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Momentary Associations Across Specific Affective States and Dysregulated Eating Experiences Among Children and Adolescents With Loss of Control Eating Symptoms

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ABSTRACT

Objective: Dysregulated eating is common among youth and is associated with trait-level negative affect and emotion regulation difficulties. Despite the transient nature of affect, momentary associations among affect and eating behavior are unclear, which limits development of more impactful treatment tools, such as "just-in-time" intervention approaches (JITAI). The current study ($N = 62$) drew from two ecological momentary assessment (EMA) studies involving children and adolescents who endorsed loss of control (LOC) eating symptoms during a two-week assessment period.

Method: Intensive time series network analysis tested concurrent and prospective relationships across six specific affective states (i.e., upset, guilty, scared, tired, excited, attentive) and four eating-related experiences (e.g., LOC, overeating, hunger, craving) in real time. Additionally, we repeated these models within demographic subgroups of the sample based on age, race, and sex.

Results: In the full-sample models, contemporaneously assessed guilt was associated with craving and LOC eating, and tiredness was associated with LOC eating. In the prospective analysis, tiredness was negatively predicted by LOC eating and positively predicted by overeating at the previous timepoint, and attentiveness positively predicted craving. Differences in affect-eating relationships were identified across teens and preteens as well as male and female participants.

Discussion: These results suggest that specific affective states are associated with dysregulated eating-related experiences in real time among youth, and associations may differ depending on demographic characteristics. Findings may be used to inform the development and tailoring of momentary interventions.

Summary

- Loss of control eating is a prevalent and impairing behavior during childhood and adolescence that has been linked to emotional states.
- Understanding what emotions contribute to engaging in loss of control eating or overeating in real time can help us predict and prevent this behavior.
- This study found that specific emotions, namely feeling guilty, tired, and attentive, were bidirectionally associated with dysregulated eating behaviors or urges throughout the day.

1 | Introduction

One of the most prevalent and impairing forms of disordered eating endorsed by adolescents is loss of control (LOC) eating, which is characterized by feeling out of control with respect to what or how much one is eating, regardless of the amount consumed (Goldschmidt 2017). In prior research, approximately one in four adolescents in community samples endorsed LOC eating, with rates rising to one in three among adolescents with higher weight (He, Cai, and Fan 2017; Schlüter et al. 2016). LOC eating is associated with eating-related psychopathology, excess weight gain, anxiety, and depression (Schlüter et al. 2016; Stojek et al. 2017; Tanofsky-Kraff et al. 2011). Most research on LOC eating has focused on trait-level onset and maintenance factors (Byrne, LeMay-Russell, and Tanofsky-Kraff 2019). However, these studies do not address why individuals may engage in LOC eating *sometimes*, but not other times, and what *momentary* factors may contribute to LOC eating. Emotions—including positive and negative affect—represent state-level, transient processes that may relate to LOC eating engagement among children and adolescents.

2 | Affect and LOC Eating

The bidirectional association between affect and LOC eating is well supported by the literature, such that many prior studies have found that LOC eating and binge eating are influenced by both positive (e.g., excited) and negative (e.g., sad) affective states among children and adolescents (Mikhail 2021; Ranzenhofer et al. 2014; Van Malderen et al. 2021). Additionally, dysregulated eating behaviors may contribute to heightened negative affect (e.g., guilt about eating) after the temporary relief, leading to a positive feedback loop between emotions and LOC eating episodes (Dingemans, Danner, and Parks 2017; Stevenson et al. 2018). However, most research examining these associations among younger individuals has used cross-sectional survey data collection or lab-based paradigms, which are subject to limitations (e.g., inability to capture directionality in cross-sectional surveys; lack of ecological validity in lab-based studies), thereby inhibiting our understanding of eating and emotions in real time. Given the transient and fluctuating nature of both emotions and eating-related symptoms, it is important to study these processes in real time in participants' naturalistic environments.

A few prior studies have paved the way for using ecological momentary assessment (EMA; assessment method collected in real-time in one's natural environment) to study how affect impacts LOC eating across time and contexts among children and adolescents. Overall, these studies did not find support for a link between negative affect and subsequent LOC eating episodes (Egbert et al. 2022; Goldschmidt et al. 2018; Hilbert et al. 2009; Parker et al. 2022b). However, EMA studies on LOC eating and negative affective states in adults have consistently found an association (Haedt-Matt and Keel 2011). Specifically, across studies of adults with LOC eating, negative affect was elevated on days with LOC eating episodes and temporarily reduced following dysregulated eating episodes (Berg et al. 2014, 2015; Goldschmidt et al. 2014; Stevenson et al. 2018; Wonderlich et al. 2022). There are several possible explanations for this discrepancy.

3 | Gaps in the Literature

First, a major limitation of EMA studies of dysregulated eating and affect in children and adolescents is that negative affect has been conceptualized broadly. Many unique emotional states comprise overall negative affect, such as fear, sadness, and shame, and these unique emotions may relate differentially to eating episodes. For example, past research in adults with eating disorders identified that some negative emotional states, such as guilt and shame, are more interconnected with eating disorder pathology, compared to other emotions (Berg et al. 2015; Wong et al. 2021). Considering these findings, adolescents may be more prone to engage in LOC eating when they feel particular emotions, compared to others. However, these nuanced associations may be missed when examining negative affect unidimensionally. Further, prior research suggests that sum scores for affect measures developed at the between-persons level may not retain validity at the within-persons level (Brose et al. 2020). Second, positive affective states were not included in these past studies. However, children often engage in LOC eating and overeating during times with heightened positive affect, such as at a birthday party (Tanofsky-Kraff et al. 2007).

