ordinal DE frequency scores were specified as the dependent variable. The equation for this initial model is presented in Figure 1, below.
**Level 1 Equation:**

\[ \text{DEFrequency}_{ij} = \beta_0 + \beta_1 \text{(Time}_{ij}) + \beta_2 \text{(Negative Urgency}_{ij}) + e_{ij} \]

**Level 2 Equation:**

\[ \beta_0 = Y_{00} + Y_{01} u_{0i} \]
\[ \beta_1 = Y_{20} + u_{2i} \]
\[ \beta_2 = Y_{30} + u_{3i} \]

*Figure 1.* Level-1 and Level-2 equations for the coupled MLM examining if negative urgency shares a coupled relationship with DE frequency when assessed frequency across seven points.

To examine the moderating role of depression, anxiety and stress in the coupled relationship between negative urgency and DE frequency, I employed three additional coupled MLM, with person-centered DAS scores and the interaction between person-centered negative urgency and person-centered DAS scores as additional predictors of DE frequency (see Figures 2., 3., and 4. for the corresponding moderating MLM equations). I assessed the significance of the interaction term’s to determine if there was a moderating effect of each of the DAS scores on the association between negative urgency and DE frequency, and plotted significant moderating effects to determine the direction of the effect.
Level 1 Equation:

\[ \text{DEFrequency}_{ij} = \beta_0 + \beta_1 \text{(Time}_{ij}) + \beta_2 \text{(NegativeUrgency}_{ij}) + \beta_3 \text{(Depression}_{ij}) + \beta_4 \text{(Depression x Negative Urgency}_{ij}) + e_{ij} \]

Level 2 Equation:

\[ \begin{align*}
\beta_0 &= Y_{00} + Y_{01} + u_0 \\
\beta_1 &= Y_{20} + u_2 \\
\beta_2 &= Y_{20} + u_3 \\
\beta_3 &= Y_{30} + u_4 \\
\beta_4 &= Y_{40} + u_5
\end{align*} \]

Figure 2. Level-1 and Level-2 equations for the MLM examining if depression moderates the coupled association between negative urgency and DE frequency when assessed frequency across seven points.

Level 1 Equation:

\[ \text{DEFrequency}_{ij} = \beta_0 + \beta_1 \text{(Time}_{ij}) + \beta_2 \text{(NegativeUrgency}_{ij}) + \beta_3 \text{(Anxiety}_{ij}) + \beta_4 \text{(Anxiety x Negative Urgency}_{ij}) + e_{ij} \]

Level 2 Equations:

\[ \begin{align*}
\beta_0 &= Y_{00} + Y_{01} + u_0 \\
\beta_1 &= Y_{20} + u_2 \\
\beta_2 &= Y_{20} + u_3 \\
\beta_3 &= Y_{30} + u_4 \\
\beta_4 &= Y_{40} + u_5
\end{align*} \]

Figure 3. Level-1 and Level-2 equations for the MLM examining if anxiety moderates the coupled association between negative urgency and DE frequency when assessed frequency across seven points.
**Level 1 Equation:**

$$\text{DEFrequency}_{ij} = \beta_0 + \beta_1 (\text{Time}_{ij}) + \beta_2 (\text{NegativeUrgency}_{ij}) + \beta_3 (\text{Stress}_{ij}) + \beta_4 (\text{Stress} \times \text{Negative Urgency}_{ij}) + e_{ij}$$

**Level 2 Equations:**

$$\beta_0 = Y_{00} + u_{0i}$$  
$$\beta_1 = Y_{10} + u_{1i}$$  
$$\beta_2 = Y_{20} + u_{3i}$$  
$$\beta_3 = Y_{30} + u_{4i}$$  
$$\beta_4 = Y_{40} + u_{5i}$$

*Figure 4.* Level-1 and Level-2 equations for the MLM examining if stress moderates the coupled association between negative urgency and DE frequency when assessed frequency across seven points.
Results

Preliminary Analyses

Variable distributions.

As a first step in exploring the data, I examined the distribution of each of the independent and dependent variables using descriptive statistics, box plots and bar charts. Tabachnick and Fidell (2013) suggest that in samples larger than 200 participants, small to moderate deviations from normality in skewness and kurtosis often do not make substantive differences in parameter estimates. More specifically, others suggest that within larger samples, skewness should not exceed three while kurtosis should not exceed ten (Aminu & Shariff, 2014; Kline, 2012). With respect to the distribution of the independent variable, negative urgency scores were normally distributed, consistent with previous studies using the UPPS-P in undergraduate samples (e.g., Anestis, Anestis, & Joiner, 2009; Scott, DiLillo, Maldonado, & Watkins, 2015; see Table 1 below). For the moderators, I expected that DAS symptom scores would be positively skewed, given the clinical nature of these scales and a previous study showing skewed distributions in a large community sample for depression (Mdn = 2, M = 5.66, SD = 7.74 Range = 0-42), anxiety (Mdn = 2, M = 3.76, SD = 5.90. Range = 0-40), and stress (Mdn = 8, M = 9.46, SD = 8.40, Range = 0-42) subscale scores (Henry & Crawford, 2005). DAS scores were considered to be relatively normally distributed, according to the aforementioned cutoffs (i.e., Aminu & Shariff, 2014; Kline, 2012; see Table 1, below). Moreover, visual inspection of the box plots and frequency distributions revealed that DAS scores did not deviate substantially from a normal distribution, therefore, I did not transform any of the
variables. DE frequency, or the dependent variable, was re-scored to a 4-point ordinal scale as described above and was also relatively normally distributed in this sample (see Table 1, below). Moreover, MLM has been shown to be relatively robust to normal distribution violations (Mass & Hox, 2004), particularly when robust standard errors are used. Robust standard errors correct for any model misspecifications by conservatively adjusting the parameter estimates. Therefore, I present results with robust standard errors throughout the remaining results. A correlation table of all variables included in the student are presented in Table 2.

