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**Daily Ups and Downs in Women’s Binge Eating Symptoms: The Role of Basic Psychological Needs, General Self-Control, and Emotional Eating**

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Abstract

The high prevalence rates of problematic eating behaviors, such as binge eating symptoms, have urged researchers to investigate why and when control over eating behaviors is lost. The current study employs a daily diary methodology to examine whether the daily satisfaction and frustration of the basic psychological needs for autonomy, competence, and relatedness, as conceptualized within Self-Determination Theory (Deci & Ryan, 2000), is associated with daily binge eating symptoms. In a sample of female adolescents ($N = 302$, age $= 14-23$), daily fluctuations in need frustration were related to daily fluctuations in binge eating symptoms. Furthermore, frustration of all three needs yielded an independent association with binge eating symptoms. Apart from the main effects of low self-control strength and emotional eating, emotional eating served as a moderator of the link between need frustration and binge eating symptoms. Theoretical and clinical implications of these findings are discussed.

Key words: Self Determination Theory; Psychological Need Satisfaction; Binge Eating Symptoms, Self-control Strength, Emotional Eating; Diary Study
Past research has indicated that adolescents and young adults suffer from many eating problems (Ogden, 2010). Prevalence rates of binge eating, which is defined as “episodes of eating which are experienced as excessive and beyond the subject’s control” (Fairburn, 1984, p. 235), are high, with recent estimates of 19.6% in female adolescents (Goossens & Braet, 2010) and 12.9% in university students (Nicoli & Liberatori, 2011). These binge eating symptoms can contribute to overweight and obesity, which, in turn, are associated with a variety of physical (e.g., coronary disease, diabetes, hypertension; e.g., World Health Organization, 1996) and mental health (e.g., depressive symptoms, low self-esteem; e.g., Bray, 1986; Wadden et al., 2006) problems.

Given these high prevalence rates, it is important to investigate why people sometimes lose control over eating. Quite a lot of studies have addressed the role of individual characteristics (i.e., between-person differences), such as general self-control strength (e.g., Baumeister & Heatherton, 1996; Vohs & Heatherton, 2000) and eating style (e.g., Ouwens, van Strien, van Leeuwe, & van der Staak, 2009) in unsuccessful eating regulation. Another approach, however, is to investigate fluctuations in eating regulation from day to day. Indeed, besides the more general and relatively stable differences between persons in controlling eating behaviors, there is likely day-to-day variability within persons in binge eating symptoms. Simply put, one day is not the other.

**The Ups and Downs in Binge Eating Symptoms**

Previous research on within-person fluctuations in eating behaviors has focused mainly on the role of daily hassles and negative affect in snacking behaviors and binge eating. Daily hassles are defined as ‘events, thoughts, or situations which, when they occur, produce negative feelings such as annoyance, irritation, worry or frustration, and/or make you aware that your goals and plans will be more difficult to achieve’ (O’Connor,Conner, Jones, McMillan, & Ferguson, 2009, p. 185). A number of studies found that daily hassles are
associated with a variety of unhealthy eating behaviors, such as eating more high-fat foods and sugar snacks (O’Connor, Jones, Conner, McMillian, & Ferguson, 2008), snacking between meals (Conner, Fitter, & Fletcher, 1999), and eating less vegetables (e.g., O’Connor et al., 2008) on a daily basis. Further, in samples of eating disordered patients, negative affect has been found to precede binge eating symptoms (Haedt-Matt & Keel, 2011). For instance, in a comprehensive review, Haedt-Matt and Keel (2011) concluded that individuals experience more negative affect prior to binge eating episodes compared to their average levels of negative affect throughout the day. Also, specific emotional states such as anger (e.g., Engel et al., 2007; Smyth et al., 2007), low alertness (Greeno, Wing, & Shiffman, 2003) and stress (e.g., Smyth et al., 2007) have been found to precede binge eating symptoms. Apart from studies examining the role of emotions, other studies have shown that decreases in self-concept (Steiger et al., 2005), poor social experiences (Steiger et al., 1999) and negative family interactions (Okon, Greene, & Smith, 2003) are related to daily binge eating symptoms.

The current study aims to extend previous work on processes involved in within-person fluctuations of binge eating symptoms by implementing a motivational perspective (Verstuyf, Patrick, Vansteenkiste, & Teixeira, 2012). Specifically, we aimed to investigate whether daily fluctuations in satisfaction and frustration of the basic psychological needs for autonomy, competence and relatedness, as defined within Self-Determination Theory (SDT; Deci & Ryan, 2000; Ryan & Deci, 2000), are associated with daily fluctuations in binge eating symptoms.

**Self-Determination Theory: The Role of Basic Psychological Needs in Eating Regulation**

SDT is a motivation theory that investigates individuals’ adaptive (e.g., well-being) and maladaptive (e.g., psychopathology) functioning in general, but also in more specific behavioral contexts (e.g., work, sports, eating regulation). Central to SDT is the tenet that
people are born with a set of basic psychological needs, which are considered as the psychological nutriments necessary for growth and integration (Ryan & Deci, 2000). Three universally important psychological needs have been identified, that is, the needs for competence, relatedness, and autonomy. Competence reflects the need to feel efficacious and capable of achieving desired outcomes. Relatedness involves the need to feel close to and valued by important others and to have a sense of belonging with peers, family, and the larger community. Finally, autonomy concerns the experience of volition and psychological freedom in carrying out an activity.