Third, research in children has typically examined affect as an antecedent only, despite research in adults demonstrating that eating behaviors may also impact subsequent affect (e.g., Stevenson et al. 2018). Fourth, prior research has focused on eating *behavior* only; yet emotional states may also impact internal experiences known to increase risk for engaging in LOC eating, such as hunger and food craving. Specifically, hunger and craving are both associated with engaging in LOC eating, and temporally precede LOC eating episodes (e.g., Lowe et al. 2016; Verzijl et al. 2018). Thus, to better understand antecedents and consequences of LOC, we must leverage momentary insights into hunger and craving, which can improve prediction and preventative interventions. Overall, examining how facets of affect, rather than affect broadly, may bidirectionally relate to LOC eating-related experiences among children and adolescents can contextualize discrepancies in the

literature and inform assessment and intervention in high-risk moments.

4 | Sociodemographic Correlates

Finally, the associations between affective states and eating episodes may differ based on sociodemographic factors, such as age, sex, and race. For example, past research suggests that LOC eating is more prevalent and presents differently among post-pubertal adolescents, compared to preadolescents (Egbert et al. 2022; López-Gil et al. 2023; Vannucci et al. 2014). Additionally, sex and gender impact the prevalence of LOC eating and the association between LOC eating and emotion dysregulation (Hautala et al. 2008; López-Gil et al. 2023). Specifically, one study found that girls who engaged in LOC eating used less adaptive emotion regulation strategies compared to boys who endorsed LOC eating (Goossens et al. 2016). Further, preliminary research found Black adolescents had higher rates of binge eating and lower levels of distress related to dysregulated eating behaviors, compared to white peers (Lee-Winn et al. 2016). Thus, examining how the momentary associations across specific affective states and LOC eating-related experiences may differ among adolescents based on sex, age, and race, can provide insight into how to personalize interventions to better meet the needs of all individuals, especially children and adolescents with marginalized identities.

5 | Current Study Approach and Hypotheses

This exploratory study aimed to fill these gaps in the literature through examining momentary, bidirectional relations across discrete affective states (i.e., upset, guilty, scared, tired, excited, attentive) and LOC eating-related experiences (i.e., LOC, overeating, hunger, craving) among children and adolescents. Specifically, we examined concurrent and prospective associations among affective states and eating experiences 1) with all participants in the sample, and 2) in subgroups based on sex (male, female), age (preteens, teens), and racial identity (Black-identified, white-identified) using time-series network analysis. Network analysis is the ideal approach to answer the proposed research questions for a few reasons. First, this methodology creates partial correlation networks, allowing for the identification of unique relations between several items, while accounting for all other symptoms in the model. This approach creates opportunity for the exploration of several possible associations in one model while reducing risk for type I error (Lütkepohl 2005). Second, network analysis is equipped to examine associations between specific item-level constructs (e.g., unique affective states), in contrast to other methods, which assume the presence of a latent variable (e.g., negative affect broadly).

We hypothesized that both negative and positive affective states would be associated with prior (assessed contemporaneously) and later (lagged assessment of) eating experiences. However, given that past literature has primarily examined affect broadly, we did not make hypotheses regarding specific emotional states and eating experiences. Models comparing demographic subsamples are considered exploratory, and thus, we did not make any specific predictions regarding the nature of these differences. Instead, we hoped to elucidate potential dissimilarities related to demographic characteristics that can be further explored in future research.

6 | Methods

6.1 | Participants

The current study used existing data for 90 children and adolescents, aged 8–17 years, participating in one of two completed EMA studies to examine associations across momentary affect and LOC eating-related experiences. In addition to study-specific inclusion and exclusion criteria (see Table 2), inclusion criteria for the current project included: (1) having at least 20 timepoints of data that included self-report of an eating episode since the last check in, and (2) endorsing at least one LOC eating symptom (i.e., a score > 1 on the LOC eating items) during the EMA period. We did not exclude individuals with low, potentially subclinical, LOC symptom endorsement because we are interested in studying LOC eating on a continuum to better understand risk and inform prevention of this behavior. Additionally, we excluded participants with < 20 measurements to reduce the likelihood of biased estimates resulting from too few observations (Epskamp, Deserno, and Bringmann 2019). Twenty-eight participants did not meet these inclusion criteria, leaving $n = 62$ (68.9%) participants (1508 total observations; median = 26 observations per participant) in the current analyses and interpretation. See Table 1 for demographics and descriptive statistics for all participants in the current study.

6.2 | Procedures

This project used data from two EMA studies conducted by the same principal investigator. Procedures for each study were approved by their respective institutional review board(s) prior to data collection. Informed consent and assent were obtained prior to participation. Across both studies, participants completed 2 weeks of EMA surveys, which were sent directly to their personal mobile device or a loaned mobile device from the research team. EMA surveys were sent 3–5× per day on an interval-contingent schedule throughout the day, excluding during school hours. Specifically, participants typically received three prompts on schooldays and five on the weekends. Participants in Study 1 also were given the option to initiate event-contingent surveys following eating episodes. Both EMA surveys included identical overlapping items assessing affective states and eating behaviors. Participants were compensated $1 for each EMA survey completed. See Table 2 for detailed project information for each study.