Table 1. Descriptive statistics for measures of DE, Negative Urgency, and DAS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Min.</th>
<th>Max.</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness Statistic</th>
<th>SE</th>
<th>Kurtosis Statistic</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE Frequency</td>
<td>0</td>
<td>3</td>
<td>.44</td>
<td>.89</td>
<td>1.85</td>
<td>.04</td>
<td>2.05</td>
<td>.08</td>
</tr>
<tr>
<td>Negative Urgency</td>
<td>3</td>
<td>47</td>
<td>24.80</td>
<td>7.50</td>
<td>.287</td>
<td>.05</td>
<td>-.52</td>
<td>.10</td>
</tr>
<tr>
<td>Depression</td>
<td>0</td>
<td>42</td>
<td>11.68</td>
<td>9.24</td>
<td>.735</td>
<td>.04</td>
<td>-.03</td>
<td>.08</td>
</tr>
<tr>
<td>Anxiety</td>
<td>0</td>
<td>42</td>
<td>7.66</td>
<td>8.29</td>
<td>1.14</td>
<td>.04</td>
<td>1.87</td>
<td>.08</td>
</tr>
<tr>
<td>Stress</td>
<td>0</td>
<td>42</td>
<td>9.00</td>
<td>9.25</td>
<td>1.36</td>
<td>.04</td>
<td>1.39</td>
<td>.08</td>
</tr>
</tbody>
</table>

Note. Min. = the minimum value in the range of the scale. Max. = the maximum value in the range of the scale. SD = the standard deviation of the scale.

Table 2. Correlations of all variables included in the study

<table>
<thead>
<tr>
<th></th>
<th>Depression</th>
<th>Anxiety</th>
<th>Stress</th>
<th>DE Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>NU</td>
<td>.348**</td>
<td>.308**</td>
<td>.409**</td>
<td>.187**</td>
</tr>
<tr>
<td>Depression</td>
<td>.608**</td>
<td>.674**</td>
<td>.323**</td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>.751**</td>
<td>.275**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stress</td>
<td>.274**</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. NU = Negative Urgency, ** = significant at p ≤ .01
Nested structure of the data.

To evaluate the suitability of the data for multilevel analyses, and to assess whether the model assumptions were supported, I calculated the Intraclass Correlation Coefficient (ICC) for each of the independent and dependent variables using five “null” multilevel models. To obtain the ICC’s, each variable (negative urgency, depression, anxiety, stress, and DE frequency) was modeled as a dependent variable without any predictors. ICC’s account for both the consistency of performance from test to retest (i.e., within-subject change), as well as changes in average performance of participants as a group over time (i.e., between-individual, systematic change in mean). The ICC value indicates what portion of the total variance within a given variable is at the between-person level. Moreover, the total variance, minus the ICC value, represents the total portion of variance that is at the within-person level. Thus, an ICC value closer to one indicates more variance at the between-person level, while an ICC value closer to zero indicates more variance at the within-person level.

Significant random effects for negative urgency, symptoms of DAS, and frequency of DE in the null models (p’s < .001) indicated that there was sufficient within-person variance across the seven time points, to justify multilevel modeling (see Table 3). Additionally, ICCs indicated that 60-77% of the variance within each variable was due to between-person differences, while 23-40% of the variance was due to within-person differences (see Table 3). Of note, 23% of the variance of negative urgency was at the within-person level, indicating that it would be most appropriately modeled as a time varying predictor. Despite previous research suggesting that, apart from developmental changes, broad impulsivity may be a relatively stable trait (Niv, Tuvblad, Raine, Wang,
& Baker, 2012), our results suggest that negative urgency fluctuates month to month, and would be most appropriately modeled as such. See Figure 5 for a graphical depiction of variance in scores of negative urgency relative to a given individuals’ own mean negative urgency. Finally, a design effect of 3.6 was obtained from the DE frequency ICC, which exceeds the threshold of 2.0, indicating that MLM techniques are indeed necessary to account and control for the nestedness of the data.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Residual ($\sigma^2$)</th>
<th>Intercept $u_0i$ ($\tau$)</th>
<th>$p$</th>
<th>ICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE Frequency</td>
<td>0.47</td>
<td>.32</td>
<td>&lt; .001</td>
<td>.60</td>
</tr>
<tr>
<td>Negative Urgency</td>
<td>12.97</td>
<td>43.57</td>
<td>&lt; .001</td>
<td>.77</td>
</tr>
<tr>
<td>Depression</td>
<td>31.46</td>
<td>54.20</td>
<td>&lt; .001</td>
<td>.63</td>
</tr>
<tr>
<td>Anxiety</td>
<td>24.43</td>
<td>46.69</td>
<td>&lt; .001</td>
<td>.65</td>
</tr>
<tr>
<td>Stress</td>
<td>28.94</td>
<td>58.28</td>
<td>&lt; .001</td>
<td>.67</td>
</tr>
</tbody>
</table>

*Note.* ICC = Intraclass Correlation Coefficient, $p$ = the random effect of the null model for each variable.

*Figure 5.* Plot illustrating variance in ten participants’ negative urgency scores, in relation to their own personal mean, over time. The plot demonstrates the pure within-person variance in negative urgency over time.
Missing data.

Descriptive statistics of the 645 participants who were retained in the current study, including their gender, age, and ethnicity are displayed in Table 4. I used independent t-tests to examine if there was an attrition bias for participants that only completed the baseline session of the study, compared to those who provided at least one follow-up data point. Results revealed that there were no systematic differences in negative urgency, anxiety, stress or DE frequency between those who dropped out after baseline and those that completed one or more follow-ups (see Table 5). However, those that dropped out after baseline displayed significantly higher levels of depression than those that continued on in the study, indicating that the sample used in the current study may have lower levels of depression than is representative or typical of first year undergraduates.
Table 4. Descriptives of each cohort and full sample of the current study

