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"I will fast … tomorrow": Intentions to restrict eating and actual restriction in daily life and their person-level predictors

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ABSTRACT

Objective: Dietary restraint is a common, yet controversial practice to tackle overweight. Yet, despite good intentions to reduce food intake, most restraint-based diets fail to produce long term weight loss. A better understanding of the naturalistic course of daily dieting intentions and their effectiveness in guiding subsequent eating behavior are therefore needed.

Method: In two studies, participants (n = 49 and n = 59) reported both their state intention to restrict eating on the next day, as well as their actual restriction on that day via smartphone-based evening reports of 12 and 10 days, respectively. *Intention-behavior gap* scores were calculated as differences between intention at t1 (e.g. evening intention Monday for restriction Tuesday) and restriction at t2 (evening report of actual restraint on Tuesday). Restriction-related trait questionnaires served as predictors of general intention or restriction level, whereas several trait-level disinhibiting eating style questionnaires served as predictors for intention-behavior gaps (difference scores).

Results: Daily intentions to restrict were rated higher than the daily actual restrictive behavior. Participants with higher scores on restriction-related questionnaires (restrained eating, dieting, lower intuitive eating) showed higher levels of daily state intention and restriction. Larger state intention-behavior gaps, by contrast, were seen in participants scoring high on trait-level disinhibiting eating styles (emotional eating, stress eating and food craving).

Discussion: The results point to potential risk factors of diet failure in everyday life: emotional, stress eating, and food craving are disinhibiting traits that seem to increase intention-behavior gaps. These findings can inform individualized weight-loss interventions: individuals with disinhibiting traits might need additional guidance to avoid potentially frustrating diet failures.

1. Introduction

Prevalence rate of obesity and overweight has risen dramatically over the last three decades, resulting in a global pandemic (Ng et al., 2014). Obesity comes with several physical (e.g., diabetes, cardiovascular diseases) and psychological impairments (e.g., higher depression rates, lower self-esteem) (e.g., Murphy et al., 2006; Reilly et al., 2003; Wyatt, Winters, & Dubbert, 2006) and can be a result of higher energy intake relative to energy expenditure. At the same time approximately 30–50% of adults are trying to lose weight or tried to control weight within the past year (e.g., Kruger, Galuska, Serdula, & Jones, 2004; Weiss, Galuska, Khan, & Serdula, 2006). Successful weight loss and long-term maintenance of lower body weight is difficult, however, with many dieters failing to maintain their weight and even regaining more weight (Mann et al., 2007). Controversially debated, dietary restraint may involve both helpful (e.g., reduction of binge eating and bulimic symptoms) and harmful effects (e.g., predictor of eating pathology with an increase in binge eating and bulimic symptoms) in eating disordered as well as healthy individuals, partially driven by varying definitions or assessments (e.g., Johnson, Pratt, & Wardle, 2012; Schaumberg, Anderson, Anderson, Reilly, & Gorrell, 2016; Stice, Sysko, Roberto, & Allison, 2010).

1.1. Several measures of dietary control: measures of intention or behavior?

Typical psychometric restrained eating measures ask about behaviors related to meal skipping, compensation for larger meals and calorie-conscientious food choice. These questionnaires have shown some

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external validity in relation to actual behaviors (e.g., Rodgers, Fuller-Tyszkiewicz, Holmes, Skouteris, & Broadbent, 2018). Yet, there are also negative results: A series of studies showed that measures assessing dietary restraint do not relate to actual caloric intake either in the laboratory or in daily life (e.g., Stice, Cooper, Schoeller, Tappe, & Lowe, 2007; Stice, Fisher, & Lowe, 2004; Stice et al., 2010; but see Van Strien, Engels, van Staveren, & Herman, 2006; for a contrary view). This would suggest that restrained eating questionnaires tap more into an *intention* to restrict than into actual restrictive *behavior*. Consequently, some effort goes into differentiating dietary restraint into intention and behavior in existing scales (Larsen, van Strien, Eisinga, Herman, & Engels, 2007), whereas other initiatives go toward developing new measures that directly assess dieting intentions as proxies of future dieting without actual behavioral components (Cruwys, Platow, Rieger, & Byrne, 2013). In addition, measures differentiating between successful and unsuccessful weight control, such as the Perceived Self-Regulatory Success in Dieting (Fishbach, Friedman, & Kruglanski, 2003; Meule, Papies, & Kübler, 2012) have been proposed. In sum, the relationship of various measures of dietary restriction with intentions vs. actual behavior remains equivocal.

1.2. Intention-behavior gaps

Intentions and their relationships with behavior have also been studied intensively in several general theoretical models of behavior change. Within one of the most influential models, the Theory of Planned Behavior (Ajzen, 1991), intention emerges as the best predictor of actual behavior among other predictive factors such as social norms and attitudes. The theory has been applied to a range of food-related behaviors like healthy or restrained eating, showing that the intention to perform these eating behaviors in fact significantly predicts actual behavior (McDermott et al., 2015; Riebl et al., 2015). Yet, a systematic review by McEachan, Conner, Taylor, and Lawton (2011) showed that all factors of the theory combined still only explain 21.2% of dietary behavior, and thus other factors might be needed. The fact that behavior often fails to follow intentions has been termed *intention-behavior gap*, and such gaps have been documented across a range of health-related behaviors (Sheeran, 2002). In addition, as mentioned above, the high prevalence of failed diets document the variability in success of dietary restraint.