Consistent with SDT’s claim that the psychological needs are implicated in individuals’ adjustment, a variety of studies have demonstrated that need satisfaction is associated with more global well-being and with positive outcomes in specific behavioral contexts, such as sports, health care and work (e.g., Vansteenkiste, Niemiec, & Soenens, 2010 for an overview). Conversely, need frustration has been found to be associated with more negative outcomes, such as emotional and physical exhaustion (e.g., Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011). In addition, a few studies have addressed the question of within-person fluctuations in psychological need satisfaction and well-being. It has been demonstrated that individuals report more positive affect, more vitality, and less negative affect on days their needs had been satisfied, with all three needs yielding an independent contribution to these outcomes (Reis, Sheldon, Gable, Roscoe, & Ryan 2000; Ryan, Bernstein, & Brown, 2010; Sheldon, Ryan, & Reis, 1996).

No previous study has investigated within-person associations between daily need satisfaction and frustration and daily eating behaviors. However, a few previous studies that relied on between-person designs demonstrated that psychological need satisfaction is implicated in one’s eating behaviors. Between-person differences in need satisfaction were found to be associated with a healthier diet, such as a higher intake of fruits and vegetables.
Psychological Needs and Binge Eating (see Ryan, Patrick, Deci, & Williams, 2008 for an overview), whereas psychological need frustration was related to more unhealthy weight control behaviors (Thogerson-Ntoumani, Ntoumanis, & Nikitaras, 2010), more eating disorder symptoms (Bartholomew et al., 2011), and more binge eating behaviors (Schüler & Kuster, 2011; Verstuyf, Vansteenkiste, & Soenens, 2012).

The present study extends this rather small body of work by examining whether day-to-day fluctuations in need satisfaction and need frustration relate to daily variation in binge eating symptoms. Two different, albeit related, theoretical processes might help to understand why satisfaction and frustration of the psychological needs might relate to one’s eating behaviors. First, individuals whose psychological needs are satisfied feel more energetic and vital (e.g., Ryan & Deci, 2008). As eating regulation is on average a challenging task that requires self-control and energy to resist unhealthy foods (Vohs & Heatherton, 2000), the energy-providing character of need satisfaction (Moller et al., 2006) might prevent one of losing control over eating. Need frustrating experiences, on the other hand, might deplete energy (Muraven, Gagné, & Rosman, 2008) such that one does not have sufficient energy left to resist binge eating. Second, psychological need satisfaction and frustration might influence eating behaviors through the experience of positive and negative affect. Given that daily need satisfaction was found to relate to more positive affect and less negative affect (e.g., Ryan et al., 2010) and given that low positive affect and high negative affect were found to precede snacking (e.g., O’Connor et al., 2009) and binge eating behaviors (e.g., Haedt-Matt & Keel, 2011), these affective experiences may account for the association between psychological needs and binge eating symptoms.

The Moderating Role of General Self-control Strength and Emotional Eating

In addition to examining how daily need satisfaction and frustration relate to daily eating behaviors, we also examined whether individual (i.e., between-person) characteristics
moderate these associations. In other words, is every person who experiences need frustration on a given day equally susceptible to losing control over eating behaviors that day? Are there individual characteristics that attenuate or strengthen the association between the psychological needs and binge eating symptoms? Based upon the hypothesized pathways of energy-depletion and negative affect, we reasoned that general self-control strength (Baumeister & Heatherton, 1996) and emotional eating style (e.g., O’Connor & O’Connor, 2004) may moderate the link between the psychological needs and binge eating.

The concept of self-control strength stems from the Self-Control Model (Baumeister & Heatherton, 1996), which states that people's self-control capacity is a limited resource or strength that gets depleted over time (i.e., ego-depletion). Self-control is defined as "the use of cognitive and attentional resources to override, inhibit, or alter impulses in the service of attaining personal goals or satisfying motives" (Vohs & Heatherton, 2000, p. 214). On days people have engaged in various activities that require self-control, they are said to be less able to resist tempting foods because their limited energetic resources are eroded. Yet, there are considerable differences between persons in their general self-control strength, with high self-control strength being related to a variety of adaptive behaviors, both outside the eating domain (e.g., school performance, optimal emotional response; Tangney, Baumeister, & Boone, 2004) and within the eating domain (e.g., less bulimic and binge eating symptoms; Peluso, Ricciardelli, & Williams, 1999; Tangney et al., 2004).