6.3 | EMA Measures

Although the measures included in the EMA protocols varied by study, affective and eating items included in both studies are the focus of the current analyses. These items were drawn from valid and reliable instruments of affect and eating behavior used in prior research, as described below.

TABLE 1 | Demographics and descriptive statistics.

	Full sample ($N = 62$)	Study 1 ($n = 21$)	Study 2 ($n = 41$)
M (SD)			
Age	13.5 (2.7)	10.9 (2.0)	14.9 (2.0)
zBMI	1.88 (0.78)	2.07 (0.52)	2.04 (0.61)
Grade level	8.05 (2.8)	5.7 (2.1)	9.3 (2.4)
n (%)			
Sex			
Male	21 (33.9%)	9 (42.9%)	12 (29.3%)
Female	39 (62.9%)	12 (57.1%)	27 (65.9%)
Missing	2 (3.2%)	0 (0%)	2 (4.8%)
Race/ethnicity			
White	29 (46.8%)	2 (9.5%)	27 (65.9%)
Black	14 (22.6%)	14 (66.7%)	0 (0%)
Hispanic	6 (9.7%)	3 (14.3%)	3 (7.3%)
Asian/Pacific Islander	2 (3.2%)	1 (4.8%)	1 (2.4)
Native American/Hawaiian	2 (1.1%)	0 (0%)	2 (4.9%)
Multiple racial/ethnic identities	5 (8.1%)	0 (0%)	5 (12.2%)
Missing	4 (6.5%)	1 (4.8%)	3 (7.3%)
M (SD)			
EMA items			
Guilty	1.18 (0.6)	1.03 (0.3)	1.26 (0.7)
Upset	1.29 (0.7)	1.16 (0.6)	1.38 (0.8)
Tired	2.53 (1.4)	2.14 (1.4)	2.74 (1.4)
Scared	1.13 (0.5)	1.06 (0.4)	1.16 (0.5)
Attentive	2.00 (1.3)	1.65 (1.2)	2.18 (1.3)
Excited	2.49 (1.5)	2.48 (1.6)	2.49 (1.4)
Hunger	1.61 (1.1)	1.67 (1.2)	1.58 (1.0)
Craving	1.60 (1.1)	1.36 (1.0)	1.73 (1.1)
Overeating	1.67 (1.0)	1.26 (0.7)	1.89 (1.1)
LOC eating	4.42 (2.6)	3.63 (1.6)	4.84 (2.9)

Note: zBMI = body mass index for participants relative to age- and sex-matched children.

6.3.1 | Affect Items

Items from the Positive and Negative Affect Schedule (PANAS; Watson, Clark, and Tellegen 1988) were used to assess current affective state at each EMA timepoint. Each affect item was rated on a scale from 1 (not much or not at all) to 5 (a lot) to describe how participants felt *right now*. The PANAS has frequently been used in EMA studies to measure momentary affective states (Engel et al. 2013; Smyth et al. 2007). The PANAS has also been utilized in prior EMA studies involving children (Baltasar-Tello et al. 2018). The PANAS affective items *guilty, sleepy, upset, scared, attentive*, and *excited* were assessed across both studies and included in the current analyses. PANAS items were selected for the original parent studies to capture a broad range of emotional experiences (including both positive and negative affect), while minimizing burden on participants. Because this study is interested in how unique affective states relate to eating behaviors, we included individual PANAS items in the network models, as opposed to a sum score.

TABLE 2 | Parent study procedures and descriptives.

	Study 1	Study 2
Purpose	To characterize contextual factors impacting momentary eating behaviors among youth with higher weight	To test the association between working memory and eating behavior in real time among youth with higher weight and age matched controls
IRB approval	University of Chicago and Illinois Institute of Technology Institutional Review Boards	Lifespan Institutional Review Board
Sample size in current study	21	41
Original Sample size	41	49
Recruitment strategies	Community advertisements Referrals from healthcare providers Study contact lists	Community advertisements Referrals from healthcare providers Study contact lists
Timeframe of data collection	2015–2017	2019–2021
Location of data collection	Chicago, IL metro area	Providence, RI
Inclusion criteria	Age 8–14 Overweight/obesity (BMI > 85th percentile)	Age 10–17 Overweight/obesity ($n = 42$) Controls without overweight/obesity ($n = 7$)
Average EMA compliance	Parent study: 58.8% Current study: 65% (Range = 28%–96%)	Parent study: 71% Current study: 63% (Range = 19%–95%)
Exclusion criteria	Medical conditions impacting eating/weight Medications impacting eating/weight Eating disorder other than BED Currently in weight-management treatment	Medical conditions impacting eating, weight, or executive functioning Medications impacting eating/weight Eating disorder other than BED Currently in weight-management treatment WASI score of borderline or lower
EMA survey administration	Event-contingent (following meals) and time contingent (Pinged 3–5x semi-random intervals throughout the day outside of school hours)	Time contingent (Pinged 4-5x semi-random intervals throughout the day outside of school hours)
Additional ambulatory assessment	N/A	Working memory task at three daily timepoints
Duration of baseline EMA	2 weeks	2 weeks
Compensation	$1 for every EMA survey completed	$1 for every EMA survey completed
Source for additional information	Goldschmidt et al. (2018)	Goldschmidt et al. (2024)

Note: BMI = body mass index; BED = binge eating disorder; WASI = Wechsler Abbreviate Scale of Intelligence.