1.3. Disinhibiting traits and their relationship with intention-behavior gaps

So why is successful food intake restriction so hard to achieve for some individuals, whereas others succeed? Individuals with dietary restraint tendencies are vulnerable to *disinhibition*, referring to a breakdown of cognitive control that leads to subsequent overeating (Polivy & Herman, 1985). Cognitive control in restrained individuals can be compromised by various events like the occurrence of stress and negative emotions (e.g., Heatherton, Striepe, & Wittenberg, 1998; Wardle, Steptoe, Oliver, & Lipsey, 2000), alcohol consumption (Polivy & Herman, 1976) or social factors (presence of others who overeat, or minor dietary violations; Herman & Mack, 1975; Herman, Polivy, & Esses, 1987). These disinhibiting conditions might point to the presence of other disadvantageous trait eating styles that co-occur in restrained eaters: *Emotional eating* refers to the trait of eating in response to negative affect (e.g., van Strien, Frijters, Bergers, & Defares, 1986) whereas *stress eating* refers to changes in eating behavior in response to stress (e.g., Meule, Reichenberger, & Blechert, 2018). Both eating styles are believed to make an individual vulnerable to food intake under emotional/stressful circumstances and can thus be related to as disinhibiting eating styles. In addition, *external eating* refers to the trait of eating in response to food cues like its sight or smell (van Strien et al., 1986) and previous research showed that restrained eaters increased food consumption when exposed to tasty food cues (e.g., Fedoroff, Polivy, & Herman, 1997; 2003; Jansen & van den Hout, 1991). Another eating style associated with disinhibition is *food craving,* defined as an intense desire or urge to consume specific foods (Hill, 2007). Restrained eating and food caving are positively correlated (e.g., Massey & Hill, 2012; Polivy, Coleman, & Herman, 2005) possibly because restrained eaters deprive themselves of certain 'forbidden' food types (Massey & Hill, 2012), which may predispose them for episodes of stronger food cravings and resultant disinhibition and overeating (Massey & Hill, 2012; Polivy, 1996; Polivy et al., 2005; Richard, Meule, Friese, & Blechert, 2017). Moreover, food cravings are also elevated in unsuccessful compared to successful dieters (Meule, Lutz, Vögele, & Kübler, 2012; Meule, Papies, et al., 2012).

1.4. Measuring intention-behavior gaps using ecological momentary assessment

From a methodological standpoint dietary restraint research has mainly relied on retrospective self-report and experimental studies. However, questionnaire-based self-report often suffers from memory biases (Shiffman, Stone, & Hufford, 2008), among other concerns. On the other hand, eating behavior (i.e. overeating) in the laboratory is often inhibited compared to daily life (Robinson, Hardman, Halford, & Jones, 2015) and this might affect restrained eaters in particular (Tomiyama, Moskovich, Haltom, Ju, & Mann, 2009). Intentions to restrict and their impact on behavior likely vary on a day-to-day basis, making it difficult to assess retrospectively and in aggregation across weeks. Hence the current study assessed the intention to restrict and the actual restrictive behavior repeatedly across several days using ecological momentary assessment (EMA).

1.5. The present research: linking EMA-based intention-behavior gaps with restriction-related and disinhibiting traits

Thus, the present study used the intention-behavior framework, realized with day-level EMA questions, and tested the relationship of these EMA measures with questionnaire measures of restriction-related eating styles on the one hand and with disinhibiting eating styles on the other. *Aim 1* assessed whether EMA measures of a) daily restrictive behavior and b) daily intention to restrict, were related to questionnaire based restriction-related eating styles (i.e. cross validation of EMA data and psychometric measures). We expected that dieting status and higher trait restrained eating style would relate to higher EMA measures of daily restrictive behavior and intention to restrict whereas higher perceived self-regulatory success in dieting would related to lower daily restrictive behavior and intention to restrict. In addition, *intuitive eating*, defined as eating in response to physiological hunger and satiety cues, can be seen as a counterpart of dietary restraint. Thus, we used intuitive eating as further validation of dietary restraint by expecting that higher intuitive eating would relate to lower restrictive behavior and intention to restrict. *Aim 2* investigated EMA measures of intention-behavior gaps (i.e. deviation of the restrictive behavior from previous intention to restrict) in relation to questionnaire based disinhibiting eating styles and thus asked who would be more or less successful in realizing ones' intentions. We expected that higher stress eating, emotional and external eating as well as food craving would relate to higher intention-behavior gaps. In addition, we modelled related eating styles (restriction-related versus disinhibiting eating styles) concurrently to determine which questionnaire measure would emerge as the strongest predictor for daily EMA measures. Several auxiliary analyses tested for the role of covariates such as body-mass-index (BMI), gender and age and for relationships between the two groups of questionnaires. To enhance generalizability of findings, a two-study design in two independent samples was used.

2. Study 1

2.1. Method

2.1.1. Participants[1]

Participants were recruited via a student mailing list at the university, flyer and word of mouth into a study of "eating, stress, emotions and daily activities via smartphone". Fifty-three participants partook in exchange for course credit or compliance dependent payment (30–50 €). Four individuals were excluded because of overall low compliance or low compliance at the end-of-the-day questionnaire (< 50%). The resulting 49 individuals (67% female) had a mean age of $M = 23.4$ ($SD = 2.56$) and a mean BMI of 22.0 kg/m^2 ($SD = 3.28$ kg/m^2; range 16.6–34.9 kg/m^2). Participants were mostly students (96%), with German (67%) or Austrian (31%) citizenship and a mean of $M = 15.9$ ($SD = 2.36$) years of education. They signed an informed consent form approved by the ethics committee of the University of Salzburg.