<table>
<thead>
<tr>
<th></th>
<th>Cohort 1</th>
<th>Cohort 2</th>
<th>Full Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>325</td>
<td>320</td>
<td>645</td>
</tr>
<tr>
<td>Mean Age</td>
<td>18.02</td>
<td>17.91</td>
<td>17.99</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>73.2%</td>
<td>75.5%</td>
<td>74.3%</td>
</tr>
<tr>
<td>Male</td>
<td>25.9%</td>
<td>24.2%</td>
<td>25.0%</td>
</tr>
<tr>
<td>Other</td>
<td>.9%</td>
<td>.3%</td>
<td>.7%</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>81.6%</td>
<td>79.1%</td>
<td>80.5%</td>
</tr>
<tr>
<td>Black/African/Caribbean</td>
<td>1.8%</td>
<td>1.6%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Hispanic/Latina(o)</td>
<td>1.8%</td>
<td>2.5%</td>
<td>2.2%</td>
</tr>
<tr>
<td>East, Southeast, and South Asian</td>
<td>17.5%</td>
<td>20.3%</td>
<td>18.9%</td>
</tr>
<tr>
<td>First Nations</td>
<td>1.5%</td>
<td>2.8%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Middle Eastern</td>
<td>1.8%</td>
<td>1.6%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Other</td>
<td>3.7%</td>
<td>2.8%</td>
<td>3.3%</td>
</tr>
</tbody>
</table>
Table 5. T-test results comparing those that dropped out after baseline to those who completed one or more follow-up surveys

<table>
<thead>
<tr>
<th></th>
<th>&lt; 1 Follow-up completed</th>
<th>≥ 1 Follow-up completed</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Urgency</td>
<td>28.92 (8.26)</td>
<td>27.72 (7.32)</td>
<td>702</td>
<td>1.196</td>
<td>.232</td>
</tr>
<tr>
<td>Stress</td>
<td>12.47(10.01)</td>
<td>12.17(8.75)</td>
<td>698</td>
<td>.249</td>
<td>.804</td>
</tr>
<tr>
<td>Anxiety</td>
<td>10.17(9.49)</td>
<td>9.30(8.30)</td>
<td>698</td>
<td>.760</td>
<td>.447</td>
</tr>
<tr>
<td>Depression</td>
<td>10.50(9.84)</td>
<td>7.78(7.66)</td>
<td>697</td>
<td>2.56</td>
<td>.011*</td>
</tr>
<tr>
<td>DE Frequency</td>
<td>1.17(1.18)</td>
<td>.96(1.10)</td>
<td>702</td>
<td>1.38</td>
<td>.167</td>
</tr>
</tbody>
</table>

Table 6 displays the response rates at each follow-up time point, and Table 7 displays the number of monthly surveys completed by participants. Overall, 60.4% of participants completed six or more of the seven follow-ups, 20.6% of participants completed between four and five follow-ups, and 19% completed three or fewer follow-ups. In total, 3452 records were collected from 645 unique participants across the seven months.
Table 6. Response rates of participants across seven monthly follow-ups

<table>
<thead>
<tr>
<th>Time point</th>
<th>Retention rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>October</td>
<td>89.46%</td>
</tr>
<tr>
<td>November</td>
<td>86.82%</td>
</tr>
<tr>
<td>December</td>
<td>73.33%</td>
</tr>
<tr>
<td>January</td>
<td>79.22%</td>
</tr>
<tr>
<td>February</td>
<td>72.40%</td>
</tr>
<tr>
<td>March</td>
<td>72.09%</td>
</tr>
<tr>
<td>April</td>
<td>61.55%</td>
</tr>
</tbody>
</table>

Note. Retention rates were calculated from the number of participants that completed a baseline survey (n = 704).

Table 7. Number of monthly follow ups completed by participants

<table>
<thead>
<tr>
<th>Number of monthly surveys completed</th>
<th>Percentage of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.0%</td>
</tr>
<tr>
<td>2</td>
<td>7.1%</td>
</tr>
<tr>
<td>3</td>
<td>5.9%</td>
</tr>
<tr>
<td>4</td>
<td>9.3%</td>
</tr>
<tr>
<td>5</td>
<td>11.3%</td>
</tr>
<tr>
<td>6</td>
<td>18.8%</td>
</tr>
<tr>
<td>7</td>
<td>41.6%</td>
</tr>
</tbody>
</table>
Main Analyses

Study Aim 1.

Roughly half of the participants in this study (53.7%, n = 347 participants) engaged in at least 1 episode of DE across the seven-month study, indicating that DE holds a striking prevalence within undergraduate students over their first academic year. Among those that did engage in DE at some point throughout the year, majority (68.2%) reported DE within one or two months, while very few (2.3%) reported engaging in DE within all seven months (see Table 8). Figure 6 illustrates the prevalence of specific DE behaviours each month. Overall, the results indicate that October had the highest prevalence of DE, and that engagement in DE decreased steadily across the year. Moreover, binge eating and fasting were the most common types of DE behaviours and had relatively similar prevalence’s within each month, while compensatory behaviours were consistently the least common type of DE. All monthly prevalence rates in the current study were calculated based on the number of respondents for the given month, so that changes in the number of respondents across months did not influence reported prevalence rates. Figure 7 illustrates the frequencies at which DE occurred among all the participants that responded within the given month, further depicting the decrease in DE engagement across the year. Figure 8 illustrates the frequencies (i.e., Once, 2-3 times, 4 or more times) of each type of DE across the entire seven month study period. Results revealed that the frequency at which the DE occurred appears to be relatively similar across the three frequencies that were representative of engagement in DE (i.e., Once, 2-3 times, 4 or more times), suggesting that undergraduates engage in very low as well as higher frequencies of DE. Finally, Figure 9 depicts the number of cases wherein various
DE behaviours occurred on their own, or in combination, within a given month. The results suggest that although binge eating and fasting tend to occur on their own, there are a fair number of instances when the two behaviours are comorbid within a given month. Finally, given the linear decrease in DE prevalence over the course of the academic year, I also wanted to examine scores of negative urgency, depression, anxiety, and stress over the year. Figure 10. depicts group average depression, anxiety, and stress symptoms scores, as well as groups average negative urgency scores, over the academic year. The results demonstrate that unlike DE engagement, which decreased across the year, DAS symptom scores and negative urgency scores remain relatively stable over the year.