6.3.2 | Eating-Related Items

Participants answered questions related to hunger (*I am hungry*), craving (*I am craving food*), and overeating (*To what extent do you feel that you overate [during the last eating episode]?*). These items were previously used in several EMA studies on LOC eating (Goldschmidt et al. 2014, 2018, 2024). Three questions adapted from the Eating Disorder Examination (Fairburn and Beglin 1994) were utilized to measure LOC eating: *did you feel a sense of loss of control?*, *did you feel that you could not stop eating once you had started?*, and *did you feel like a car without brakes, you just kept eating and eating?*. The three assessed LOC items were summed to create a total LOC eating score; internal consistency for these three items was excellent (Mcdonald's $\omega = 0.94$). Hunger, craving, overeating, and LOC eating items were all measured on a scale from 1 (not at all) to 5 (a lot).

6.4 | Transparency and Openness

The study aims, hypotheses, and statistical analyses plan were not formally preregistered. The R code for the models is included in the supplemental materials. Deidentified data, measures, and other study materials are available upon request from the senior author. We report all data exclusions, all manipulations, and all measures in the study.

6.5 | Data Analytic Procedure

LOC eating and overeating items were only assessed at timepoints in which participants endorsed having eaten since the last timepoint; timepoints in which participants did not endorse an eating episode were deleted listwise. The remaining missing data were imputed with a Kalman smoothing filter, using the *impute* TS package in R (Moritz and Bartz-Beielstein 2017). Less than 0.1% of data were imputed. Multi-level vector autoregressive analyses (VAR; i.e., time series network analyses) were used to estimate group-level models of affective states and eating-related phenomena using the *mlVAR* package in R (Epskamp, Deserno, and Bringmann 2019). VAR models calculate unique partial correlations (i.e., edges) between several variables (i.e., nodes) measured using intensive longitudinal data collection. A time-series network approach was chosen for this research question, as opposed to longitudinal SEM approaches, as VAR models allow for the exploration of multiple associations, while reducing the likelihood for Type I error through accounting for multilevel and temporal dependencies, estimating permutations (2000 iterations per model), and using shrinkage techniques. Additionally, VAR models are designed to handle item-level data, allowing us to explore the role of specific affective states, rather than affect broadly.

mlVAR was used to estimate temporal (i.e., directed network indicating unique time-lagged associations) and contemporaneous (i.e., undirected partial correlation network within one window of measurement) models (Epskamp et al. 2018; Epskamp, Deserno, and Bringmann 2019). Temporal models in this study examined a lag of one, meaning these models tested bidirectional associations from one EMA timepoint to the next, typically a few hours later. Temporal models do not include lagged associations that may occur overnight; thus days with only one survey were removed from lagged analyses. Although contemporaneous models detect associations from a single measurement window, due to the phrasing of questions (i.e., eating *since the last timepoint* vs. emotions *right now*), eating episodes often preceded affective states in these models. The average time delay between an eating episode and its subsequent EMA assessment was 51 min. This study is specifically interested in "bridge edges," which are associations *across*, rather than within, clusters (i.e., affective states and eating experiences). Bridge edges that were significant at $p < 0.05$ are included in the models.

We first examined associations in the full sample ($N = 62$; 1508 contemporaneous observations; 1252 lagged observations). As a secondary, exploratory aim, we also replicated these analyses in demographic subgroups of the sample based on age, sex, and ethnicity. The *mnet* package was used to statistically test for differences between networks for male and female, teen and preteen, and Black and white participants (Haslbeck, Epskamp, and Waldorp 2023). Specifically, we ran models with participants in the sample that identified as preteen (8–12; $n = 22$; observations = 537) and teen (13–17; $n = 40$; observations = 972); female ($n = 40$; observations = 989) and male ($n = 21$; observations = 479). Unfortunately, when estimating difference tests among white ($n = 31$; observations = 752), and Black ($n = 16$; observations = 365) participants, we were unable to achieve a stable difference test, which is likely due to the small n and low variability for some symptoms in the Black participant network.

7 | Results

7.1 | Overall Sample Network

See Figure 1 for visual depictions of the models in the full sample. In the contemporaneous assessment model, *LOC eating* was associated with *feeling guilty* ($r_{partial} = 0.10$) and *feeling tired* ($r_{partial} = 0.06$). *Craving* was also positively associated with *feeling guilty* ($r_{partial} = 0.06$).

In the lagged model, *overeating* was prospectively positively associated with *feeling tired* ($r_{partial} = 0.10$), *LOC eating* was prospectively negatively associated with *feeling tired* ($r_{partial} = -0.09$), and feeling *attentive* was prospectively positively associated with elevated *food craving* ($r_{partial} = 0.08$) at the next timepoint.

7.2 | Demographic Subsample Networks

Regarding contemporaneously-assessed network models for participants identifying as male versus female, the association between *overeating* and *feeling upset* was more strongly positive among female participants, compared to male participants ($\Delta = 0.19$; $p = 0.012$). Temporally, positive prospective associations between *feeling guilty* and *LOC eating* ($\Delta = 0.21$; $p = 0.029$) and negative prospective associations between *overeating* and *feeling scared* ($\Delta = 0.28$; $p = 0.032$) were stronger in the male versus female network. Male and female networks and network differences, with all edge values, are visualized in Figure 2.