2.1.2. Questionnaires – restriction-related and disinhibiting eating styles

To assess higher *restriction-related* eating we applied various questionnaires: a) a dieting question, identifying individuals who are actually dieting, and b) the Dutch Eating Behavior Questionnaire - Restrained subscale, characterizing individuals with a rather cognitive intention to restrict food intake. Complementing these two – with opposite polarity – we applied c) the Perceived Self-Regulatory Success in Dieting scale, identifying successful dieters, and d) the Intuitive Eating Scale, identifying individuals who are not deliberately restricting their food intake but rather eat according to homeostatic energy deficits. To capture the full range of restrained eating no restrictions were set in this regard. *Disinhibiting eating styles* were obtained by the Dutch Eating Questionnaire – Emotional and External subscale, the Salzburg Stress Eating Scale and the Food Craving Questionnaire – Trait – reduced, based on the revised literature above. Correlations between questionnaires are reported in Table 1.

2.1.2.1. Dieting. Current dieting was assessed by asking participants: "Are you currently deliberately restricting your food intake to change your shape or weight (e.g., by trying to eat less or avoiding specific food types)?" answered 'Yes/No' (Yes = 1; No = 0). Twenty out of 49 participants answered 'Yes'.

2.1.2.2. Perceived self-regulatory success in dieting (PSRS). The PSRS (Meule, Papies, et al., 2012) assesses how successful individuals are in watching their weight, in losing weight, and how difficult it is for them to stay in shape. The three items are scaled from 1 (*not successful/not difficult*) to 7 (*very successful/very difficult*) and sum scores are calculated after reversing one item. Thus, higher values indicate higher perceived self-regulatory success in weight regulation. Internal consistency was $\alpha = 0.67$.

2.1.2.3. Intuitive Eating Scale (IES). The IES (Tylka, 2006) assesses intuitive eating behavior (i.e. eating in response to physiological hunger and satiety cues) with 21 items. Its items are scaled from 1 (*strongly disagree*) to 5 (*strongly agree*) and averaged scores are calculated after recording reversed items. Although three different subscales can also be calculated, we used the total score. Hence, higher values represent higher intuitive eating. Internal consistency was $\alpha = 0.88$.

2.1.2.4. Dutch Eating Behavior Questionnaire (DEBQ). The DEBQ (current study used the German version of Grunert, 1989; van Strien et al., 1986) is a frequently used, well validated scale assessing the three eating styles – restrained, external and emotional eating. The 10 items each are scaled from 1 (*never*) – 5 (*very often*) and average scores are calculated with higher scores indicating a more pronounced eating style. The subscales of the questionnaire showed internal consistencies of $\alpha = 0.92$ for emotional eating, $\alpha = 0.87$ for external eating, and $\alpha = 0.95$ for restrained eating.

2.1.2.5. Salzburg Stress Eating Scale (SSES). The SSES (Meule et al., 2018) measures eating in response to stress. The 10 items depict stressful situations, asking individuals how they react to such situations with answers being scaled from 1 (*I eat much less than usual*) to 5 (*I eat much more than usual*). Averaged scores are calculated with higher values representing eating more when stressed while lower values represent eating less when stressed. Internal consistency was $\alpha = 0.86$.

2.1.2.6. Food Craving Questionnaire – trait – reduced (FCQ-T-r). The FCQ-T-r (Meule, Hermann, & Kübler, 2014) measures the frequency of food craving in general. The self-report consists of 15 items, which are scaled from 1 (*never/not applicable*) to 6 (*always*). Sum scores are calculated with higher scores indicating more frequent food craving. Internal consistency was $\alpha = 0.91$.

2.1.3. Procedure

After completing several psychometric questionnaires and demographic information on an online survey platform, participants were instructed on the installation and usage of a smartphone app (PsyDiary). Afterwards, participants completed one practice day, followed by six study days, of EMA with compliance being monitored closely by staff. At the end of this period, participants completed additional questionnaires via the online survey platform. A second week of EMA assessment (equal to the first week) for each participant was added to increase variability and representativeness. Hence, all participants resumed the EMA data collection roughly 2.5 months after (again with one practice day). Order was roughly balanced across participants so that 17 started with their high stress week, whereas 32 started with their low stress week. This corresponds to a naturalistically occurring rather low-stress (mainly at the beginning of a semester; coded = 1) and high-stress period (mainly at the end of a semester; coded = 0) for students (i.e. the main group in the sample). No significant difference in the number of reported evening questionnaires between both weeks could be revealed using a paired samples *t*-Test ($t(48) = 0.244$, $p = .808$). At the conclusion of the study, participants completed final questionnaires and were compensated for their participation.

The study used signal-, event-, and interval-contingent sampling (see Shiffman et al., 2008), prompting individuals at five equidistant times (10 a.m., 1 p.m., 4 p.m., 7 p.m., 10 p.m.). Of interest for the current study, shortly before going to bed, participants self-initiated a questionnaire on their smartphone asking about restrictive behavior on the current day and intention to restrict for the next day (in cases where participants failed to initiate the bed time report, the data for that day were treated as missing).

2.1.4. EMA measures

At the end of the day, participants completed questions about *restrictive behavior* ('To what extent did you deliberately eat less today to influence your weight?') and *intention to restrict* on the following day ('To what extent do you deliberately want to eat less tomorrow to influence your weight?') answered from 0 to 100 (not at all – very much).[2] This end-of-the-day approach was used to obtain a summary

[1] This study sample was already used by Reichenberger, Smyth, and Blechert (2018) and Reichenberger, Richard, et al. (2018) to explore different research questions using other parts of the data.

[2] Restrictive behavior (t1, person-mean centered) significantly predicted intention to restrict (t1) on the same day ($\beta_{10} = 0.422$, $p < .001$), indicating that higher restrictive behavior results in higher intention to restrict.

Table 1
Correlations among all questionnaire measures in study 1.