In addition to examining the between-person effect of self-control strength in the prediction of binge eating across days, we investigated whether individuals with low self-control strength would be more prone to binge eating symptoms on need frustrating days. There is some indirect evidence for this moderation hypothesis. For instance, Schüler and Kuster (2011) found that the association between unfulfilled needs and binge eating was present for people low in achievement motivation, but not for those high in achievement
motivation. As people high in achievement motivation have high self-control capacities (Mischel, 1961), Schüler and Kuster argued that differences in self-control could account for this moderation effect. Further, O’Connor and colleagues (2009) found that several aspects of conscientiousness, a personality dimension sharing conceptual overlap with the notion of self-control strength, moderates the relation between daily hassles and eating behaviors (O’Connor et al., 2009). In line with these findings, we hypothesized that daily associations between psychological need frustration and binge eating would be stronger for persons with low general self-control strength.

Next to self-control strength, we explored whether emotional eating would alter the relation between the psychological needs and binge eating. Emotional eating refers to a tendency to eat more when people feel anxious or are emotionally aroused (e.g., O’Connor & O’Connor, 2004). It has been studied frequently as an individual characteristic that strengthens the relation between negative affect and binge eating symptoms. For instance, laboratory studies found that people with an emotional eating style ate more high-fat and/or sugared food after induction of negative affect or stress (e.g., Wallis & Hetherington, 2009; Loxton, Dawe, & Cahill, 2011), although other studies could not confirm these findings (e.g., O’Connor & O’Connor, 2004). The results of diary studies were equally mixed. Whereas O’Connor et al. (2008) reported that emotional eating moderated the association between daily hassles and snacking behaviors, Conner et al. (1999) reported no evidence for such a moderation effect. Given the mixed findings, we deemed it important to further explore this issue.

Present Study

In the present study we investigated the role of the psychological needs in the prediction of eating regulation by using diary methodology in a group of young female participants. Given that we wanted to investigate within-person processes, a diary study was
considered an appropriate technique (Bolger, Davis & Rafaeli, 2003). Diaries offer the opportunity to investigate individuals’ experiences within an everyday context, which increases the ecological validity of the study. Furthermore, given the limited time interval between the experiences and the measurement of these experiences, the likelihood of measurement errors due to retrospective recall are diminished, which increases the reliability and validity of the findings (Bolger et al., 2003).

The first and primary aim of the study was to examine within-person associations between the three basic psychological needs and binge eating symptoms within days. A prerequisite for investigating within-person processes is that there is significant within-person variability in binge eating symptoms. This means that, apart from differences between persons, there are considerable day-to-day fluctuations within persons. Therefore, we began with examining the amount of variation situated at the within- and between-person level.

Next, we investigated whether an aggregated score of daily need satisfaction and an aggregated score of daily need frustration would be associated with daily binge eating symptoms. As recent studies indicate that need satisfaction is associated with more positive outcomes, whereas need frustration is associated with more negative outcomes (e.g., Bartholomew et al., 2011; Sheldon et al., 2011), we hypothesized that especially need frustration would relate to binge eating symptoms (Hypothesis 1).

Further, we investigated the unique contribution of each of the three needs. Whereas the use of a composite measure of need satisfaction and frustration (e.g., Schüler & Kuster, 2011) is valid in light of the high correlations between the three needs, it might also obscure unique effects of the three needs separately. Given that previous diary studies indicated that all three needs contributed uniquely to wellbeing (e.g., Ryan et al., 2010), we expected that the three needs would be associated uniquely with binge eating symptoms (Hypothesis 2).
A second aim involved investigating whether the individual characteristics of general self-control strength and an emotional eating style would moderate the within-person associations between the needs and binge eating. A premise for investigating these moderation effects, is that there are significant between-person differences in the strength of the associations between the needs and binge eating. If so, this opens the possibility to investigate which individual characteristics can explain this variability.

Specifically, two separate equations were built to investigate main and moderation effects of low self-control strength and emotional eating. In addition to a main effect of low self-control strength, we expected that especially people with low self-control strength, compared to those with high self-control strength, would be less able to control their eating on need frustrating or less need satisfying days (Hypothesis 3). Given the inconclusive evidence obtained in previous studies regarding the role of an emotional eating style, we examined in a rather explorative fashion the possible main and moderating effects of emotional eating (Research Question 1). In examining this research question, we explored whether three between-person background variables, that is, BMI, educational level and age, had significant effects on binge eating symptoms and, thus, should be controlled for in the analyses.

Finally, in a set of ancillary analyses we explored significant correlational relationships more extensively by examining changes rather than correlations. First, we tested the relation between basic need frustration and binge eating symptoms more conservative by controlling for baseline levels of both variables (Research Question 2). This analysis allows us to examine correlated change in which increases in basic need frustration would relate to increases in binge eating symptoms. Second, we tested whether need frustration and binge eating symptoms would mutually reinforce each other across days in a set of cross-lagged models (Research Question 3).