Table 8. Number of months that participants engaged in at least one episode of DE

<table>
<thead>
<tr>
<th>Number of months ≥ 1 DE episode was reported</th>
<th>% of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41.7%</td>
</tr>
<tr>
<td>2</td>
<td>26.5%</td>
</tr>
<tr>
<td>3</td>
<td>14.1%</td>
</tr>
<tr>
<td>4</td>
<td>7.5%</td>
</tr>
<tr>
<td>5</td>
<td>4.3%</td>
</tr>
<tr>
<td>6</td>
<td>3.5%</td>
</tr>
<tr>
<td>7</td>
<td>2.3%</td>
</tr>
</tbody>
</table>
Figure 6. Prevalence rates of DE engagement among first year undergraduates within a given month, further broken down by the type of DE behaviour.
Figure 7. The percentage of first year undergraduates who endorsed no DE, and various levels of DE frequency.
Figure 8. Number of reports of each type of DE behaviour, further broken down by the number of endorsements for each frequency level of DE.
Figure 9. Number of cases across seven months wherein various DE behaviours occurred alone, or in combination, within a given month.
Figure 10. Group mean scores of depression, anxiety, and stress symptoms, and group mean scores of negative urgency across the academic year.
Study Aim 2.

To examine the performance of the MLM that included a coupled relationship between negative urgency and DE (see Figure 1 for equation), I compared the fit of this model to a MLM that had no predictors (i.e., a “null” model of DE frequency), and a MLM that included time as the sole predictor of DE frequency (see Table 9). In particular, given that decreases in DE can be observed across the seven months (see Figure 6), I wanted to ensure that including negative urgency as a predictor offered distinct improvements in model fit over and above the time only model. Comparisons between the time only model and the coupled model revealed that the deviance parameter substantially decreased (see Table 9). Moreover, the Log Likelihood test was significant ($p < .001$), indicating that despite being less parsimonious than the time only model, the coupled model provides a significant improvement in fit to the data. Finally, differences in the residual variance terms (i.e., $\sigma^2$) between the two models indicated that the coupled model accounted for 13.5% more variance in DE frequency than the time only model. A comparison of variance terms between the null model and coupled model revealed that the coupled model accounts for a total 33.5% of the variance in DE frequency.

Results of the coupled MLM revealed that DE frequency was significantly different from zero at baseline ($p < .001$; see Table 9), indicating that in October, on average, the sample engaged in DE at a frequency that was significantly higher than zero. Next, the significant slope of time indicated that DE frequency significantly decreased as a function of time, and that time was an important covariate within the current model. Finally, results revealed that negative urgency and DE frequency share a significant, positive coupled association, such that a one unit change in a given individuals average
negative urgency was associated with a 0.02 unit increase in DE frequency within the same month, on average ($p < .001$). The significant slope of negative urgency within the coupled model indicates that negative urgency and DE frequency concurrently fluctuate month to month. As such, at times when individuals’ negative urgency was higher than their own average negative urgency, their DE frequency was also higher within a given month. Similarly, at times when an individuals’ negative urgency was lower than usual, their DE frequency also declined. See Table 9 for results of the coupled model.
Table 9. MLM results for the null, time only, and coupled model between negative urgency and DE severity

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Null Model</th>
<th>Time Only Model</th>
<th>Coupled Model between NU and DE Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Effect Coefficients (Standard Error)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept ($Y_{00}$)</td>
<td>0.045(.026)***</td>
<td>0.686(.038)***</td>
<td>0.574(.042)***</td>
</tr>
<tr>
<td>Time ($Y_{10}$)</td>
<td>-</td>
<td>-0.087(.007)***</td>
<td>-0.061(.009)***</td>
</tr>
<tr>
<td>NU ($Y_{20}$)</td>
<td>-</td>
<td></td>
<td>0.020(.004)***</td>
</tr>
<tr>
<td>Random Effects Variance Component (Standard Deviation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual ($\sigma^2$)</td>
<td>0.471(.687)</td>
<td>0.362(.602)</td>
<td>0.313(0.559)</td>
</tr>
<tr>
<td>Intercept ($u_{0i}$)</td>
<td>0.315(.562)***</td>
<td>0.692(.832)***</td>
<td>0.568(0.754)***</td>
</tr>
<tr>
<td>Time ($u_{1i}$)</td>
<td>-</td>
<td>0.016(.126)***</td>
<td>0.013(.113)</td>
</tr>
<tr>
<td>NU ($u_{2i}$)</td>
<td>-</td>
<td></td>
<td>0.002(.041)</td>
</tr>
</tbody>
</table>

Model Summaries

| Deviance            | 8124.80 | 7706.27 | 5592.79 |
| Estimates Parameters| 3       | 6       | 10      |

Note. NU = Negative Urgency. *** indicates p < .001, ** indicates p < .01, and * indicates p <.05. Study Aim 3.

**Depression Moderated Model.**

An additional MLM was conducted to examine if depression moderated the coupled relationship between negative urgency and DE frequency. In terms of model fit, the deviance parameter decreased from the coupled model to the depression moderated model, indicating an improvement of fit (see Table 10 below). Moreover, the Log Likelihood test between the two models was significant ($p < .001$), indicating that the
depression moderated model provides a significantly improved fit to the data compared to the unmoderated coupled model. Finally, the moderated model accounted for 15.34\% more variance in DE frequency compared to unmoderated coupled model, further indicating that considering depression as a moderator significantly improves the fit of the model to the data. The depression moderated model accounted for 48.84\% of the total variance in DE frequency. Parameter estimates (Table 10) revealed a significant main effect for depression, indicating that depression significantly predicted DE frequency. Moreover parameter estimates revealed a significant interaction of depression and negative urgency (Table 10). More specifically, the strength of the coupled relationship was moderated such that for every one-unit increase in depression, the coupling parameter between negative urgency and DE frequency increased by 0.003 units (SE = 0.001, \( p = .009 \); Table 10). To probe this interaction, I examined a graph plotting the coupled relationship between negative urgency and DE frequency when depression scores were centred at one standard deviation (SD) above and below each individual's own average depression (see Figure 11). This graph demonstrates that the coupled association between negative urgency and DE frequency becomes stronger as the saliency of depressive symptoms increases.
Figure 11. Interaction plot depicting the slope of negative urgency on DE frequency at 1 Standard Deviation below individuals' own average depression (Low value of moderator) and 1 Standard Deviation above individuals' own average depression (Higher value of moderator).

Anxiety Moderated Model.