	1	2	3	4	5	6	7
1. Restrained eating style (DEBQ)	-						
2. Intuitive Eating Scale	-.731**	-					
3. Perceived Self-Regulatory Success in Weight Regulation	-.419**	.497**	-				
4. Food Craving Questionnaire - Trait - reduced	.488**	-.721**	-.356*	-			
5. External eating style (DEBQ)	-.191	.000	.260	.457**	-		
6. Emotional eating style (DEBQ)	.415**	-.611**	-.290*	.758**	.415**	-	
7. Salzburg Stress Eating Scale	.158	-.351*	-.473**	.286*	-.062	.352*	-

Note: * significant $p < .05$; ** significant $p < .01$; DEBQ = Dutch Eating Behavior Questionnaire.

across the day as different facets constituting restraint might not optimally be captured intraday (e.g., skipping meals, fasting for several hours).

2.1.5. Data analyses

In order to assess intention-behavior gaps, a difference score between intention (assessed prospectively, i.e. evening of day n-1) and actual behavior the next day (day n) was calculated. Positive scores indicate a stronger intention than actual behavior, thus, the intention exceeds the behavior; in contrast, negative scores reflect a lower intention than behavior. Gender, BMI and age were used as control or predictor variables as females are 1.5 times more likely to attempt weight loss than men (Andreyeva, Long, Henderson, & Grode, 2010; Laska, Pasch, Lust, Story, & Ehlinger, 2011) and weight status has previously been associated with dietary restraint (e.g., Nagl, Hilbert, de Zwaan, Braehler, & Kersting, 2016).

Hierarchical linear models, using restricted maximum likelihood models, were applied because of the nested, longitudinal structure of the data, using the software HLM7 (Raudenbush, Byrk, & Congdon, 2011). Days (Level 1) were nested within participants (Level 2). We separately modeled eating styles at Level 2 as predictors of intention to restrict and restrictive behavior, as well as on intention-behavior gaps, respectively. Intercepts were allowed to vary randomly and Level 2 predictors were grand-mean centered in case of continuous questionnaire scores and uncentered for gender (coded 1 = female and 0 = male). In case of significant effects, pseudo-R^2 was calculated by the proportion of variance in the outcome variable associated with the predictor ($error_{null\text{-}model}$ - $error_{final\ model}$)/$error_{null\text{-}model}$. Formulas for the models, including explanation, are provided in Supplement 1.

In *auxiliary analyses* we additionally checked for the effect of disinhibiting eating styles on daily restrictive behavior and intention to restrict, to provide more specificity of restriction-related eating measures for these daily outcome variables. Likewise, to provide specificity of disinhibiting eating styles for the intention-behavior gaps, we checked for the effect of restrained eating on this daily outcome variable. Additionally, as study 1 contained two separate study periods, a high and a low stress week, we checked for additional effects of study week on results and outcome measures themselves as well as an effect of study day on intention-behavior gaps. These analyses are provided in Supplement 2.

3. Results

3.1. Descriptives

Table 2 shows descriptives of the variables used in study 1. On average, participants completed 87% (*SD* = 13%) of their end-of-the-day entries (range 50–100%), reflecting overall good compliance. On average, individuals' intention were 6.3 points above their actual (next day) behavior (see Table 2), illustrating the inability to act according to ones intentions. Although there was considerable variability in this discrepancy, 65% of participants underperformed with an intention-behavior gap > 0.

Table 2
Descriptive statistics of variable assessed in study 1.

Variable	*M*	*SD*	*Min*	*Max*
Level 1				
Restrictive Behavior	19.1	23.6	0.00	100
Intention to Restrict	25.2	29.0	0.00	100
Difference score Tomorrow's intention and Next day's restriction (intention-behavior gap)	6.26	21.2	-100	90.0
Level 2				
Restrained eating style (1-5)	2.22	0.95	1.00	5.00
Intuitive eating (1-5)	3.67	0.61	2.19	4.81
Perceived self-regulatory success in weight regulation (3-21)	13.2	4.18	5.00	21.0
Food craving (15-90)	35.8	11.4	15.0	67.0
External eating style (1-5)	3.26	0.66	1.80	4.80
Emotional eating style (1-5)	2.17	0.74	1.00	4.00
Stress eating (1-5)	2.83	0.57	1.80	4.40
BMI (kg/m^2)	22.0	3.28	16.6	34.9

Note. BMI = Body-mass-index. Level 2 based on 49 participants. Level 1 restriction was based on 510 occasions; intention-behavior gap was based on 378 occasions.

3.2. Daily level of restriction as a function of restriction related eating styles

Daily restrictive behavior was separately modelled as a function of each of the restriction related eating styles (restrained eating, dieting, perceived self-regulatory success in dieting, and intuitive eating). Daily intention to restrict was modelled in the same vein.

All restriction related eating styles predicted daily *restrictive behavior* in the expected direction (see Table 3). Higher restrained eating style and dieting predicted higher daily restrictive behavior. Higher intuitive eating and perceived self-regulatory success in weight regulation were associated with lower restrictive behavior. Concurrently modelling all significant predictors revealed a significant contribution of dieting only ($\beta_{03} = 16.8$, $p = .005$) with an overall pseudo $R^2 = 60\%$.

Restriction related eating styles further predicted daily *intention to restrict* in the expected direction (see Table 3). Higher restrained eating style and dieting predicted higher intention to restrict. Higher intuitive eating and perceived self-regulatory success in weight regulation were associated with lower intention to restrict. Concurrently modelling all significant predictors again revealed a significant unique contribution of dieting only ($\beta_{03} = 23.7$, $p = .003$) with an overall pseudo $R^2 = 67\%$. These results provide some support for the validity of restriction related eating styles.