Method
Sample and Procedure

Female adolescents aged 14 to 23 were invited by bachelor students psychology to take part in a diary study on their daily feelings and eating habits. Students were asked to exclude participants who currently have or have had an eating disorder in the past. In total 302 females with Belgian nationality aged 14 to 23 (mean age = 17.7) participated in the study. Most participants were attending secondary education in Flanders with 45.7% enrolled in academic education, 14.2% in technical education, and 3.7% in vocational education. In addition, 29.9% of the participants were enrolled in higher education and 4.1% were working. BMI ranged between 14.53 and 34.01 (M = 20.93; SD = 2.68). Most participants’ weight status was situated within the normal range from 18.5 to 25 (77.5%). About 16.6% had a BMI below 18.5, whereas 5.6% were overweight and 0.3% were obese. Prior to the diary study, informed consents were signed by participants and by one of the parents for under aged participants. During this first visit, participants completed a set of self-report questionnaires including items tapping into demographic information (e.g., age, education, height and weight) and measures of dispositional traits (e.g., general self-control strength, emotional eating style). At the end of the first visit, participants were handed over a booklet of questionnaires which had to be filled in at evenings before bedtime for 14 consecutive days. Participants received an email or text message each day to help them remember to fill in the questionnaires. In addition, the students who contacted the participants visited the participant at home a second time after one week and a third time at the end of the study to give participants the opportunity to ask questions about the ongoing diary questionnaires. This ensured maximal participation of all participants. Only two participants were removed from the analyses because they failed to fill in the questionnaire for two weeks. In total, there were 2% missing values in the data. By default, these missing values are treated as structural missing values by MIWin, the statistical package we used to analyze the data.
Questionnaires

*Body Mass Index (BMI).* Participants reported their height and weight. Based on this information, BMI was calculated with the formula $[\text{weight in kg} / (2 \times \text{length in m})]$.

*Emotional Eating.* Emotional eating was assessed with the Dutch Eating Behavior Questionnaire (DEBQ; Van Strien, Frijters, Bergers, & Defares, 1986). Participants indicated on a scale from 1 (never) to 5 (very often) how often they eat in response to emotions such as anger, anxiety, and restlessness (e.g., “If you feel disappointed, would you like to eat something?”). The items were scored such that a higher score represented a stronger tendency to eat in response to these emotions. Cronbach’s alpha was .92.

*General Self-Control Strength.* To assess general self-control strength a selection of 11 out of 13 items of the Self-Control Questionnaire (Tangney et al., 2004) was used. The questionnaire intends to measure individual differences in the disposition to control impulses, thoughts and emotions and to suppress undesirable behavior (Finkenauer, Engels, & Baumeister, 2005). The selection of items was based on the study by Finkenauer et al. (2005) who translated the items in Dutch. Participants responded on a scale from 1 (completely disagree) to 5 (completely agree) on items such as “I’m good at resisting temptations” and “I find it difficult to break with bad habits”. As most items were negatively worded, we created a composite score with higher scores indicating a stronger lack of general self-control strength. Cronbach’s alpha was .71.

*Daily Psychological Needs.* To measure daily satisfaction and frustration of the needs for autonomy, competence, and relatedness, we used a measure developed by Sheldon and Gunz (2009). Participants rated on a scale from 1 (not at all true) to 5 (very true) whether they felt their needs for autonomy (e.g. “Today my choices were based on my true interests and values” or “Today I had a lot of pressures I could do without”), competence (e.g. “Today I was successfully completing difficult tasks and projects” or “Today I struggled doing
something I should be good at”) and relatedness (e.g. “Today I felt close and connected to people who are important to me” or “Today I felt lonely”) were satisfied or frustrated during the day. This daily assessments of needs consisted of 18 items, that is, 6 items per need, 3 of which tapped into satisfaction and 3 of which tapped into frustration of the psychological needs. Reliabilities (Cronbach’s alpha) were calculated at each measurement time and for each separate need as well as for the aggregated measures of need satisfaction and need frustration. The aggregate measures had average reliabilities of .85 (range .79-.88) for need satisfaction and .79 (.74-.84) for need frustration. Satisfaction of the needs for autonomy, competence and relatedness had respective reliabilities of .75 (.70-.79), .77 (.69-.84), and .85 (.79-.89), whereas frustration of these needs had respective reliabilities of .67 (.56-.77), .72 (.69-.77), and .58 (.48-.70). Although most measures had sufficient reliability, the effects of relatedness frustration should be interpreted with some caution as Cronbach’s alpha revealed relatively low internal consistency on some days.

**Binge Eating Symptoms.** The bulimia-scale of the Dutch version (Van Strien, 2002) of the Eating Disorder Inventory (EDI; Garner, 1991) was used to assess binge eating symptoms. The bulimia subscale assesses “the tendencies to think about and engage in bouts of uncontrollable overeating” (Garner, 1991, p. 5). One item was not included in the computation of the scale score (“i.e. “I have thought of trying to vomit in order to lose weight”) since we were mainly interested in binge eating rather than compensatory bulimic behaviors (see also Woods, Racine, & Klump, 2010). Further, we adapted the remaining 6 items to capture the daily experiences of participants by adding ‘today’ before each item. Participants responded on a scale from 1 (not at all) to 6 (very much) to items such as “Today I stuffed myself with a lot of foods“ and “Today I had episodes of eating in which I felt like I could not stop eating“ . The scale had an average reliability of .83 (.77-.87).

