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Personality Psychology

On the Trait Like Nature of Emotion Regulation Dynamics: Limited Evidence

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Measuring the variable and flexible use of emotion regulation (ER) has been increasingly viewed as a more nuanced approach to understanding ER than only assessing mean-level strategy use. However, it is unclear to what extent ER variability and flexibility are trait-like individual differences that show longitudinal consistency and validity across time. In the current study, we use data from an experience sampling study that uses a burst design, wherein the same participants were tested twice across an interval of one year (N_{W1} = 396, N_{W2} = 175). We test the extent to which ER tendency, variability, flexibility, and responsivity are stable across time and show consistent relationships with outcome measures. Tendency and, to some extent, responsivity showed consistency across time; variability and flexibility did not. Further, the associations with outcomes were inconsistent across time for tendency and few consistent patterns of associations emerged for variability, flexibility, or responsivity. These findings suggest that these dynamic measures of emotion regulation may not be best conceptualized as stable within-person traits.

The Longitudinal Consistency of Emotion Regulation Dynamics

As you move through your day, you experience a variety of different emotions, engaging with each by choosing from a range of strategies, such as by suppressing or reframing them. These strategies are examples of emotion regulation – the process through which emotions are monitored, modulated, and expressed (Gross, 1998, 2015). At breakfast, you spill milk on your new shirt and let out a frustrated yell. By contrast, you fake a smile when your colleague is promoted above you at work. Even though the emotion (anger) may be the same, your regulation of that emotion changes due to the cause of the emotion or the context in which you experience it. The ability to use emotion regulation strategies based on context is known as emotion regulation *flexibility* (Aldao et al., 2015).

As people experience emotions in their daily lives, they can choose if and how to alter the experience or communicate it to others. The selection of a strategy can be highly consequential. Imagine a person is feeling angry about not receiving a promotion; the decision to suppress that anger in the moment is more or less functional depending on the details of the situation. Suppression may be ideal, for example, if their boss is stubborn and sensitive to criticism because it may prevent an unproductive interpersonal interaction. On the other hand, expressing anger may be more optimal under other circumstances such as their boss being open to a reversal of the decision. Prior research has identified a number of ER strategies – including suppression and expression (Blanke, Brose, et al., 2020) – and evaluated the relative merits of each (Livingstone & Isaacowitz, 2021). Evidence suggests that the momentary selection of any one strategy is influenced by the valence and intensity of the emotion experienced and also the characteristics of the situation (Aldao, 2013; Matthews et al., 2021). What is important is not necessarily using the most effective strategies in general (i.e., across circumstances) but rather selection of the most effective strategy for each unique situation. Consequently, other dynamics of emotion regulation – including variability, flexibility, and responsivity – may be more important than the tendency to use specific strategies (Aldao et al., 2015; Southward & Cheavens, 2020).

Individual differences in emotion regulation *tendency* – the extent to which someone uses a particular strategy over time – have been well documented and shown to associate with a wide range of outcomes (Gross, 2015). These findings have led researchers to implicitly and explicitly conceptualize emotion regulation as a trait (Zimmermann & Iwanski, 2014). The assessment of emotion regulation has increasingly involved daily diaries and experience sampling methodologies, which enable researchers to assess dynam-

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ics like variability and flexibility that cross-sectional measures of emotion regulation typically cannot. Some have argued that trait emotion regulation tendency can be viewed as the intraindividual mean of state measurements of emotion regulation use, and that trait variability can be viewed as the intraindividual standard deviation of state measurements (Blanke, Kalokerinos, et al., 2020). However, the extent to which these findings relate to other measures of emotion regulation dynamics remains unclear.

There is a need to understand the extent to which emotion regulation dynamics are distinct individual differences that are consistent over time and predictive of person-level outcomes. In other words, we argue that if these dynamics of emotion regulation are not meaningful trait-like characteristics of individuals, theories that emphasize these dynamics will have limited explanatory power and inconsistent relationships with outcome measures. In the current study, we investigate whether dynamics of emotion regulation – tendency, variability, flexibility, and responsivity – represent meaningful individual characteristics by examining their consistency over time and their relationship with mental health, well-being, and other outcomes.