Contemporaneously, preteens exhibited stronger associations between affective states and LOC eating experiences compared to teens, including the associations between *LOC eating* and *feeling tired* ($\Delta = 0.26$; $p = 0.037$), *hunger* and *feeling scared* ($\Delta = 0.21$; $p = 0.016$), and *food craving* and *feeling scared* ($\Delta = 0.28$; $p = 0.022$), and *feeling attentive* ($\Delta = 0.15$; $p = 0.032$). Temporally, the positive prospective associations between *food craving* and *feeling upset* ($\Delta = 0.27$; $p = 0.019$), and *feeling upset* and *overeating* ($\Delta = 0.16$; $p = 0.025$), were both stronger in the preteen network, compared to the teen network. Preteen and teen networks and network differences are visualized in Figure 3.

8 | Discussion

The current exploratory study investigated associations across specific affective states and LOC eating-related experiences in

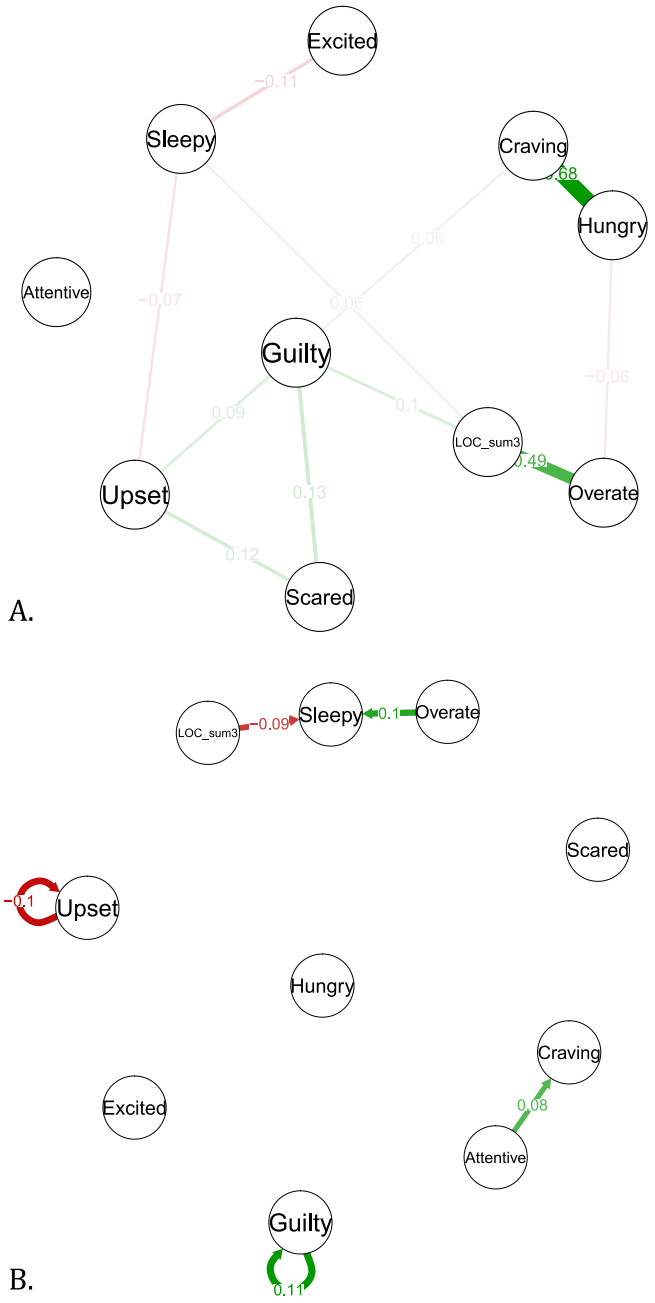

FIGURE 1 | Full sample (A) contemporaneously-assessed and (B) temporal networks. Green lines represent positive partial correlations, red lines represent negative partial correlations. The thickness and shading of the line corresponds to the strength of the association, and the number on the line is the partial correlation coefficient. Lines with arrows in the temporal network are partial directed correlations; lines without arrows in the contemporaneous network are partial contemporaneous correlations.

near real time among children and adolescents and explored differences across sex, age, and race. Overall, feeling tired and feeling guilty were associated with LOC eating since the last timepoint, and guilt was also associated with food craving. Prospectively, feeling tired was positively predicted by overeating and negatively predicted by LOC eating, and attentiveness predicted future craving. These preliminary findings provide support for specific affective states that may be important to assess and intervene on to disrupt the cycle across affect and dysregulated eating episodes. Additionally, differences were identified in the exploratory models based on age and sex, which may provide insight into how intervention targets may be tailored for children and adolescents based on demographic characteristics.

8.1 | Contemporaneously-Assessed Models

The contemporaneously-assessed models are important to interpret within the context of the EMA sampling strategy. Specifically, at each EMA timepoint, participants reported on their *most recent* eating episode (on average 51 min prior to the EMA assessment) and *current* affect. Thus, although the data were collected concurrently, eating episodes preceded affective states. In these models, guilt was associated with LOC eating and craving. Specifically, guilt may be higher in the minutes and hours after a LOC eating episode. This finding is consistent with prior research in adults supporting that guilt is an important emotion that is often elevated preceding and following LOC eating (Parker et al. 2022b; Stevenson et al. 2018; Wong et al. 2021). Guilt's association with food craving also may be reflective of the theorized reinforcing cycle between affect and LOC eating, such that guilt may contribute to higher levels of food craving after a recent eating episode (Schaefer et al. 2023). However, it is important to explore the real-world clinical utility of these associations, especially given the small effect sizes. For example, does intervening on guilt lead to reductions in LOC eating?