A third MLM was conducted to examine if anxiety moderated the coupled relationship between negative urgency and DE frequency. An examination of model fit using the deviance parameters and the Log Likelihood test showed significant improvement in model fit as compared to the unmoderated coupled model ($p < .001$). Parameter estimates (Table 10) revealed a significant main effect for anxiety, indicating that anxiety significantly predicted DE frequency. However, parameter estimates revealed a non-significant interaction term for anxiety, indicating that anxiety did not
moderate the association between negative urgency and DE frequency (Table 10). No further probing was conducted.

**Stress Moderated Model.**

A final MLM was conducted to examine if stress moderated the coupled relationship between negative urgency and DE frequency. Similar to anxiety, although examination of model fit using the deviance parameters and the Log Likelihood test showed significant improvements in fit of the model ($p < .001$). Parameter estimates (Table 10) revealed a significant main effect for stress, indicating that stress significantly predicted DE frequency. However, parameter estimate revealed a non-significant interaction term for stress. Therefore, stress did not moderate the association between negative urgency and DE frequency (Table 10). No further probing was conducted.
Table 10. MLM results for the moderating effects of DAS on the association between negative urgency and DE severity

<table>
<thead>
<tr>
<th>Parameters</th>
<th>NU, DE frequency moderated by Depression</th>
<th>NU, DE frequency moderated by Anxiety</th>
<th>NU, DE frequency moderated by Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed Effect Coefficients (Standard Error)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept ($Y_{00}$)</td>
<td>0.538(.041)***</td>
<td>0.543(.041)***</td>
<td>0.552(.041)***</td>
</tr>
<tr>
<td>Time ($Y_{10}$)</td>
<td>-0.054(.008)***</td>
<td>-0.054(.008)***</td>
<td>-0.056(.008)***</td>
</tr>
<tr>
<td>NU ($Y_{20}$)</td>
<td>0.018(.004)***</td>
<td>0.017(.004)***</td>
<td>0.017(.004)***</td>
</tr>
<tr>
<td>Depression ($Y_{30}$)</td>
<td>0.009(.003)**</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Anxiety ($Y_{30}$)</td>
<td></td>
<td>0.011(.001)**</td>
<td>-</td>
</tr>
<tr>
<td>Stress ($Y_{30}$)</td>
<td></td>
<td></td>
<td>0.008(.003)*</td>
</tr>
<tr>
<td>NU x Depression ($Y_{40}$)</td>
<td>0.003(.001)**</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NU x Anxiety ($Y_{40}$)</td>
<td></td>
<td>0.002(.001)</td>
<td>-</td>
</tr>
<tr>
<td>NU x Stress ($Y_{40}$)</td>
<td></td>
<td></td>
<td>0.001(.001)</td>
</tr>
<tr>
<td><strong>Random Effects Variance Component (Standard Deviation)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual ($\sigma^2$)</td>
<td>0.265(0.515)</td>
<td>0.271(0.520)</td>
<td>0.285(0.534)</td>
</tr>
<tr>
<td>Intercept ($u_{0i}$)</td>
<td>0.529(0.727)***</td>
<td>0.527(0.727)***</td>
<td>0.522(0.722)***</td>
</tr>
<tr>
<td>Time ($u_{1i}$)</td>
<td>0.011(.107)***</td>
<td>0.011(.106)***</td>
<td>0.011(.106)***</td>
</tr>
<tr>
<td>NU ($u_{2i}$)</td>
<td>0.001(.031)***</td>
<td>0.001(.037)***</td>
<td>0.001(.037)***</td>
</tr>
<tr>
<td>Depression ($u_{3i}$)</td>
<td>.001(.007)*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Anxiety ($u_{3i}$)</td>
<td>-</td>
<td>0.001(.031)**</td>
<td>-</td>
</tr>
<tr>
<td>Stress ($u_{3i}$)</td>
<td>-</td>
<td>-</td>
<td>0.001(.031)*</td>
</tr>
<tr>
<td>Interaction</td>
<td>Estimate</td>
<td>Std. Error</td>
<td>p-value</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-----------</td>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td>NU x Depression (u_i)</td>
<td>.000(.007)***</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NU x Anxiety (u_i)</td>
<td>-</td>
<td>0.000(.010)*</td>
<td>-</td>
</tr>
<tr>
<td>NU x Stress (u_i)</td>
<td>-</td>
<td>-</td>
<td>0.000(.003)</td>
</tr>
</tbody>
</table>

**Model Summaries**

<table>
<thead>
<tr>
<th></th>
<th>Deviance</th>
<th>Parameters Estimated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5438.57</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>5453.01</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>5492.75</td>
<td>21</td>
</tr>
</tbody>
</table>

*Note.* NU = Negative Urgency, NU x Depression = the interaction between person-mean centered Negative Urgency and Depression, NU x Anxiety = the interaction between person-mean centered Negative Urgency and Anxiety, NU x Stress = the interaction between person-mean centered Negative Urgency and Stress. *** indicates p < .001, ** indicates p < .01, and * indicates p < .05.
**Discussion**

The current study had three aims: to investigate the prevalence and frequency of binge eating, fasting, and purging behaviours among first-year undergraduate students over the course of the academic year, to investigate if monthly fluctuations in negative urgency co-vary with DE frequency, and to investigate if depression, anxiety or stress moderates the association between negative urgency and DE frequency. First, approximately half of first year undergraduate students reported at least one episode of DE within their first year of post-secondary, however, the prevalence of DE decreased across the academic year. Binge eating and fasting were the most common types of DE behaviours and had similar prevalence rates, while compensatory behaviours were the least prevalent DE behaviour. Second, endorsement of various DE frequencies was relatively even across the three frequency categories (i.e., Once, 2-3 times, 4 or more times) for each DE behaviour, indicating that DE does not solely occur at the lowest frequencies within undergraduates. Third, results indicated that a substantial portion of fluctuations in DE frequency were explained by variability in negative urgency month to month. Finally, in partial support of my final hypothesis, study results revealed that depression significantly moderated the coupled association between negative urgency and DE frequency, such that the coupled association was strengthened as depressive symptoms increased. Anxiety and stress, however, did not moderate this association. The
current study highlights the striking prevalence of DE among a large sample of first-year undergraduate students, provides contextual information regarding the types and frequency at which these behaviours occur, and provides key information about mechanisms that underpin propensities for DE engagement by underscoring the importance of considering substantiated DE risk factors and emotional states in fluctuations of DE over time.