Emotion Regulation Strategies

Emotion regulation strategies are specific behaviors that manage emotional experience and expression (Gross, 1998). Strategies can be antecedent-focused, in that they are used before an emotion is fully experienced, or response-focused, in that they occur after the emotional response. Antecedent-focused strategies include cognitive *reappraisal*, in which the person cognitively changes the meaning of a stimulus in order to alter or avoid a specific emotion (Gross & John, 2003). Reappraisal involves thinking about the emotional antecedent to modulate the emotional experience. It is often deployed in response to negative emotions, with the aim of decreasing the intensity of the emotion. This strategy represents a central component of Cognitive Behavioral Therapy (Berking et al., 2008) and is thought to be generally associated with positive emotional outcomes like the increased frequency of positive emotions and the decreased frequency and intensity of negative emotions (Blanke, Brose, et al., 2020; Brockman et al., 2017). Other antecedent-focused strategies include situation selection, situation modification, and attentional deployment (Gross, 2015).

Response-focused strategies include expressive *suppression*, which involves inhibiting the behavioral expression of an emotion (Gross & John, 2003). Given that the goal of suppression relates to expression rather than experience, the primary effect of suppression is to prevent others from perceiving our emotions. Thus, it is no surprise that suppression is commonly practiced in social situations (Cutuli, 2014). This suggests that suppression is a tool for maintaining interpersonal relationships, particularly non-close interpersonal relationships in which we have instrumental goals (English et al., 2017). That is, we suppress not because we're trying to change the experience of our own emotion but because we're trying to selectively communicate our emotions to those around us in pursuit of our goals. The idea that the goal of suppression is not intrapersonally focused is supported by evidence that suppression increases psychological arousal (Gross, 1998); in other words, suppressing negative emotions can make us feel worse, not better. English and colleagues (2017) found that suppression is often justified with inter-personal explanations like avoiding conflict and keeping up appearances. However, there is evidence to suggest this does not have the intended effect and can lead to worsening social relations, at least in emerging adulthood (Srivastava et al., 2009).

Emotion Regulation States

The tendency to use specific emotion regulation strategies — alternatively acknowledged as an ability (Extremera & Rey, 2015) or a skill (Berking et al., 2008) — has been conceptualized as both a stable individual difference (e.g., Gross & John, 2003) and a more variable "momentary" behavior (e.g., Brans et al., 2013). This parallels other work in the study of individual differences, which conceptualizes person-level traits as the average of a distribution of states (Fleeson & Jayawickreme, 2015). A benefit to modeling emotion regulation as a state, rather than a stable trait, is the ability to integrate affect and situation into models. Prior work using this approach (e.g., Hollenstein & Lanteigne, 2018) has highlighted the ways in which different emotion regulation strategies are used in reaction to specific situations.

Of course, features of the situation can be particularly important to the dynamics of emotion regulation, in addition to an individual's traits (Aldao, 2013; Colombo et al., 2020; Greenaway et al., 2018). Examples of situational features include how we feel in the moment (state affect) and who we are with (sociality). At the trait level, individuals who experience more negative affect are less likely to typically use strategies like reappraisal that decrease negative affect (Brans et al., 2013). Conversely, in moments when people experience negative affect, they are more likely to use suppression (Brockman et al., 2017), which can paradoxically increase the intensity of the negative affect (Gross, 1998). In a recent meta-analysis of the determinants of emotion regulation choice, Matthews and colleagues (2021) found that the intensity of the emotional experience was strongly associated with both the intention to regulate emotions and the choice of strategy, whereas the valence of emotions (positive versus negative) was associated with the choice of strategy, choice of stimuli, time spent with stimuli, and emotional preferences.

In situations that are social – here defined as situations in which a person interacts with at least one other person – people are more likely to use strategies aimed at altering the expression of emotions, like expressive suppression (English et al., 2017; Tamir, 2016). The case of suppression in social situations points to the need to adapt emotion regulation strategies to not only the emotion, but to other characteristics of the situation. Imagine a scenario in which someone fails to suppress. The coworker becomes angry when passed up for a promotion. The funeral attendee laughs at a funny memory. These emotions can make other people in the situation feel poorly and damage their re-

lationships with the person expressing emotion. But also consider when someone is alone and suppresses negative emotions anyway. This can be equally problematic, if suppressing a negative emotion can increase arousal and stress. This example illustrates both the point that overreliance on a single strategy can be harmful and that strategies should be tailored to the situation.