3.3. Intention-behavior gap

The daily intention-behavior gap was greater among individuals with higher scores in stress eating, emotional eating style, and food craving (see Table 3). Intention-behavior gaps were not related to external eating style. Concurrently modelling all significant predictors revealed significant unique contributions of food craving ($\beta_{01} = 0.584$, $p = .003$) and stress eating ($\beta_{02} = 11.7$, $p = .001$), but not of emotional eating ($\beta_{03} = -2.98$, $p = .273$) to intention-behavior gaps with an

Table 3
Multilevel model results of study 1.

Variable	β_{01}	pseudo R^2	*p*
Level 1 outcome: daily restrictive behavior			
Level 2 predictors			
Dieting	26.2	54%	< .001
Restrained eating style	12.0	41%	< .001
Intuitive eating	-19.4	44%	< .001
Perceived self-regulatory success in weight regulation	-1.40	9%	.013
Level 1 outcome: intention to restrict			
Level 2 predictors			
Dieting	37.8	60%	< .001
Restrained eating style	17.2	44%	< .001
Intuitive eating	-28.9	52%	< .001
Perceived self-regulatory success in weight regulation	-2.75	21%	< .001
Level 1 outcome: intention-behavior gaps			
Level 2 predictors			
Food craving	.611	28%	.001
Stress eating	13.7	40%	< .001
Emotional eating	6.87	15%	.025
External eating	3.08	-	.449

overall pseudo R^2 = 52%.

Moreover, we used gender and BMI as independent predictors, each of which was significantly related to higher intention-behavior gaps (female gender, β_{01} = 8.94, p = .035, pseudo R^2 = 8%, and higher BMI, β_{01} = 1.03, p = .017, pseudo R^2 = 6%).

4. Study 2

4.1. Participants[3]

Participants were recruited into the study of "stress and eating in daily life" via several newspaper articles, a television report as well as word of mouth. Sixty participants partook in exchange for payment (dependent on overall study compliance; 35 to 60 €). One individual was excluded because of overall low compliance (< 50%) and missing questionnaires. The resulting 59 individuals (78% female) had a mean age of M = 39.9 (SD = 11.9) and a mean BMI of 26.7 kg/m^2 (SD = 5.76 kg/m^2; range 17.5–38.6 kg/m^2). Participants were mostly employees (49%), self-employed (17%) or students (15%) with mainly German (44%) or Austrian (54%) citizenship and a mean of M = 15.8 (SD = 4.33) years of education. They signed an informed consent form approved by the ethics committee of the University of Salzburg.

4.2. Questionnaires

Study 2 used the same questionnaires as study 1, with the exception that an updated version of the IES was utilized. With regard to dieting, 37 out of 59 participants answered 'Yes'. Internal consistencies of the questionnaires was α = 0.69 for the PSRS, α = 0.90 for emotional eating, α = 0.89 for external eating, α = 0.86 for restrained eating in the DEBQ, α = 0.95 for the SSES, and α = 0.95 for the FCQ-T-r. Correlations between questionnaire measures are reported in Table 4.

4.3. Intuitive Eating Scale 2 (IES-2)

The IES-2 (Van Dyck, Herbert, Happ, Kleveman, & Vögele, 2016) assesses intuitive eating behavior (i.e. eating in response to physiological hunger and satiety cues) with 23 items. Its items are scaled from 1 (*strongly disagree*) to 5 (*strongly agree*) and averaged scores are calculated after recoding reversed items. Although four different subscales can also be calculated, we used the total score. Hence, higher values represent higher overall intuitive eating. Internal consistency was α = 0.85 in the present sample.

4.4. Procedure

After completing several questionnaires and demographic information on an online survey platform, participants were instructed on the installation and usage of a smartphone app. Afterwards, participants completed one practice day, followed by 10 study days, of EMA with data completeness being monitored closely by staff. At the end of this period, participants completed additional questionnaires via online survey platform and were compensated for their participation.

The study used signal-contingent sampling, prompting individuals at five equidistant times (9 a.m., 12 a.m., 3 p.m., 6 p.m., 9 p.m.). Of interest for the current study, the questionnaire at 9 p.m. asked about behavioral and intentional restraint. Thus, in contrast to study 1, participants had to complete the measures about restriction at the last signal (9 p.m.) and not self-initiated shortly before going to bed. This approach was used as, because of the broader advertisement, we expected more employees compared to students with potentially smaller ranges and variability in sleep-wake cycles. In case participants failed to complete the signal, the data for that day were treated as missing.

4.5. EMA measures

EMA measures were analogous to study 1: At the end of the day, participants completed questions about *restrictive behavior* and *intention to restrict* answered from 0 to 100 (not at all – very much).[4]

4.6. Data analyses

Data analyses were analogous to study 1: Intention-behavior gaps were calculated with positive scores indicating a stronger intention than actual behavior, thus, the intention exceeds the behavior; in contrast, negative scores reflect a lower intention than behavior. Gender, BMI and age were used as control or predictor variables. Hierarchical linear models, using restricted maximum likelihood models, were applied with days (Level 1) being nested within participants (Level 2). We separately modeled eating styles at Level 2 as predictors of intention to restrict and restrictive behavior, as well as on intention-behavior gaps, respectively. Intercepts were allowed to vary randomly and Level 2 predictors were grand-mean centered in case of continuous questionnaire scores and uncentered for gender (coded 1 = female and 0 = male).

Again, in auxiliary analyses we additionally checked for the effect of disinhibiting eating styles on daily restrictive behavior and intention to restrict, to provide more specificity of restriction-related eating measures for these daily outcome variables. Likewise, to provide specificity of disinhibiting eating styles for the intention-behavior gaps, we checked for the effect of restrained eating on this daily outcome variable. Additionally, we checked for effects of study day on intention-behavior gaps. These analyses are provided in Supplement 2.