The current study aimed to provide a nuanced picture of DE engagement among first year undergraduate students. First, I found that just over half of students engaged in any one of three DE behaviours, namely binge eating, fasting, or compensatory behaviours, during their first academic year, which is higher than past research has suggested (Celio et al., 2006; Eisenberg, Nicklett, Roeder, & Kirz, 2011; Hoerr, Bokram, Lugo, Bivins, & Keast, 2002; Luce, Crowther, & Pole, 2008; Prouty, Protinsky, & Canady, 2002). However, the prevalence rate of DE engagement decreased steadily from October to April, indicating that these behaviours are most common in the beginning of the academic year. Although no known research has examined DE at multiple time points over the course of the first academic year, the steady decrease in DE frequency was surprising. In line with the emotion regulation model (Heatherton & Baumeister, 1991), I would have expected DE to be more prevalent around times of higher stress and negative affect, such as during exam periods (i.e., in December and April). Alternatively, and in keeping with the emotion regulation model, it may be that negative affect is most salient
the first few months of post-secondary, and as students learn effective coping and emotion regulation strategies, the need to engage in DE decreases. In partial support of this hypothesis, researchers have found that psychological, social, well-being, and cognitive-affective strengths decreased over the first semester of college, and plateaued during the second semester when assessed at the start, mid-way, and end of the first academic year (Conley, Kirsch, Dickson, Bryant, 2014).

In contrast with these findings and the emotion regulatory hypotheses, our results indicated that symptoms of DAS were relatively stable over the academic year. Another explanation may be that the environmental factors associated with the transition to post-secondary contribute to engagement in DE, which similarly attenuates over the academic year. During this transition, many students’ habits and routines are interrupted. Moreover, they are often wholly responsible for their nutritional choices and caloric intake for the first time, engage in poor dietary habits, experience decreased physical activity, increased alcohol consumption, and weight gain (e.g., Deforche, Van Dyck, Deliens, & Bourdeaudhuii, 2015; Racette, Deusinger, Strube, Highstein, & Deusinger, 2008; Serlachius, Hamer, & Wardle, 2007) which may contribute to dysregulated eating. For instance, students may engage in over-eating due to the overwhelming number of food options in the cafeteria, and subsequently engage in fasting behaviours to try to counteract perceived over-eating. Given that researchers have found that general distress decreases over the course of post-secondary (Sher, Wood, Gotham, 1996), it may be that
as the first year progresses, students become better equipped to regulate their eating behaviours and establish new eating patterns and routine. More research is needed to better understand this trajectory of DE prevalence over the academic year in order to reduce the impact of factors that could exacerbate DE engagement, and bolster factors that promote healthy eating behaviours.

The results illuminating the striking prevalence rates of DE within undergraduates points to the importance of engaging stakeholders on campus in the prevention and intervention of these behaviours. Programming that is meant to prepare students for the transition to postsecondary would benefit from providing psycho-education about DE and the context in which it occurs during the first academic year, as well as highlighting the importance of establishing healthy coping mechanisms and eating behaviours during the first few months of the academic year. University counselling centres, residence advisors, and campus health clinics may also consider highlighting the prevalence at which these behaviours occur, and provide ongoing psycho-education that helps students identify and differentiate DE from normative eating behaviours. Providing students with information regarding DE may promote students to seek help from these various stakeholders if they, or someone they know, is engaging in DE. This research also demonstrates the importance of engaging dining services in discussions around access and affordability of nutritious food. Past research suggests that a striking number of of post-secondary students want more freshly prepared food, more variety, detailed labelling and nutritive
information, and lower costs and discounts on healthy foods being sold on campus (Tam, Yassa, Parker, O’Connor, & Ailman-Farinell, 2017). Engaging residence and dining services stakeholders to ensure that students have the necessary information to make informed nutritive decisions, as well as access to affordable, healthy food choices is crucial given that institutions have the opportunity to influence future eating behaviours during this transitional period.

Next, I found that a large majority (68.2%) of those that had engaged in DE at some point across the seven months reported DE behaviours in only one or two months, 21.6% reported DE in three or four months, and very few of these individuals (10.1%) reported engaging in DE in five or more months, suggesting that while DE holds an alarming prevalence among first year undergraduates, these behaviours rarely persist across the entire year. However, my results also demonstrate that among those that engage, DE occurs at very low, as well as higher frequencies, as there was relatively even endorsement rates across various DE frequency levels (i.e., Once, 2-3 times, 4 or more times) within all months. In terms of prevalence of specific DE behaviours, the current study found that binge eating and fasting were the most common types of DE behaviours, and although they often occurred on their own within a given month, the most highly comorbid DE behaviours were binge eating and fasting. Conversely, although engagement in compensatory behaviours was infrequent within the sample, there were
slightly higher rates of it occurring in combination with fasting and binge eating, as compared to on its own.