Measures of emotion regulation dynamics

A person's emotion regulation *tendency* can be conceptualized as their average state level, yet tendency only tells part of the story. Given the importance of adapting emotion regulation strategies to the context at hand, there are additional dynamics of emotion regulation use that may explain outcomes. In particular, dynamics defined previously in the affect literature (Aldao et al., 2015; Dejonckheere et al., 2019) may be especially useful for the study of emotion regulation. Those dynamics include emotion regulation variability, flexibility, and responsivity.

Variability. While the overuse of suppression might lead to negative outcomes in the long term, there are many situations where it is adaptive in the short term. This insight has led researchers to pay increasing attention to emotion regulation *variability,* which typically refers to measures like the intra-individual standard deviation (*iSD*) of strategy use (Eldesouky & English, 2018). Notably, emotion regulation variability can characterize the variability of use of a specific strategy – e.g., the *iSD* of suppression across days within a person – or the use of multiple strategies – e.g., the *iSD* of the number of different strategies used across days (Eldesouky & English, 2018). Greater emotion regulation variability is associated with lower negative affect (Blanke, Brose, et al., 2020; Wenzel et al., 2022) and less severe PTSD symptoms among refugees (Specker & Nickerson, 2022). However, greater ER variability is also associated with less close relationships (Niven et al., 2012). In laboratory contexts, the ability to switch between strategies was prospectively associated with lower distress (Bonanno et al., 2004). However, a limitation of variability is that it does not capture the extent to which individuals coordinate emotion regulation with changes in the environment.

Flexibility. Emotion regulation *flexibility* builds on the concept of variability by measuring the degree to which the use of emotion regulation strategies varies with context (Aldao et al., 2015). Flexibility is operationalized as the person-specific residual variability in emotion regulation strategy use after controlling for features of the context, such as affect valence, affect intensity, and sociality of the situation (e.g., English & Eldesouky, 2020). The residual variability thus indicates the degree to which emotion regulation is not coordinated with context; thus, smaller residual variability indicates greater flexibility in emotion regulation use (Springstein, Jackson, et al., 2022). Notably, this operationalization requires highly reliable measures of momentary ER strategy use: as reliability decreases, the degree to which residuals reflect measurement error increases. Flexibility has been studied in non-clinical contexts (Southward & Cheavens, 2020) as well as in depression (Chen & Bonanno, 2021) and anxiety (Conroy et al., 2020) and is associated with positive emotional outcomes and general life satisfaction.

Responsivity. An alternative conceptualization of flexibility as described by Aldao and colleagues (2015) uses the randomly varying slopes between contextual features and emotion regulation as indices of flexibility, rather than residual variance. Slopes of larger magnitudes suggest that emotion regulation is deployed flexibly in response to different contextual features. Person-level slopes can thus be used as a measure of individual differences in responsiveness. For example, the magnitude of a person's random slope between the sociality of the situation and suppression indicates the degree to which they use suppression in response to sociality. A benefit of this approach is that slope estimates provide insight into how specific features of the situation contribute to the use of emotion regulation. For clarity, we will refer to this operationalization as emotion regulation *responsivity*, as these slopes may be capturing the degree to which someone modulates their ER in response to situational features.

To what extent are ER state dynamics trait-like individual differences?

An underlying assumption of the study of emotion regulation tendency, variability, flexibility, and responsivity is that by estimating these dynamics across individuals, researchers are measuring meaningful trait-like individual differences (Blanke, Kalokerinos, et al., 2020). The key defining qualities of traits is their consistency across time and their validity (Allport, 1931; Cronbach & Meehl, 1955; DeYoung et al., 2022; McCrae et al., 2011).