5. Results

5.1. Descriptives

Table 5 shows descriptives of the variables used in study 2. On average, participants completed 86% (SD = 14%) of their last entries of the day (range 50–100%), reflecting good compliance. Similar to study 1, on average, individuals' intention were 17.2 points above their actual

[3] Sample was already used by Reichenberger, Kuppens et al. (2018); Reichenberger, Richard, et al. (2018); Reichenberger, Smyth et al. (2018).

[4] Of note, restrictive behavior (t1, person-mean centered) did not significantly predict intention to restrict (t1) on the same day (β_{10} = 0.122, p = .062).

Table 4
Correlations among all questionnaire measures in study 2.

	1	2	3	4	5	6	7
1. Restrained eating style (DEBQ)	-						
2. Intuitive Eating Scale 2	-.245	-					
3. Perceived Self-Regulatory Success in Weight Regulation	.272*	.194	-				
4. Food Craving Questionnaire - Trait - reduced	.117	-.678**	-.294*	-			
5. External eating style (DEBQ)	-.090	-.237	-.252	.556**	-		
6. Emotional eating style (DEBQ)	.122	-.716**	-.247	.746**	.645**	-	
7. Salzburg Stress Eating Scale	.055	-.579**	-.302*	.609**	.360**	.644**	-

Note: * significant $p < .05$; ** significant $p < .01$; DEBQ = Dutch Eating Behavior Questionnaire.

Table 5
Descriptive statistics of variable assessed in study 2.

Variable	*M*	*SD*	*Min*	*Max*
Level 1				
Restrictive Behavior	28.3	28.4	0.00	100
Intention to Restrict	45.5	32.9	0.00	100
Difference score Tomorrow's intention and Next day's behavior (intention-behavior gap)	17.2	27.6	-53.0	95.0
Level 2				
Restrained eating style (1-5)	2.66	0.73	1.10	4.00
Intuitive eating (1-5)	3.12	0.54	1.43	4.00
Perceived self-regulatory success in weight regulation (3-21)	9.80	4.26	3.00	19.0
Food craving (15-90)	42.4	15.8	15.0	86.0
External eating style (1-5)	3.14	0.75	1.20	5.00
Emotional eating style (1-5)	2.72	0.86	1.00	5.00
Stress eating (1-5)	3.13	0.98	1.00	5.00
BMI (kg/m^2)	26.7	5.76	17.5	38.6

Note. BMI = Body-mass-index. Level 2 based on 59 participants. Level 1 restriction was based on 510 occasions; intention-behavior gap was based on 406 occasions.

(next day) behavior (see Table 5), illustrating the inability to act according to ones intentions. Although there was considerable variability in this discrepancy, 80% of participants underperformed with an intention-behavior gap > 0.

5.2. Daily level of restriction as a function of restriction related eating styles

Models were set up analogously to study 1: Daily restrictive behavior was separately modelled as a function of each of the restriction related eating styles (restrained eating, dieting, perceived self-regulatory success in dieting, and intuitive eating). Daily intention to restrict was modelled in the same vein.

Similar to study 1, higher restrained eating style and dieting predicted higher restrictive behavior (see Table 6). Higher intuitive eating was associated with lower restrictive behavior. Contrary to study 1, perceived self-regulatory success in weight regulation was not related to restrictive behavior. Concurrently modelling all significant predictors reduced the unique contribution of each variable to non-significance, although intuitive eating still exhibited a trend-level effect ($\beta_{02} = -8.55$, $p = .057$).

Restriction related eating styles predicted daily intention to restrict in the expected direction. Higher restrained eating style and dieting predicted higher intention to restrict. Higher intuitive eating was associated with lower intention to restrict. Perceived self-regulatory success in weight regulation was not related to intention to restrict. Concurrently modelling all significant predictors revealed a significant unique contribution of dieting ($\beta_{03} = 18.3$, $p = .032$) and intuitive eating ($\beta_{03} = -21.3$, $p < .001$) with an overall pseudo $R^2 = 35\%$.

5.3. Intention-behavior gap

The intention-behavior gap was higher in individuals with higher scores in stress eating, emotional eating style, and food craving (see Table 6). Intention-behavior gaps were not related to external eating style. Concurrently modelling all significant predictors revealed a unique contribution of food craving only ($\beta_{01} = 0.633$, $p = .002$), while stress eating ($\beta_{03} = 0.149$, $p = .958$) and emotional eating style ($\beta_{02} = 0.316$, $p = .946$) turned non-significant with an overall pseudo $R^2 = 30\%$. Fig. 1 illustrates combined findings of study 1 and study 2.

As in study 1, we used gender and BMI as independent predictors: females exhibited stronger gaps ($\beta_{01} = 13.6$, $p < .001$, pseudo $R^2 = 8\%$). BMI ($\beta_{01} = -0.120$, $p = .815$) was not related to intention-behavior gaps in sample 2.

Table 6
Multilevel model results of study 2.

Variable	β_{01}	pseudo R^2	*p*
Level 1 outcome: daily restrictive behavior			
Level 2 predictors			
Dieting	19.0	17%	< .001
Restrained eating style	12.8	17%	.001
Intuitive eating	-11.8	7%	.017
Perceived self-regulatory success in weight regulation	.121	-	.862
Level 1 outcome: intention to restrict			
Level 2 predictors			
Dieting	25.4	19%	< .001
Restrained eating style	16.3	17%	.003
Intuitive eating	-24.7	22%	< .001
Perceived self-regulatory success in weight regulation	-.401	-	.647
Level 1 outcome: intention-behavior gaps			
Level 2 predictors			
Food craving	.651	33%	< .001
Stress eating	6.63	12%	.014
Emotional eating	9.22	19%	.004
External eating	5.31	-	.162

6. Discussion

The present study assessed restriction intentions and actual behavioral restriction using daily EMA measures alongside psychometric trait-level measures of dietary restraint and disinhibition to help inform the ongoing debate about the benefits and risks of dietary restraint. As expected, trait-level self-report measures of restriction-related eating styles were consistently associated with higher daily restrictive behavior and intention to restrict as measured by EMA-evening reports. Additionally, stronger divergence between EMA measures of intention and behavioral restraint (i.e. intention-behavior gaps) were positively predicted by trait level self-report scales measuring the disinhibiting eating styles trait food craving, emotional and stress eating. High correspondence in these results across two independent samples was found. We will discuss each of these findings in turn.