These findings also raise the importance of time in studying emotions and eating behaviors, as the associations across emotions and LOC eating likely change over short periods of time. Specifically, overeating and LOC eating are conceptualized as maladaptive coping strategies, and may temporarily numb or distract from uncomfortable emotions. However, negative affective states may intensify with increasing time after the episode (e.g., feeling guilt about what or how much one ate). Future research should empirically test associations across eating and affect at varying intervals to establish the optimal timeframe for measuring these associations to inform momentary interventions. Relatedly, the requirement of eating since the last EMA timepoint may have led to lower overall ratings of hunger and craving in our models, as one would expect both hunger and craving would be highest after *longer* periods of not eating. As suggested during peer review, we estimated associations across affective states, hunger, and craving at all timepoints (including non-eating timepoints; included in the supplemental materials). These models identified associations between craving and guilt, but hunger was not associated with any affective states, consistent with our primary models. Testing the relations across hunger, craving, and affective states specifically during periods of restriction or fasting remains an interesting future research question.

8.2 | Temporal Models

There were several associations among negative affective states and LOC eating-related experiences across the course of hours. The size of these correlations ranged from 0.09 to 0.11, which are similar to other studies that have tested

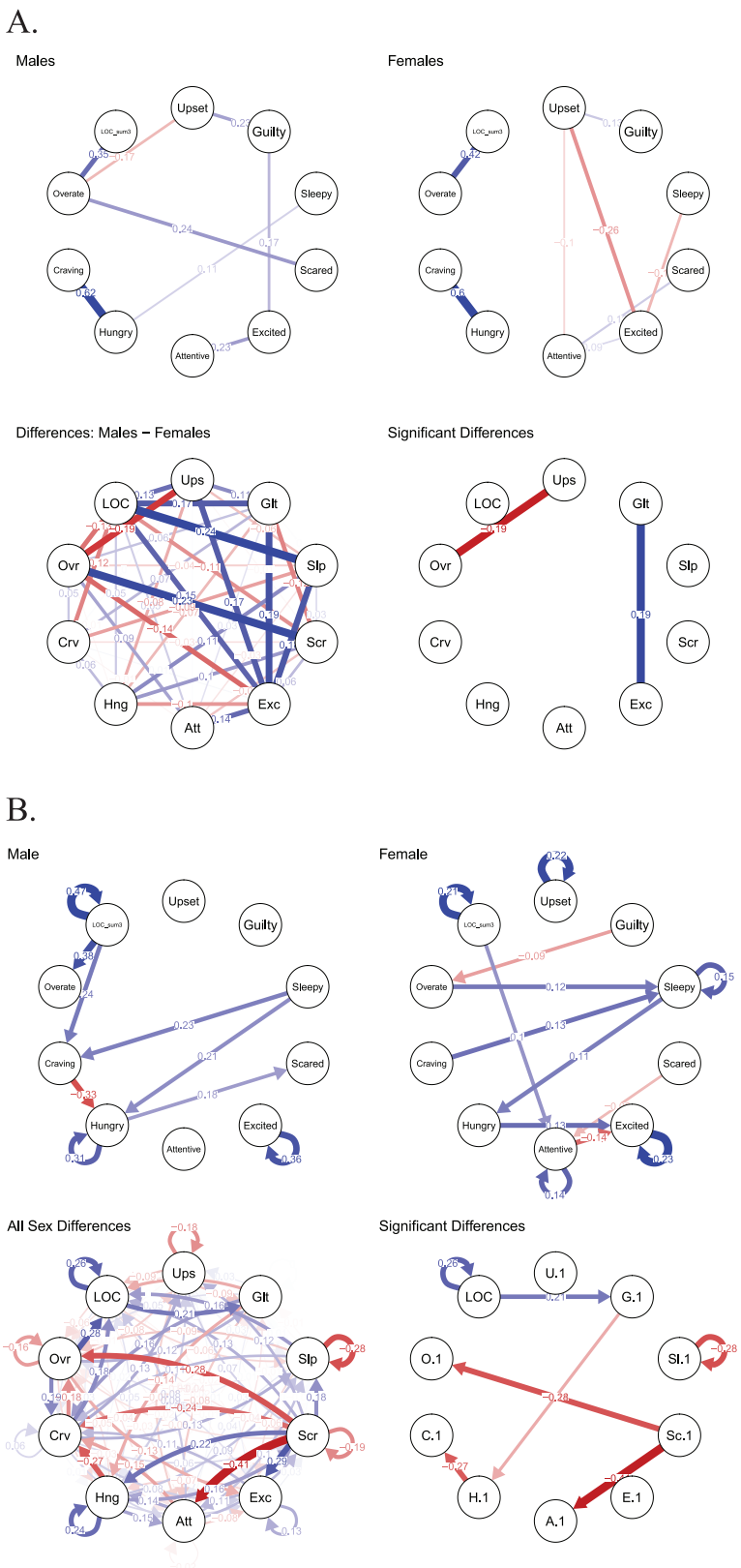

FIGURE 2 | Networks differences across male and female subsamples. (A) Contemporaneously-Assessed. (B) Temporal. LOC and LOC_sum3 = loss of control eating, Ovr and O.1 = overeating, Ups and U.1 = upset, Glt and G.1 = guilt, Sl.1 and Slp = sleepiness, Scr and Sc.1 = scared, Exc and E.1 = excited, Att and A.1 = attentiveness, Hng and H.1 = hungry, Crv and C.1. = craving.

temporal associations across eating disorder-related symptoms and affective processes using VAR modeling (Christian et al. 2023, 2024; Levinson et al. 2020, 2022). One interesting finding from these models is the positive prospective association between overeating and feeling tired and the negative prospective association between LOC eating and feeling tired.