**Plan of Analysis**
This study has a repeated measurements design with 14 measurement times (Level 1) being nested within 302 persons (Level 2). To investigate daily variations within persons, the hierarchical structure of the data needs to be taken into account as large dependencies within persons can be expected. Also, some of our research questions require simultaneously analyzing information at the between-person and within-person level. Therefore, multilevel analysis was considered the most appropriate technique. All analyses were performed with the statistical software package MLWin 2.02 and all predictor variables were centered around their grand mean to facilitate convergence and interpretation of the models.

Prior to investigating our hypotheses, we examined whether there was significant variability in binge eating symptoms on a daily basis. A null model with random intercepts and a constant as the only predictor was created for this purpose. This model decomposed the total variation into variation at the between-person and within-person levels and served as a baseline model against which other models were compared.

Then, we proceeded by examining whether the aggregated scores of need satisfaction and need frustration were related to binge eating symptoms (Hypothesis 1). Next, need satisfaction and frustration were further decomposed into their respective subcomponents of autonomy, competence, and relatedness to test unique associations between the three needs and binge eating symptoms (Hypothesis 2). In each model we started with a random intercepts model only and then gradually included random effects at Level 1 and Level 2. In all models reported in Table 1, we controlled for significant random effects at both levels of analyses (as indicated by likelihood-ratio tests and by chi-square tests).

For the second aim, we first tested whether there was significant variation between persons in the association between the needs and both outcomes and second, whether BMI, educational level and/or age had to be included as background variables. Then, we examined
the moderating role of general self-control strength (Hypothesis 3) and an emotional eating style (Research Question 1) on the association between the needs and eating behaviors.

In the last set of models, we explored changes in need frustration and binge eating symptoms. First, we repeated the analysis in which basic need frustration predicted binge eating symptoms, but we additionally controlled for baseline levels of both binge eating symptoms and need frustration (Research Question 2). Second, we ran cross-lagged models in which we investigated whether basic need frustration would predict binge eating symptoms the next day, after controlling for baseline levels of both variables. These models allowed us to investigate whether need frustration one day predicts increases in binge eating symptoms the next day and vice versa (Research Question 3).

**Results**

**Aim 1: Within-day Associations between Psychological Needs and Binge Eating Symptoms**

In a first step, the null model with random intercepts indicated significant variability in binge eating symptoms at the within-person level $\chi^2(1) = 964.514, p < .001$ and at the between-person level $\chi^2(1) = 132.163, p < .001$. Specifically, 52% of the variance was attributed to between-person differences, whereas 48% was attributed to within-person differences. In other words, in addition to significant variation between participants in binge eating symptoms, there were significant fluctuations from day to day in these symptoms within persons. This finding indicated that it is necessary to take into account the hierarchical structure of the data and, hence, to use a multilevel approach.

Second, the aggregated measures of need satisfaction and need frustration were entered into the equations to test Hypothesis 1 (Model 1 in Table 1). Results indicated that need frustration had a significant positive association with binge eating symptoms $\chi^2(1) = 50.749, p < .001$, whereas need satisfaction was unrelated to binge eating symptoms $\chi^2(1) = \ldots$
After excluding need satisfaction from the model, the fit did not deteriorate [$\chi^2(1) = 0.190, ns$] which further indicates that need satisfaction did not yield additional information above need frustration. For every standard deviation (i.e., SD = 0.672) above the overall mean in need frustration, there was an average increase of 0.116 points on the 1 to 6 scale of binge eating symptoms. The model explained 15% of the within-person variance in binge eating.

Next, we decomposed the need frustration composite score into its subcomponents of relatedness, autonomy and competence frustration (Model 2 in Table 1), which allowed us to investigate Hypothesis 2. After controlling for significant random effects at both levels of analysis, a positive fixed effect of relatedness [$\chi^2(1) = 24.388, p < .001$], autonomy [$\chi^2(1) = 5.707, p < .05$] and competence [$\chi^2(1) = 7.342, p < .01$] frustration on binge eating symptoms was found. On average, one standard deviation above the mean in relatedness (SD = 0.859), autonomy (SD = 0.886) and competence (SD = 0.789) frustration was associated with an increase of 0.061, 0.024, and 0.038 points (in the 1 to 6 scale) in binge eating symptoms.

This model explained 35% of the within-person variance in binge eating symptoms. In other words, the decomposition into the three separate needs explained an additional 20% of the within-person variance in binge eating symptoms. However, the fit of this model was lower compared to the previous model. For this reason and to limit the number of parameter estimates, we proceeded with the composite measure of need frustration when examining the potential moderating role of emotional eating and self-control.

**Aim 2: Main and Moderation Effects of General Self-Control Strength and Emotional Eating**

Aim 2 involved testing between-person differences in the association between need frustration and binge eating symptoms. Results indicated significant variation in the slope between participants [$\chi^2(1) = 22.095, p < .001$], meaning that the strength of the association between need frustration and binge eating symptoms varied across women.
the main and moderation effects of three background variables, that is, BMI, age, and educational level. No main or moderation effects for BMI $\chi^2 (1) = 1.71$, $ns$; $\chi^2 (1) = 1.678$, $ns$, age $\chi^2 (1) = 0.859$, $ns$; $\chi^2 (1) = 2.295$, $ns$ and educational level $\chi^2 (1) = 2.835$, $ns$; $\chi^2 (1) = 0.136$, $ns$ were found. Therefore, these background variables were not included in the subsequent analyses investigating low-self control strength and emotional eating style.