With few exceptions, traits do not vacillate quickly and dramatically. Most typically, consistency across time is assessed through test-retest reliability, or the degree to which one's level of a trait is correlated across time. However, the time scale of assessment for emotion regulation is crucial. Affective states can vary dramatically during the span of a day, whereas trait levels are usually thought to remain consistent across longer periods of time, such as several months or a year. Emotion regulation tendency, as measured using the Emotion Regulation Questionnaire (Gross & John, 2003), has shown test-retest reliability of about .70 for both suppression and reappraisal scales across three months, suggesting that the ERQ measures a stable individual difference, though there is also evidence that the ERQ is somewhat less stable in adolescents (one-month test-retest reliability of .55 and .44 for suppression and reappraisal, respectively; Gómez-Ortiz et al., 2016). Blanke, Kalokerinos, and colleagues (2020) found that the one-year retest correlations of emotion regulation ranged from .68-.78 for tendency (iM), and .64-.71 for variability (iSD), leading them to conclude that these are trait-like characteristics. If other ER state dynamics, such as flexibility, are meaningful, trait-like individual differences, we would expect them to retest reliability in the same range.

The second important quality of trait-like individual differences is validity and can be demonstrated by associations with relevant behaviors and outcomes. As described above, ER dynamics have been linked to trait negative affect

(Blanke, Brose, et al., 2020; Wenzel et al., 2022), distress (Bonanno et al., 2004), mental health (Specker & Nickerson, 2022), and relationship quality (Niven et al., 2012). However, much of this prior work focuses on tendency and variability. Thus, it remains to be seen whether flexibility and responsivity associate with behaviors, traits, and outcomes. One clue lies in the stress reactivity literature, which tracks the degree to which negative affect, positive affect, and stress correlate with situations within-person. Stress-reactivity is associated with Big Five traits (Leger et al., 2016), affective disorders (Charles et al., 2013), and mortality (Mroczek et al., 2015). We might expect high responsivity to negative emotions would limit stress reactivity; thus, responsivity may be associated with more positive outcomes and traits. More broadly, we seek to investigate the degree to which ER dynamics are associated with functioning broadly by measuring several psychological traits and outcomes.

The Current Study

In the current study, we use data from a large longitudinal study that utilizes a burst design wherein college students complete multiple bursts of ESMs across the span of years. The burst design allows us to model individual differences in ER tendency, variability, flexibility, and responsivity. Further, the longitudinal data collection design allows us to examine the consistency of these dynamics across one year, which is an important characteristic of measures of individual difference. We hope to contribute to a growing body of empirical findings on individual differences in the dynamics of emotion regulation. We expect these measures to be comparable to prior work on the consistency of trait and dynamic measures of ER in the .5-.7 range. In addition, we examine the associations of these dynamics with other individual differences, such as depression, mental health satisfaction, life satisfaction, and relationship satisfaction. We expect suppression tendency to be related to negative outcomes while reappraisal tendency to be related to positive outcomes and both suppression and reappraisal flexibility to be related to positive outcomes. These analyses were not preregistered and should therefore be considered exploratory.

Method

Participants

Survey and experience sampling measures of emotion, situation, and emotion regulation were collected as a part of the Personality and Interpersonal Relationships Study (PAIRS; Vazire et al., 2015). Participants were students at a private, Midwestern university, recruited through a combination of a psychology participant pool, classroom announcements, and flier advertisements on campus. While the total recruitment in this study was 434 participants, we used a subset of participants who completed all relevant measures (N = 400). Participants were ages 18-30 (M = 19.27, SD = 1.75, 68% female). See Table 1 for full details.

Table 1. Sample Demographics. Gender and race are presented as N (% of full sample).

	Overall (N=400)
Age	
Mean (SD)	19 (1.75)
Range	18 – 29
Gender	
N-Not reported	6
Female	268 (68.0%)
Male	126 (32.0%)
Race	
American Indian or Alaska Native	1 (0.2%)
Asian or Asian-American	94 (23.5%)
Black or African American	44 (11.0%)
Hawaiian Native or Pacific Islander	1 (0.2%)
Hispanic or Latino	25 (6.2%)
Not Reported	7 (1.8%)
Other	27 (6.8%)
White	201 (50.2%)

Procedure

The study utilizes a burst design wherein large self-report surveys and experience sampling measures (ESM) were administered at three timepoints, each spaced roughly one year apart. Only the first two waves (N_{W1} = 396, N_{W2} = 175) were included in the final analyses, as participant attrition led to an inadequate sample size for the third wave (N_{W3} = 108; average time between waves 1 and 2 = 382 days; SD = 26)[1]. To determine whether attrition related to relevant participant characteristics, we used two sample t-tests to compare mean scores between returning- and non-returning-participants for all ESM variables in the first wave and found no statistically significant differences (results included in Supplementary Table 2).