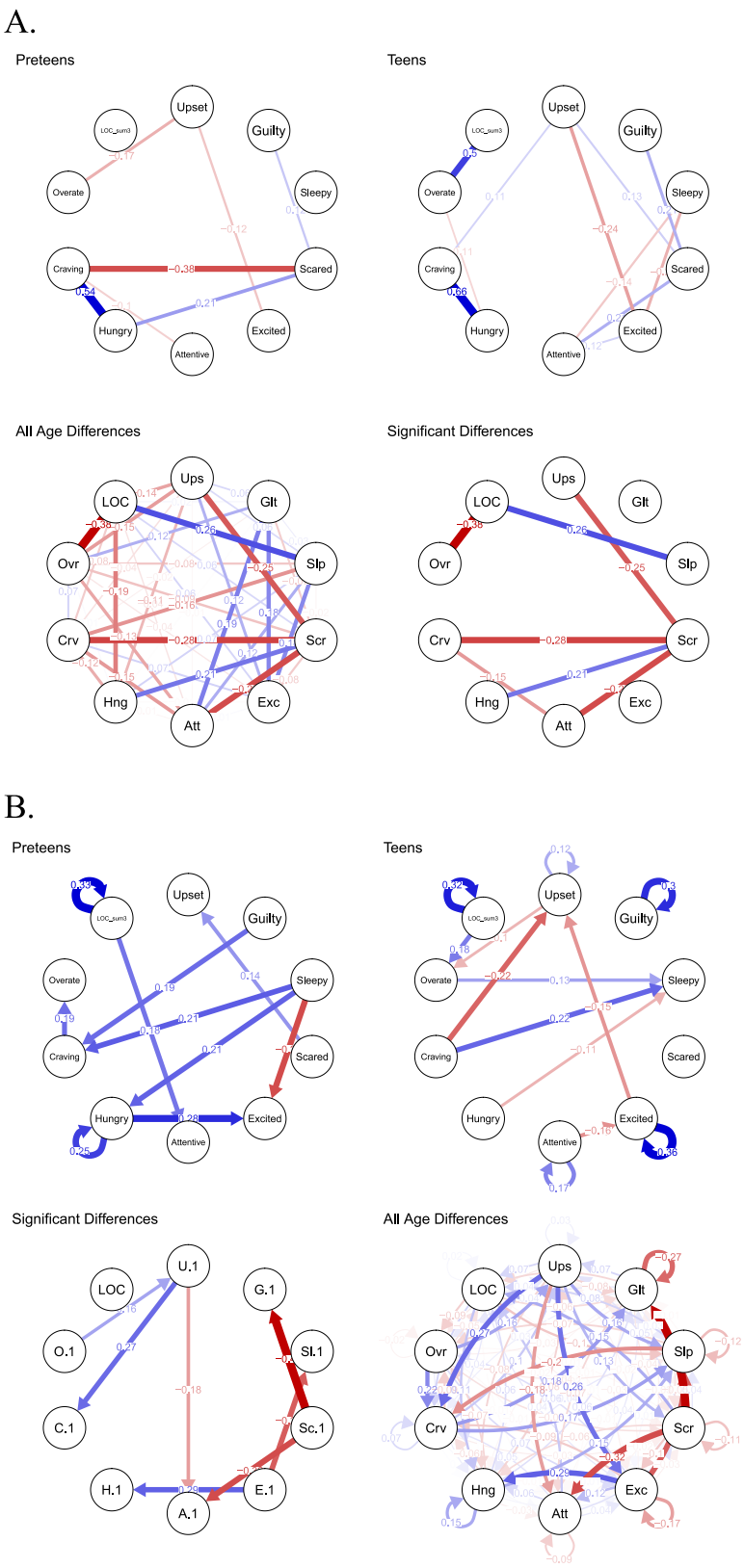

FIGURE 3 | Networks differences across preteen and teenage subsamples. (A) Contemporaneously-Assessed. (B) Temporal. LOC and LOC_sum3 = loss of control eating, Ovr and O.1 = overeating, Ups and U.1 = upset, Glt and G.1 = guilt, Sl.1 and Slp = sleepiness, Scr and Sc.1 = scared, Exc and E.1 = excited, Att and A.1 = attentiveness, Hng and H.1 = hungry, Crv and C.1. = craving.

Overeating predicting tiredness is consistent with research suggesting that hyperglycemic spikes following overeating are associated with fatigue and lethargy (Inchauspe 2022). However, the presence of a sense of LOC during an eating episode may have a contrary impact on sleepiness, potentially making it more difficult to fall asleep. The mechanism

underlying this association is unknown from this study, but it is possible that rumination or distress following LOC could play a role. Promotion of adequate sleep may be an intervention target to help break this cycle and reduce maladaptive eating episodes in children and adolescents (Hart et al. 2022; Parker et al. 2022a). Additionally, feeling attentive was associated with increased food craving at the following timepoint. This finding may suggest that attentiveness to one's environment, including to interoceptive cues, may lead to the awareness and reporting of food craving. However, more research is needed to understand the function of attentiveness in this context, as well as if this association is related to maladaptive eating behaviors.