Low self-control strength had a positive association with binge eating symptoms $\chi^2 (1) = 10.111$, $p < .01$, but no moderation effect was found $\chi^2 (1) = 0.235$, $ns$. Women with lower self-control strength experienced more binge eating symptoms throughout the 14 days of measurement, but the association between daily need frustration and daily binge eating symptoms was not more pronounced compared to women with higher self-control strength. The fit of this model was significantly better compared to the model with need frustration as the only predictor $\chi^2 (1) = 10.984$, $p < .001$.

Next, emotional eating style was entered into the equations. An emotional eating style had a significant main effect $\chi^2 (1) = 46.838$, $p < .001$ and was also a significant moderator of the need frustration – binge eating symptoms association $\chi^2 (1) = 22.588$, $p < .001$. The main effect indicated that emotional eaters experienced more binge eating symptoms across days. To interpret the moderation effect, a graph was plotted of the fixed effects in which the average binge eating symptoms score was calculated for participants with a low (Mean -1SD) or high (Mean +1SD) emotional eating style in combination with a low (Mean -1 SD) or high (Mean + 1SD) need frustration score (see Figure 1). This plot demonstrated that the association between need frustration and binge eating symptoms was stronger for women high on emotional eating. The inclusion of emotional eating as a predictor yielded a decrease of 28.6% of the variance in the slopes and resulted in a significantly better fit compared to the model with need frustration only $\chi^2 (1) = 48.668$, $p < .001$.

Supplementary Analyses
Follow-up analyses indicated that the association between need frustration and binge eating symptoms remained significant after controlling for baseline levels of both variables \( \beta = 0.240, \chi^2(1) = 72.938, p < .001 \). This indicates correlated change in which within-person change in need frustration is associated with within-person change in binge eating symptoms. Next, we examined cross-lagged relationships between need frustration and binge eating symptoms in which need frustration one day predicts changes in binge eating symptoms the next day and vice versa. These models demonstrated that need frustration one particular day could not predict increases in binge eating symptoms the next day \( \beta = -0.013, \chi^2(1) = 1.278, ns \). Similarly, binge eating symptoms on one particular day could not predict increases in need frustration the next day \( \beta = 0.017, \chi^2(1) = 0.755, ns \).

**Discussion**

In contemporary Western society many women experience problems with adequately regulating their eating behaviors. Although there are substantial and relatively stable differences between persons in the degree to which one is prone to binge eating, there also exists considerable fluctuation within people’s own eating behaviors. Investigating variables that account for these daily fluctuations might result in a more thorough and dynamic insight in eating regulation. Such insight might, in turn, provide important information about how people can be supported to remain in control over their eating. In the current study, we investigated (a) whether day-to-day variation in the satisfaction of one’s basic psychological needs, as defined within Self-Determination Theory (Deci & Ryan, 2000) is implicated in one’s daily binge eating symptoms and (b) whether general self-control strength and emotional eating, apart from yielding a main effect, play a moderating role in these daily associations. By considering predictors from a more general social-psychological framework (i.e., psychological needs) in conjunction with well-studied predictors in the eating regulation
literature (i.e., emotional eating; self-control), we aimed to help bridge the gap between both literatures.

**Basic Psychological Needs as Processes Involved in Day-to-Day Eating Regulation**

A central tenet within SDT is that people have inherent psychological needs for autonomy, competence, and relatedness. Satisfaction of these needs has been mostly studied in relation to well-being, with studies demonstrating systematically that satisfaction of these needs is associated with more well-being, both at the between-person (e.g., Vansteenkiste, Lens, Soenens, & Luyckx, 2006) and within-person level (e.g., Reis et al., 2010). Although some studies documented associations between the psychological needs and eating behaviors (e.g. Schüler & Kuster, 2011), no previous studies investigated these associations at the within-person level. In line with Hypothesis 1, we found that women experienced more binge eating symptoms on days their needs had been frustrated. This finding suggests that previously documented associations between the psychological needs and eating behavior outcomes (e.g., Thogerson-Ntoumani et al., 2010; Schüler & Kuster, 2011) also apply at the within-person level.

The finding that need frustration, but not need satisfaction, was associated with binge eating symptoms also has relevance for a recent development in SDT. Recent studies within SDT indicate that a lack of need satisfaction is not the same as need frustration and that especially need frustrating experiences are associated with pathological outcomes (e.g., Bartholomew et al., 2011; Sheldon, Abad, & Hinsch, 2011; Verstuyf et al., 2012). The current study adds to these findings by extending them to the within-person level.

A set of ancillary analyses revealed that changes in need frustration were significantly related to changes in binge eating symptoms. This finding indicates that, for instance, an increase in need frustration from day 1 to day 2 is associated with an increase in binge eating symptoms from day 1 to day 2. However, need frustration one day could not predict an
increase in binge eating symptoms the next day after controlling for baseline levels of both variables. Together, these findings suggest that the association between need frustration and binge eating symptoms is a dynamic one and merely takes place within the day. Although more research is needed to examine the direction of effects involved, it seems that need frustration and binge eating are developing in tandem from one day to the next.