My results demonstrated that negative urgency, although often conceptualized as a trait-like characteristic that differs primarily between individuals (e.g., Niv et al., 2012), tends to substantially fluctuate within individuals, month to month. Specifically, my results found that 23 percent of the total variance in negative urgency across seven months occurred at the within-person level. At least one other study has offered preliminary evidence suggesting that negative urgency may change concordantly with DE symptoms within a three to four week window (i.e., Anestis et al., 2007), however, this change was examined using only one follow-up assessment. My study is among the first to consider the stability of negative urgency across several follow-ups using advanced statistical methods, and suggests that negative urgency may be better conceptualized as a dynamic, state-like characteristic. Whiteside and Lynam (2001) noted that the impulsive actions associated with negative urgency are elicited or influenced by the presence of negative affect; given that negative affect is typically conceptualized as a state that waxes and wanes (e.g., Moberly & Watkins, 2008), and that the presence of negative affect undergirds negative urgency, it follows that negative urgency would also wax and wane with negative affect, and may best considered a state-like variable. Furthermore, my results demonstrating monthly fluctuations in negative urgency hold similarities to Bonne and colleagues’ (2012) results, who found that 44% and 37% of the day to day variance
in two subtypes of perfectionism (i.e., personal standards and evaluative concerns perfectionism) were at the within-person level: personality constructs that have also been traditionally conceptualized as a trait-like characteristic. Taken together, these results point towards a need for further research investigating shorter-term changes in personality characteristics that have historically been considered “stable”, and suggests that they may be better modeled as time varying. Moreover, my results demonstrated that fluctuations in negative urgency co-vary with fluctuations in DE frequency. More specifically, during the months when a given individual’s negative urgency is higher than his or her own average negative urgency, their DE frequency is also higher, and vice versa. These concurrent fluctuations further underscore the important role that negative urgency holds in DE, and offers new evidence of its robustness as a same-month correlate and marker for frequency of DE. Although past research has found a cross-sectional association between elevated negative urgency and greater severity and frequency of DE (e.g., Davis-Becker et al., 2014; Espel et al., 2017), our results suggest that negative urgency uniquely accounts for a notable portion (14%) of variance in DE frequency over time. My study, along with other preliminary evidence (Anestis et al., 2007), suggests that negative urgency is susceptible to changes, and therefore, teaching the importance of behavioural regulation when experiencing negative affect may be a critical target within evidence-based DE interventions (e.g., González, Penelo, Gutiérrez, & Raich, 2011; Heinicke, Paxton, McLean, & Wertheim, 2007; Sundgot-Borgen et al., 2018). Moreover,
the significant coupled association indicates that negative urgency may be an important marker of the severity of DE, and warrants inclusion in models that examine fluctuations in DE, in conjunction with other known risk factors such as body dissatisfaction.

The study’s results lend support to the emotion regulation model of DE (Heatherton & Baumeister, 1991). According to other researchers, negative urgency reflects underlying difficulties in emotion regulation, which therefore depletes resources typically dedicated to impulse control (as cited in Karyadi & King, 2011; Cyders et al., 2007; Cyders & Coskunpinar, 2010; Cyders, Flory, Rainer, & Smith, 2009).

Consequently, when an individual is experiencing higher negative urgency, he or she may be more likely to focus on their immediate emotional needs, and, if he or she is unable to find an alternate or effective strategy to modulate emotions, engage in risky behaviours to decrease negative affect (Cyders et al., 2009). Taken together, it may be that when the ability to regulate emotions is lower in a given month, possibly due to increased stressors or limited access to social support and coping strategies, undergraduates are more likely to impulsively engage in maladaptive behaviours (i.e., have higher negative urgency), such as DE, to cope with their negative affect. Although more research is needed to investigate concurrent changes in negative urgency, emotion regulation strategies, and negative affect, it seems plausible that changes in emotion regulation abilities may be an important factor that underpins changes in negative urgency and its coupled association with DE. Identifying factors such as emotion
regulation that influence fluctuations in negative urgency, and lead and lag associations
to DE, would further clarify avenues of intervention that could interrupt cyclical patterns
of maladaptive coping.

A final goal of my study was to examine if negative emotional states, namely
depression, anxiety and stress, moderated the coupled association between negative
urgency and DE frequency. First, in concordance with past literature that has found
positive associations between symptoms of DAS and DE (e.g., Ball & Lee, 2000;
Crowther et al., 2001; Gan et al., 2011; Tuschen-Caffier & Vogele, 1999; Wolff et al.,
2000), I found that symptoms of DAS each uniquely predicted DE frequency. Next,
examining symptoms of DAS as moderators allowed me to formally test the role of
negative urgency and negative affect within an integrated diathesis-stress and emotion
regulation framework, and investigate if emotional states do indeed exacerbate negative
urgency as a correlate of same month DE frequency. Examining symptoms of DAS as
moderators allowed me to formally test the role of negative urgency and negative affect
within an integrated diathesis-stress and emotion regulation framework, and investigate if
negative emotional states do indeed exacerbate negative urgency as a risk factor for same
month DE frequency. In partial support of my hypothesis, depression significantly
moderated the coupled association between negative urgency and DE frequency, such
that negative urgency and DE frequency became more strongly related as depressive
symptoms increased. This finding is in partial support of the aforementioned emotion
regulation model of DE (Heatherton & Baumeister, 1991), as it implicates the role of negative affect in DE engagement. However, our findings are better conceptualized by integrating emotion regulation aspects into a diathesis-stress framework; the tendency to impulsively engage in behaviours, such as DE, when under negative affect (i.e., higher negative urgency), is most likely to manifest in maladaptive coping behaviours when experiencing a stressor, such as depression. Although negative urgency functions as a unique same-month correlate for DE frequency, this association is further compounded with increasing depressive symptoms, as DE may be utilized as a way to cope with the heightened negative affect. Clinically speaking, this finding has important implications for DE prevention and treatment as it highlights that those with low impulse control who also experience low mood may be at an exceptional risk for engagement in higher frequencies of DE, and underscores the importance of ensuring clients’ ability to utilize their behavioural and emotion regulation strategies when experiencing strong negative emotions. In terms of research, the finding validates an important interaction between low mood and negative urgency in DE engagement and frequency, and provides a preliminary explanation and framework for conceptualizing fluctuations in DE frequency over time.

Finally, my result also point toward the utility of considering moderators within DE engagement and provides direction for future DE research and etiological models.