During the ESM portion of the study, prompts were delivered four times daily for two weeks. The primary measure of interest, emotion regulation, was assessed once, retrospectively, at the end of each day (see below). In order to capture the context that applies to those daily reports of emotion regulation, we aggregate all ESM measures to the daily level. On average, each participant completed 9.77 days per wave (SD = 4.57, min = 1, max = 15).

1 Initial analyses were run using data from all three waves of the study. The results were largely unaffected by using only the first two waves compared to all three waves.

Table 2. Descriptives of primary study variables. Correlations are Bayesian Pearson correlations with 95% credible intervals. ESM measures represent mean and SD of all observations at each wave.

	Wave 1		Wave 2		
Measure	Mean	SD	Mean	SD	r [CI]
ESM					
Reappraisal	2.81	1.05	2.50	0.70	0.32 [0.17, 0.46]
Suppression	2.83	0.95	3.26	0.60	0.18 [0.03, 0.34]
Positive Affect	3.42	0.80	3.39	0.78	0.64 [0.54, 0.73]
Negative Affect	2.14	0.81	2.04	0.78	0.39 [0.25, 0.52]
Sociality	0.74	0.33	0.71	0.35	0.48 [0.36, 0.59]
Outcomes					
CESD	1.82	0.49	1.86	0.52	0.55 [0.44, 0.65]
Satisfaction - Family	11.78	3.20	11.98	3.04	0.59 [0.49, 0.69]
Satisfaction - Friends	11.97	2.46	11.88	2.37	0.23 [0.08, 0.37]
Satisfaction - Romantic	8.50	4.62	8.72	4.48	0.46 [0.34, 0.58]
Satisfaction - Academics	10.05	3.09	10.20	3.27	0.45 [0.33, 0.57]
Satisfaction - Physical Health	9.60	3.54	9.78	3.56	0.61 [0.51, 0.70]
Satisfaction - Mental Health	10.57	3.55	10.55	3.65	0.58 [0.47, 0.68]
Satisfaction - Life	11.41	2.91	11.28	2.94	0.57 [0.46, 0.66]
GPA	3.40	0.41	3.50	0.37	0.74 [0.65, 0.84]
Physical Health	5.19	1.26	5.12	1.36	0.70 [0.61, 0.77]

Measures

Self-report surveys. Depressive symptoms were measured using the Center for Epidemiological Studies-Depression scale (CESD-R-10; Radloff, 1977), which provides continuous ratings of depression symptoms and has been successfully used to screen a wide range of individuals for depression. Participants completed ten items assessing their symptoms (e.g., "I was bothered by things that usually don't bother me", "I thought my life had been a failure") on a scale from 1 (Not at all) to 4 (A lot). Responses were averaged to create a single scale score (Wave 1: M = 1.82, SD = 0.49, α = .78; Wave 2: M = 1.86, SD = 0.52, α = .79). Participants also provided satisfaction ratings on several outcomes: relationships, academics, and mental health (e.g., "How satisfied are you with your…") were each rated on a scale from 1 (Completely dissatisfied) to 15 (Completely satisfied). Physical health was rated on a scale from 1 (Extremely poor) to 7 (Extremely good) (see Table 2).

Experience Sampling Methodology. The momentary measures (administered four times per day) for the ESM portion included single-item measures of current positive and negative affect rated on a scale from 1 (none at all) to 5 (a lot). Responses were averaged each day to create two daily affect scores (Wave 1: $M_{positive}$ = 3.42, $SD_{positive}$ = 0.80; $M_{negative}$ = 2.14, $SD_{negative}$ = 0.81; r = -.10). Participants also reported whether (1) or not (0) they had interacted with other people in the last hour. Again, responses were averaged each day to create a measure indicating what proportion of the day the participant was in a social situation (M_{social} = .74, SD_{social} = .33).