6.1. Dietary restriction in daily life

The present study showed that dietary restraint intentions and

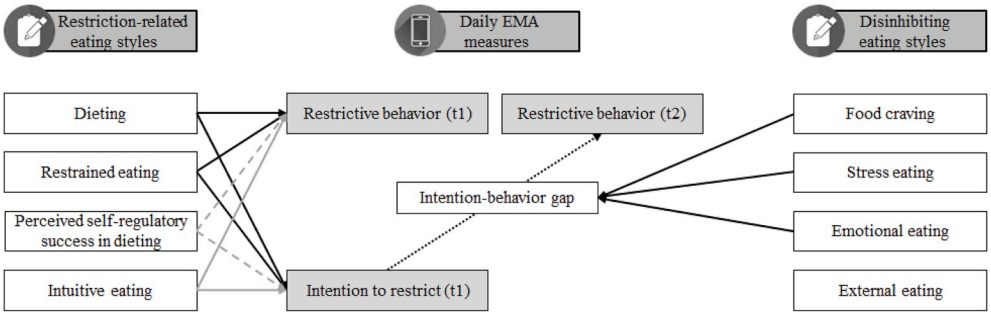


Fig. 1. Results combined across study 1 and study 2. Significant positive predictions between questionnaire-based eating styles and daily ecological momentary assessment measures (EMA) are illustrated by solid black lines, significant negative predictions are illustrated in solid grey lines. Results only obtained in one study are illustrated in dashed lines.

behaviors can be reliably assessed through daily EMA-based self-reports in everyday life. We demonstrated robust associations of the behavioral restriction and restriction intention items with trait-level restriction-related eating styles such as the restrained eating subscale of the DEBQ. These results cross-validate questionnaires on the one hand and EMA items on the other. Although in line with research showing that trait restraint measures predict daily presence and frequency of restraint behavior (Rodgers et al., 2018; Wardle & Beales, 1987), restraint questionnaires have been questioned in their predictive validity for actual food intake in daily life (e.g., Stice et al., 2010). Deviating from Stice et al. (2010), however, the present study assessed a subjective estimate of dietary restraint instead of actual caloric intake and can thus not exclude the possibility that actual, objectively measured intake can still paint a different picture. In addition, as expected, consistent relationships (albeit in the opposite direction), were observed for intuitive eating. Intuitive eating – eating according to physiological needs – can be understood as the conceptual opposite of dietary restraint. Per definition, dietary restraint relies on cognitive control, rather than physiological control of eating (e.g., Johnson et al., 2012). The negative relationship of intuitive eating with daily intention and restriction validates the concept, suggesting that these individuals rather rely on internal signals of hunger and satiety, instead of forming intentions to restrict or show restriction behavior putatively.

Results were inconsistent between study 1 and 2 regarding perceived success in dieting, presumably because of higher scores in the first sample, warranting further exploration in future research. Nevertheless, in study 1 higher dieting success related to less daily dietary restraint, tentatively suggesting that successful dieters may apply other methods than pure food intake restriction. Partly supporting this assumption, successful dieting has previously been associated with higher flexible and lower rigid control of eating behavior (Meule, Papies, et al., 2012). In sum, the most important finding is that restrained eaters – defined by the DEBQ-restraint scale here – show restraint-related intentions and (subjective report of) behavior in daily life, supporting (ecological) validity to the concept/instrument. But how successfully are these intentions when they are to be translated into actual behavior the next day? Intention-behavior gaps are well documented for various health behaviors and reflect the (in)effectiveness of planning and execution of intended behavior – and hence volitional processes.

6.2. Intention-behavior gaps with regard to dietary restraint

As expected from the broader literature, we observed positive intention-behavior gaps (intentions to restrict > restrictive behavior) on average and in the majority of the sample. Thus, although generally good predictors of behavior like restrained or healthy eating (Cruwys et al., 2013; McDermott et al., 2015; Riebl et al., 2015), intentions are often too optimistic: people often overestimated their abilities to translate them into actions and, as a consequence, intention-behavior gaps emerge (Kumanyika et al., 2000; Verplanken & Faes, 1999). Alternatively, people might also form realistic intentions but underestimate daily barriers (e.g., availability of foods that are needed to meet their goals, stress/emotions on a given day, etc.). While the present results cannot clarify the 'source' of these gaps (overambitious intentions, inadequate anticipation of barriers, stress-related reductions of behavioral control), it is plausible that consistent gaps lead to a reduction of self-efficacy in the long run. It is also possible that larger gaps on one day trigger the urge to compensate for that on the following day through yet higher intentions. Such build-up might contribute to weight cycling and unhealthy dieting-binge cycles and as could be investigated in clinical or at-risk samples in future studies. Even if consequences are not that severe, it is likely that repeated failures to meet intentions undermine successful dieting on the long run (e.g., Kendzierski & Whitaker, 1997).