8.3 | Demographic Differences

Despite identifying overall trends in how emotions may relate to LOC eating in real time, there were differences among demographic subsamples of participants. For example, male participants had a negative association between overeating and feeling upset, which was not found in female participants. This difference could be influenced by differential socialization among children and adolescents identified as boys and girls. For example, diet culture messaging to young girls emphasizes the value of thinness and exercising control over eating, whereas messaging to young boys values muscularity and growing larger, leading to different emotional responses to overeating (McCreary and Sasse 2000). Additionally, difference tests based on age group evidenced stronger associations between negative affective states and dysregulated eating experiences in children and preteens, compared to teens. If replicated, this finding may suggest that younger children and preadolescents lack emotional intelligence and regulation skills, increasing susceptibility to engaging in dysregulated eating when experiencing heightened affective states. These two examples illustrate that the function and consequences of emotions and LOC eating may differ among demographic subgroups. If these findings replicate in a larger sample, future research should explore *why* these associations differ and how we can more effectively intervene on symptoms based on unique, intersecting identities.

8.4 | Implications

This study adds insight into potential approaches for the prevention and treatment of LOC eating; primarily how specific affective states and emotion-regulation can be targeted to improve interventions. Knowledge of these direct associations might help with the prevention of maladaptive eating behaviors through promoting skills for better regulating specific emotions that are related to dysregulated eating, such as guilt and tiredness. This idea can also be employed through just-in-time adaptive interventions (JITAIs; interventions designed to provide in-the-moment support tailored to the individual and context). For example, pilot research has tested the development of a JITAI to improve real-time skill utilization and reduce disordered eating among individuals with bulimia nervosa, and found that this intervention is feasible and acceptable to patients (Juarascio et al. 2021). JITAIs for overeating or LOC eating could be enhanced by assessing specific affective states and employing momentary interventions aimed at improving emotion regulation in the moment. However, it is notable that our findings do not provide insight into the causality of these associations, so future research is needed to determine if manipulating or intervening on affect does in fact alter subsequent eating behavior.

8.5 | Limitations

This study is not without limitations. First, this is an exploratory study with a small sample size, which prevented us from being able to test differences among racial subgroups. Second, although there are strengths to having a large and geographically heterogeneous sample, there are differences between the two samples with regards to location and period of data collection (e.g., the COVID-19 pandemic overlapped with data collection for Study 2), which may limit the generalizability of our findings. Third, these data are inherently limited by their self-report nature and participant compliance. For example, younger children in the sample may have less capacity to distinguish between emotional states and interoceptive sensations like hunger and craving. Relatedly, because data were not collected during the school day, we do not know how these associations would change if we assessed eating and emotions at school. Fourth, there were limitations related to defining and grouping participants based on demographic characteristics. Specifically, there was not a consistent measure of pubertal development across both studies, so an arbitrary age cut-off was used, and may not perfectly align with stage of development. Additionally, the datasets used in this study did not measure gender on a continuum, but instead assessed biological sex as a binary variable. Children and adolescents with minoritized gender identities (e.g., transgender and/or nonbinary gender identities) may have unique concerns related to affect and LOC eating, which necessitates future research. Finally, these models are limited by the variables included; not all potentially important affective states or facets of LOC eating were included in our models.

8.6 | Future Directions

First, given the relatively small sample size and exploratory nature of this work, this study should be replicated in a large, heterogeneous sample of children and adolescents endorsing LOC eating symptoms. Conversely, beyond exploring group-level trends, testing idiographic models of affect and emotions could be informative for understanding heterogeneity and adapting clinical care at the individual level. Second, future research should extend these findings by examining a broader range of affective states and facets of affect, such as emotional lability or biomarkers of emotions, to gain a more comprehensive understanding of how momentary affect relates to dysregulated eating. Third, experimental studies should also be conducted to determine the presence and direction of *causal* associations across affective states and eating behaviors. Finally, it is important to test the translation of these findings into interventions targeting affect to improve dysregulated eating behaviors, such as the development of digital interventions or apps for real-time assessment

and prediction. Such models could utilize EMA methods, such as the data used in this study, to better assess and predict LOC eating episodes at vulnerable moments and contexts.

Author Contributions

Caroline Christian: conceptualization, formal analysis, writing – original draft, writing – review and editing. **Victoria Bell:** writing – original draft, writing – review and editing. **J. Graham Thomas:** data curation, writing – review and editing. **Alissa A. Haedt-Matt:** data curation, writing – review and editing. **Scott G. Engel:** data curation, writing – review and editing. **Chantelle N. Hart:** data curation, writing – review and editing. **Jared M. Saletin:** data curation, writing – review and editing. **Stephanie P. Goldstein:** data curation, writing – review and editing. **Claire E. Cusack:** formal analysis, visualization, writing – review and editing. **Andrea B. Goldschmidt:** conceptualization, data curation, supervision, writing – review and editing.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Transparency and Openness: The study aims, hypotheses, and statistical analyses plan were not formally preregistered. The R code for the models is included in the supplemental materials. Deidentified data, measures, and other study materials are available upon request from the senior author. We report all data exclusions, all manipulations, and all measures in the study.

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Supporting Information

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