At the end of each day, participants also completed two items for each of the Reappraisal and Suppression subscales of the Emotion Regulation Questionnaire regarding their emotion regulation use during that day (*Reappraisal*: "Did you control your emotions by changing the way you thought the situation you were in?" and "When you were faced with a stressful situation, did you make yourself think about it differently to make yourself stay calm?"; *Suppression*: "Did you control your emotions by not expressing them?" and "Did you keep your emotions to yourself") (Gross & John, 2003) rated on a scale from 1 (not at all) to 5 (a lot) ($M_{reappraisal}$ = 2.81, $SD_{reappraisal}$ = 1.05; $M_{suppression}$ = 2.83, $SD_{suppression}$ = 0.95).

Analyses

We used Bayesian mixed-effects location-scale models (MELSM; Rast et al., 2012) to investigate the consistency of typical emotion regulation use, variability, and flexibility across one year. MELSMs are extensions of classic mixed effects models, in which both between- and within-person variances are modeled simultaneously, typically denoted fixed and random effects. In these models, remaining within-person variation is relegated to the error term. However, in the MELSM extension, within-person variation is assumed to be systematic and can be regressed onto person-level covariates. This enables MELSMs to model the mean of an individual's emotion regulation strategy use (*location*) and the variability around an individual's mean (*scale*). Thus, MELSMs are ideal for research questions like ours: to what extent do people vary in their use of emotion regulation strategies?

Below, we describe the analytic strategy for each of our research questions. Note that separate models were run in each case for suppression and reappraisal, and that – in an

Table 3. ER Constructs and Definitions.

ER Term	Definition	Model	Coefficient
Tendency	Typical level of strategy use	1	$U_{0i1},\ U_{0i2}$
Variability	Variation around typical level of strategy use	1	$U_{1i1},\ U_{1i2}$
Flexibility	Coordination of strategy use with contextual details	2	U_{8ik}
Responsivity	Coordination of strategy use with *specific* contextual details	2	U_{2ik}-U_{7ik}

Coefficients represent the operationalizations of each ER construct extracted to assess longitudinal consistency.

MELSM framework – the *location* is analogous to a typical linear model and captures the relationship between predictors and the *typical value* of the outcome variable, while the *scale* captures the relationship between additional predictors and the *variability* of the outcome variable. As with mixed-effects models, the location and scale portions of the model allow for within- and between-person effects (for a more detailed explanation, see Hedeker et al., 2008). For a full list of constructs, their definitions, and the coefficients that are operationalized, see Table 3.

Are ER Tendency and Variability Consistent Across Time? In Model 1, we estimated the consistency of ER responsivity (*location*) and variability (*scale*). To account for the nested structure of the data, day (*j*) was nested within each wave (*k*) within each participant (*i*), and both intercepts and slopes were allowed to vary at the location and scale levels.

$$\begin{aligned} Emotion\ Regulation\ &\sim\ Normal\left(\mu_{ij}, \sigma_{ij}\right) \\ \mu_{ijk} &= b_0 + U_{0ik} \\ \log\left(\sigma_{ijk}\right) &= \eta_0 + U_{1ik} \\ b_0,\ U_0\ &\sim\ Normal(2.5,\ 1.5) \\ \eta_0,\ U_1\ &\sim\ Normal(0, 1) \end{aligned}$$

Individual-level intercepts (U_0, U_1) for each wave were extracted from the models. Intercepts from the location-level (U_0) represent the typical strategy use for each participant at each wave, which is analogous to the intraindividual mean of strategy use (i.e., emotion regulation *tendency)*. In other words, (U_{0ik}) captures how much the *i*th participant utilized reappraisal or suppression in wave *k* of the study. Coefficients from the scale-level (U_1) represent the variability of strategy use by each participant at each wave, which is analogous to the intraindividual standard deviation of strategy use (i.e., Emotion Regulation *Variability*). In other words, (U_{1ik}) captures how much the *i*th participant *varied in their use* of reappraisal or suppression in wave *k* of the study.