Interestingly, trait-level restrained eating did not alter the relationship between disinhibited eating styles and intention-behavior gaps when considered concurrently in the analyses (see Supplement 2). Thus, unsuccessful restraint may be better explained by the presence of disinhibiting eating styles than by a conceptual problem of restrained eating or dieting per se, a possibility which might add to the ongoing debate about beneficial or detrimental effects of dieting (e.g., Johnson et al., 2012; Schaumberg et al., 2016; Stice et al., 2010). Research looking at the interaction of several eating styles, i.e. restrained eating and disinhibited eating (measured by the Three Factor Eating Questionnaire) seem to support this, in that overeating was strongest in individuals simultaneously high on both constructs (Yeomans & Coughlan, 2009).

6.3. Intention-behavior gaps with regard to disinhibiting eating styles

Consistently across both studies, intention-behavior gaps were more pronounced in individuals high in trait food craving, emotional and stress eating. When these trait predictors were considered simultaneously, food craving constituted the strongest predictor. Results thus substantiate other research showing that food cravings predict decreased success in weight control (Meule, Richard, & Platte, 2017; Meule, Westenhöfer, & Kübler, 2011). Additionally, food cravings are more intense and more difficult to resist in dieters compared to non-dieters (Massey & Hill, 2012), potentially leading to unplanned and disinhibited eating behavior. In line with this, trait food cravers might experience frequent episodes of state craving in daily life which trigger food intake (Richard, Meule, Reichenberger, & Blechert, 2017), thereby potentially undermining previous intentions.

When modelled separately, also emotional and stress eating predicted greater intention-behavior gaps. As previously reviewed (Evers, Dingemans, Junghans, & Boevé, 2018; Hawks, Madanat, & Christley, 2008), negative and positive emotions and stress can disinhibit cognitively controlled restrained eating, thereby leading to increased food intake. This process may occur more so in individuals vulnerable for emotions and stress (i.e. emotional and stress eaters, respectively). The positive relationship between intention-behavior gaps and disinhibiting eating styles might also suggest that individuals with very high values on these traits (i.e. eating disordered patients with binge eating) show substantial intention-behavior gaps, pointing to a potentially fruitful future direction. More data on the intra-day processes would be

desirable (we measured end of the day responses here): it is known that the disinhibiting traits develop their momentary influence through corresponding states, i.e. emotional eating style through negative emotional states (Blechert, Goltsche, Herbert, & Wilhelm, 2014), trait food craving through state craving and/or hunger (Reichenberger, Richard, et al., 2018; Richard, Meule, Reichenberger, et al., 2017). This lends itself to context-dependent ecological momentary intervention approaches during such states (Nahum-Shani et al., 2018), by presenting tips or strategies that curb stress or negative emotions or that block their interference with dieting. Finally, as several eating styles provided partially overlapping information in the prediction of intention-behavior gaps, an aggregated score of 'uncontrolled eating' (as has recently been proposed by Vainik, Neseliler, Konstabel, Fellows, and Dagher (2015)) might be possible and could be validated in future research.

Specific action plans (i.e. implementation intentions) specify the when, where and how of goal-striving (Gollwitzer & Sheeran, 2006) and might therefore facilitate enactment of intentions. Previous research showed that the method of *implementation intentions* might aid in reducing intention-behavior gaps with regard to healthy eating behavior (Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011; Riebl et al., 2015). More generally, understanding the drivers of intention-behavior gaps might be especially important for practitioners. Based on current findings, coping strategies regulating stress, emotions and food temptations might support emotional, stress eaters and food cravers in particular acting upon their intentions.

Although the current food environment with high palatability and accessibility of foods gave rise to the hypothesis that the reactivity to external food cues might also contribute to intention-behavior gaps, external eating style did not predict current intention-behavior gaps with regard to dietary restraint. Already earlier research indicated that external eating might not be as tightly related to dietary restraint as for example emotional eating (van Strien et al., 1986).

6.4. Limitations and future directions

A few limitations need to be acknowledged. First, restrictive behavior was subjectively estimated by participants at the end of the day with the risk of biases with regard to over- or underestimation or memory effects. Future studies might profit from an objective assessment of food intake contrasting subjective and objective restrictive behavior. However, such research would have to solve the challenge of obtaining precise food intake records in natural environments (e.g., see Blechert, Liedlgruber, Lender, Reichenberger, & Wilhelm, 2017 for various assessment protocols). In addition, the current study assessed two diverse, however, unselected samples without explicit dieting interest. While this was done to capture the full variation on dietary restraint (i.e. also including the lower end) future research might profit from including more individuals with stronger dieting intentions as well as individuals with higher BMI or eating disorders. Similarly, participants in study 1 were mostly well-educated students with female gender, limiting generalizability. To partially account for this limitation, study 2 sampled from a population with more employees and a broader range on BMI and age. Nevertheless, generalizability of the findings is limited to these samples and results might differ in populations of e.g., eating disordered individuals. In addition, the current studies used modest sample sizes, possibly influencing Level 2 relationships. Although we replicated findings within two independent studies, future studies with larger sample sizes are required.

6.5. Conclusion and implications

To conclude, the present study established a simple and naturalistic assessment of dietary restriction intentions and behaviors in daily life. Prospective assessment of the intentions allows tapping into actual effectiveness of behavioral implementation and thus helps elucidate volitional processes or contexts. Crucially, the present study established independent trait-level correlates of each of these measures: Restriction and intention *levels* correlated with restriction-related measures whereas intention-behavior *gaps* (difference scores) correlated with disinhibiting trait measures. The first finding alleviates some of the concern that has plagued the concept of restrained eating: Our data suggest that restriction-related trait measures do in fact predict day to day intention to restrict and behavioral restriction. The second finding further substantiates that not restraint, but rather several disinhibiting eating styles, might contribute to diet failure. This has clear treatment implications, as diet interventions should consider the assessment of disinhibited eating and provide respective treatments for those with high scores. Together, results could support a more personalized treatment approach that guides dieters toward closing their intention-behavior gaps.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2019.04.019.

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