There are several explanations as to why need frustration is related to binge eating behaviors on a daily basis. For instance, previous diary studies (e.g., Ryan et al., 2010) indicated that daily need satisfaction is associated with more subjectively felt energy (i.e., vitality). Therefore, on need-frustrating days one might feel depleted of energy such that one loses control over eating more easily. Another explanation is that uncontrollable eating might be a way to cope with the negative affect associated with need frustrating experiences. More research is needed to investigate these explanatory mechanisms.

Further, to test Hypothesis 2, we decomposed the aggregate measure of need frustration into its three subcomponents, that is, the needs for autonomy, competence and relatedness. We found unique associations of each of the three needs, which is consistent with diary studies on need satisfaction and wellbeing (e.g., Reis et al., 2000; Ryan et al., 2010). The finding that relatedness frustration was strongly associated with binge eating symptoms is in line with results of experience-sampling studies which found that poorer social experiences and negative family interactions precede binge-eating in clinical samples (Steiger et al., 2005; Okon et al., 2003). To our knowledge, no previous study has demonstrated the additional role of autonomy and competence frustration in the prediction of daily binge eating behaviors.

**General self-control strength and emotional eating style as individual characteristics**

An additional aim was to investigate whether two individual characteristics, that is, general self-control strength and an emotional eating style, moderate the associations between
the needs and binge eating behaviors. Preliminary analyses revealed that the strength of the association between need frustration and binge eating symptoms varied across persons. This opened the possibility for individual characteristics to explain these between-person differences.

As for Hypothesis 3, findings showed that persons who had rather low general self-control strength experienced more binge eating symptoms across days. This finding is in line with self-control theory (Baumeister & Heatherton, 1996) and with previous findings that people with relatively more self-control strength display a healthier diet (e.g., Tangney et al., 2004). In contrast to our expectations, general self-control strength did not moderate the relation between the needs and binge eating symptoms. This finding is inconsistent with previous studies that yielded indirect support for this moderation hypothesis (e.g., Schüler & Kuster, 2011; O’Connor et al., 2009). There are several possible explanations for these different results, both conceptually and methodologically. For instance, Schüler and Kuster used a cross-sectional design in their study and operationalized self-control strength through achievement motivation. Also, O’Connor et al. (2009) measured conscientiousness rather than self-control strength. Although achievement motivation and conscientiousness share some conceptual overlap with self-control strength, there also remain important conceptual and measurement differences. Future studies could shed more light on these contradictory results.

We investigated main and moderating effects of an emotional eating style in a rather explorative fashion. We found that people with an emotional eating style experienced more binge eating symptoms across days. Apart from this main effect, the daily association between need frustration and binge eating symptoms was stronger for women with an emotional eating style. This finding is in line with laboratory studies that demonstrated that negative affect causes disinhibited eating in participants with an emotional eating style (e.g., Loxton, et. al., 2011; study 1) and with the diary study of O’Conner et al. (2008). In the latter
study, it was found that emotional eating is the most pre- eminent individual characteristic to understand the associations between daily hassles and snacking behaviors.

The finding that emotional eating plays a moderating role suggests that the association between need frustrating experiences and binge eating symptoms is especially strong for women with a tendency to eat as a coping mechanism with negative feelings. This might suggest that the negative affect associated with need frustrating experiences can help explain the association between need frustration and binge eating symptoms. In other words, need frustrating experiences might be associated with binge eating symptoms because emotional eaters tend to indulge in overeating as a strategy to cope with negative feelings arising from need frustrating experiences. This is in line with some prevailing theories on binge eating, such as the escape-of-awareness theory (Heatherton & Baumeister, 1991) and expectancy theory (Hohlstein, Smith, & Atlas, 1998). Whereas the first theory states that binge eating can function as a mechanism to escape awareness after threatening experiences, the second theory states that binge eating is associated with negative affect because people believe that eating will reduce their negative feelings. Both theories suggest that binge eating is in fact a motivated attempt to deal with negative emotions. These ideas share some overlap with the more global hypothesis within SDT that need frustration will translate into ‘need substitutes’. The notion of need substitutes implies that, following need frustration, people try to re-establish fulfillment of their needs in a maladaptive and derivative way. Specifically, people may look for short-cuts that seem to provide immediate satisfaction but that, in reality, do not provide deep and long-lasting need satisfaction. Binge eating may represent one such derivative need substitute that people engage in after need frustrating experiences (see Verstuyf, Patrick, Vansteenkiste, & Teixeira, 2012).