Importantly, there were no significant interaction effects for anxiety or stress in the coupled relationship between negative urgency and DE, contrary to my hypotheses. In
support of past findings implicating important roles of anxiety and stress in DE engagement (e.g., Beukes, Walker, & Esterhuyse, 2010; Wolff et al. 2000; Fitzsimmons-Craft et al., 2014; Freeman & Gil, 2004 Lee, & Vaillancourt, 2019; Pallister & Waller, 2008; Puccio et al., 2017; Sala & Levinson, 2016; Turel et al., 2018), our results revealed a significant positive association between both anxiety and stress and DE frequency. Given that anxiety and stress are important predictors and correlates of DE in non-clinical samples (e.g., Fitzsimmons-Craft et al., 2014; Koo-Loeb, Costello, Light, & Girdler, 2000), and our use of person-mean centred scores to identify shifts from typical anxiety and stress, it is unclear why no interaction effects were found. One possibility may be that the measure used to assess anxiety and stress (i.e., the DASS-21), examined more of physiological symptoms of anxiety and stress (e.g., “I experienced trembling”; “I was aware of the action of my heart in the absence of physical exertion”), rather than subjective cognitive symptoms and psychological effects. Given that those with DE may have more limited self-awareness, and distorted physical self-perceptions (see Heatherton & Polivy, 1992), a measure that focuses more on subjective experiences of stress and anxiety rather than objective physical sensations may have been more appropriate to exploring this particular relationship. Moreover, it is interesting that depression is characterized by low-arousal, whereas stress and anxiety are associated with hyper-arousal. These distinct arousal states may have unique influences and interactions with negative urgency, such that negative urgency is a more salient risk factor for DE.
frequency when the negative affect is characterized by low arousal and mood states. No known research has examined differences between these variables in interaction contexts with negative urgency, and more research is needed to further delineate the roles of different negative emotional states in associations between negative urgency and other risk factors, and DE engagement.

Limitations

The current study had many important strengths, including its large sample size, monthly longitudinal design, strong theoretical foundation, and the employment of advanced statistical techniques. However, there are a number of limitations to consider. First, although students undergoing the transition to postsecondary are at an increased risk for engagement in maladaptive coping behaviours (e.g., Caldeira, Arria, O’Grady, Vincent, & Wish, 2008; Delinsky & Wilson, 2008; Greenbaum, Boca, Darkes, Wang, & Goldman, 2005; Grossbard et al., 2010) and are a highly relevant sample for the current study, our results may not generalize to students in their upper years of post-secondary, community, or clinical samples, due to the unique stressors experienced by first-year students in their transition, and the subclinical levels at which these behaviours occurred. Next, a more diverse measure of stress and anxiety that includes number and perceived burden of stressors, as well as subjective and cognitive experiences of these constructs,
may be more appropriate for an undergraduate sample, particularly for those who engage in higher levels of DE and may have more limited introspective awareness.

Furthermore, although the average monthly number of DE episodes provides more information regarding DE than a dichotomous DE engagement variable (yes/no), including more indicators of DE severity such as perceived distress, or physical and social consequences, may further contextualize DE engagement within first year undergraduates. Employing exact frequency counts of DE, instead of an ordinal scale, would provide more information about individuals who engage in the most extreme levels of DE. As well, my use of the maximum value of endorsement across the three DE behaviours as the DE frequency value means that we considered each DE behaviour to hold the same importance or relevance. An exact frequency count for each DE behaviour would allow for a more nuanced examination, and subsequent decision, if certain DE behaviours should be weighted more heavily than others when examining DE frequency and severity. While a monthly longitudinal design is a notable strength of the current study, it is also a limitation as it is susceptible to recall biases, and behavioural counts and emotional states must be aggregated or recalled from the past month. Moreover, given that data was collected using self-report surveys, we were unable to clarify participant interpretations of the DE items, particularly binge eating, and it is possible that participants may have over-endorsed engagement in these DE behaviours. Finally, given that impulsivity is most elevated among those who engage in DE that is primarily
characterized by binge eating and purging, as compared to fasting (see Waxman, 2009 for a review), important information regarding unique associations between negative urgency and different types of DE behaviours may have been masked by our conglomerate DE variable. However, it is important to note that the DE behaviours often co-occurred within the same month among our sample, and as such, separate models were not conducted for unique types of DE.

**Future Directions**

The current study illuminates many important areas for future research in the field. First, it is crucial that campuses engage mental health, physical health, residence, and food and beverage stakeholders on campus to ensure that campus environmental factors are conducive to, and support, healthy eating and nutritive behaviours of students. More research is needed to better understand why DE decreases steadily over the course of the year, and what psychological, social, and/or environmental factors promote this decrease. Next, future research may reconsider the presumed stability of trait-like characteristics and risk factors of DE, and model how fluctuations in these risk factors and acute stressors may interact to influence DE engagement. Second, DE engagement research would benefit from considering moderators and mediators in statistical models, which would facilitate the consideration and integration of known risk factors, as well as acute stressors, in etiological models of DE. Future research would also benefit from
employing techniques to investigate DE engagement that limit recall biases such as daily
diary methods or Ecological Momentary Assessments. Moreover, these methods would
capture shorter terms fluctuations in DE and provide more nuanced detail of antecedents
to DE, and insight of additional moderators to consider such as social stressors. Finally,
future research would benefit from utilizing latent class or cluster analysis to further
identify factors that may differentiate those who engage in infrequent DE, and those who
engage in more extreme or clinical frequencies of DE within various time frames.
Understanding characteristics that predict and contribute to short-term fluctuations in DE
may inform future research that aims to identify factors that differentiate longer-term DE
trajectories.
References

doi:10.1080/10640266.2011.584804


American College Health Association - National College Health Association (2016). ACHA-NCHA II Canadian Undergraduate Executive Summary. Retrieved from
https://www.acha.org/documents/ncha/NCHA-II%20SPRING%202016%20CANADIAN%20REFERENCE%20GROUP%20EXECUTIVE%20SUMMARY.pdf


psychopathy. *Personality and Individual Differences, 47*(6), 668-670.

doi:10.1016/j.paid.2009.05.013

behaviours. *Behaviour Research and Therapy, 45*(12), 3018-3029.

doi:10.1016/j.brat.2007.08.012

properties of the 42-item and 21-item versions of the depression anxiety stress scales in
clinical groups and a community sample. *Psychological Assessment, 10*(2), 176-181.

doi:10.1037/1040-3590.10.2.176

anorexia nervosa and other eating disorders: A meta-analysis of 36 studies. *Archives of


doi:10.1080/08870440008407364.

Barker, E. T., & Galambos, N. L. (2007). Body dissatisfaction, living away from parents, and
poor social adjustment predict binge eating symptoms in young women making the
transition to university. *Journal of Youth and Adolescence, 36*(7), 904-911.

doi:10.1007/s10964-006-9134-6


http://dx.doi.org/10.1037/0021-843X.106.1.145


http://dx.doi.org/10.1037/abn0000111