**Limitations and Suggestions for Future Research**
Although our study has revealed several important findings, there are also some methodological and conceptual limitations. First, although we followed participants for 14 consecutive days, our analyses do not allow for conclusions about causality or direction of the effects within the day. Although we assume that need satisfying or frustrating experiences precede binge eating symptoms within a particular day, the opposite direction might be equally plausible. Second, although diary methods allow for investigating the dynamics involved in eating regulation in an ecologically valid way, experience-sampling studies allow for a closer observation of the sequence of within-day processes. In that case participants fill in the questionnaires at several random moments during the day, which strongly diminishes recall effects. Another limitation to the research design is that individuals may, to some extent, be reactive to the process of self-monitoring (e.g., Rutledge, Groesz, Linke, Woods, & Herbst, 2011). The fact that participants filled out a questionnaire about their eating behaviors each day, may have changed their eating behaviors and, thus, eating behaviors perhaps were not representative to their general eating behaviors. A third methodological limitation is that relatedness frustration had low reliabilities at some measurement times. Accordingly, we should be careful with our interpretation of these results. Further, all measures were self-reported. For some measures, such as weight and height, this way of collecting data can undermine validity. It is recommended for future research to build on the present findings by relying on observations and multi-informant assessments.

In addition to these methodological limitations, there are also some conceptual limitations. For instance, although we speculate that the associations between the psychological needs and eating behaviors can be accounted for by negative affect and depletion of energy, these specific mechanisms were not measured. It would be interesting to test these mediating path models in a within-person design. Also, all our participants were female adolescents or young adults. The inclusion of a broader age range might result in
different findings. Also, in light of the fact that men are also prone to binge eating symptoms (Goossens & Braet, 2010; Striegel-Moore et al., 2009), it is equally interesting to investigate whether experiences of need satisfaction and need frustration are implicated in men’s eating regulation. In addition to a broader age group and including both genders, it would be interesting to replicate this study in a clinical sample of eating disorder patients. A final conceptual limitation is our exclusive focus on binge eating behaviors. It would be interesting to investigate healthy eating behaviors in addition to unhealthy eating behaviors. Although need satisfaction was unrelated to binge eating symptoms, it may be implicated in one’s eating behaviors by its influence on healthy eating behaviors. Further, although the domain of eating regulation is relevant for many female youngsters, inclusion of other self-regulatory behaviors and contexts could have resulted in a broader picture of what is going on in the daily life of these youngsters. For instance, rather than experiencing binge eating symptoms, some youngsters might drink more alcohol or spend excessive time on the internet on need frustrating days.

**Clinical and Theoretical Implications of the Study**

Despite these limitations, we believe our study has some important theoretical and clinical implications. Our study has revealed that, in addition to between-person variation, there is considerable variation within persons in binge eating symptoms. Thus, a one-time measurement of people’s traits and eating behaviors is only a ‘snapshot’ of the dynamics in daily life, but fails to capture the entire film. Investigating the dynamics in eating regulation over time allows for including within-person predictors in addition relatively more stable trait-differences. Further, our study revealed that previously documented between-person associations between the psychological needs and eating behaviors also apply at the within-person level. Finally, our study indicated that especially women with an emotional eating style are vulnerable to experience binge eating symptoms on need frustrating days.
The finding that there is considerable within-person variability is also of major clinical importance. It indicates that, although there are stable differences between women, variability in eating patterns can be observed depending on other experiences throughout the day. Professionals who guide women in their attempts to regulate their eating behaviors can more thoroughly address the within-time fluctuations in problematic behaviors and improve skills to deal with the more difficult days. The associations between the psychological needs and eating regulation suggests that health care providers can help adolescents control their eating behaviors by increasing awareness about need frustrating experiences. For instance, when one is aware of need frustrating experiences, one could try to minimize or meaningfully integrate such experiences and find tools to cope with need frustrating experiences in a constructive rather than derivative fashion. Finally, our study suggests that it would be useful to target emotional eaters, as these adolescents in particular tend to lose control over eating on need frustrating days.
REFERENCES


### Table 1

<table>
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<th>Model 1</th>
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Note 1: * p < .05; ** p < .01; *** p < .001. Non significant random effects were excluded from the models.

Note 2: Random effects at the between-person level: $\mu_{ij}$ (amount of between-person variation), $\mu_{i1}$, $\mu_{i2}$ and $\mu_{i3}$ (amount of between-person variation in slopes predictor 1, 2 and 3), $\mu_{ij}\mu_{ij}$, $\mu_{ij}\mu_{ij}$ and $\mu_{ij}\mu_{ij}$ (covariation between intercept outcome and slopes predictors 1, 2 and 3 at the between-person level). Random effects at the within-person level: $\epsilon_{ij}$ (amount of within-person variation), $\epsilon_{ij}$, $\epsilon_{ij}$ and $\epsilon_{ij}$ (amount of within-person variation in slopes predictor 1, 2 and 3), $\epsilon_{ij}\epsilon_{ij}$, $\epsilon_{ij}\epsilon_{ij}$ and $\epsilon_{ij}\epsilon_{ij}$ (covariation between intercept outcome and slopes predictor 1, 2 and 3 at the within-person level).
Figure captions

Figure 1: Plot of Interaction Effect between Emotional Eating and Need Frustration in the Prediction of Binge Eating Symptoms
Figure 1: Plot of Interaction Effect between Emotional Eating and Need Frustration in the Prediction of Binge Eating Symptoms

- Low emotional eating style
- High emotional eating style

Need frustration

Binge eating

Low need frustration (-1 SD) vs. High need frustration (+1 SD)