We then extracted the individual-level intercepts for location and scale for each person at each wave and calculated Bayesian Pearson correlations between waves 1 and 2. Thus, the correlation of the location intercepts ($U_{0i1},\ U_{0i2}$) represents the consistency in ER tendency, while the correlation between the scale intercepts ($U_{1i1},\ U_{1i2}$) represents consistency in ER variability.

Are ER Flexibility and Responsivity Consistent Across Time? Next, the consistency of emotion regulation flexibility and responsivity were estimated using models that nested days (*j*) within each within each wave (*k*) within each participant (*i*) (Model 2).

To model the impact of situational features, we add covariates to Model 2: the average level of affect and sociality experienced by an individual and daily deviations from the mean of affect and sociality. The trait measures (denoted in Model 2 with the suffix "Trait") were calculated by taking intraindividual means at each wave of positive affect, negative affect, and sociality, respectively. Daily deviations (denoted in Model 2 with the suffix "Dev") in affect and sociality were calculated by taking the difference between each person's trait level at each wave and each unique observation. Trait measurements were not allowed to vary randomly for the location models (as indicated by the coefficient labels: b_2- b_4), whereas the deviations in affect and sociality were allowed to vary (as denoted by the coefficient labels: U_{2ik}- U_{4ik}). The random-intercepts for affect and sociality represent the extent to which use of emotion regulation was related to situational features (i.e., emotion regulation *responsivity*). In other words, U_{2ik}- U_{4ik} represent whether, during wave *k*, participant *i*'s use of reappraisal or suppression was related to a temporary deviation from their average level of affect or sociality.

Emotion regulation flexibility is represented by the random-intercept of the scale model U_{8ik}. This coefficient represents the amount of variability that remains unexplained after accounting for the situational features described above. Because flexibility refers to the extent to which individuals alter their emotion regulation according to the situation, values of this coefficient that are closer to zero represent *greater* flexibility. That is, individuals that respond more readily to the situation will have less unexplained variability after accounting for the features of the situation. On the other hand, individuals that either regulate their emotions the same way regardless of the situation (e.g., consistently suppressing and never reappraising) or haphazardly vary in their emotion regulation use will show higher values of this coefficient.

$$\begin{aligned} Emotion\ Regulation\ &\sim\ Normal\left(\mu_{ij}, \sigma_{ij}\right) \\ \mu_{ijk} = \ & b_0 + b_2\left(\mathrm{PosTrait}_{ijk}\right) + b_3\left(\mathrm{NegTrait}_{ijk}\right) \\ & + b_4\left(\mathrm{SocTrait}_{ijk}\right) + b_5\left(\mathrm{PosDev}_{ijk}\right) + b_6\left(\mathrm{NegDev}_{ijk}\right) \\ & + b_7\left(\mathrm{SocDev}_{ijk}\right) + U_{0ik} + U_{2ik}\left(\mathrm{PosTrait}_{ijk}\right) \\ & + U_{3ik}\left(\mathrm{NegTrait}_{ijk}\right) + U_{4ik}\left(\mathrm{SocTrait}_{ijk}\right) \\ & + U_{5ik}\left(\mathrm{PosDev}_{ijk}\right) + U_{6ik}\left(\mathrm{NegDev}_{ijk}\right) \\ & + U_{7ik}\left(\mathrm{SocDev}_{ijk}\right) \\ \log\left(\sigma_{ij}\right) = \ & \eta_0 + U_{8ik} \\ b_0,\ U_0\ &\sim\ Normal(2.5,\ 1.5) \\ b_1 \ldots b_7\ , U_1 \ldots U_7\ &\sim\ Normal(0,\ 2) \\ \eta_0,\ U_8,\ &\sim\ Normal(0, 1) \end{aligned}$$

As in Model 1, we extract the individual-level coefficients for all participants at each wave and take the Pearson correlation between waves 1 and 2. The correlation between scale intercepts (U_{8i1}, U_{8i2}), represents the consistency in flexibility, and the correlations between location intercepts for situational features (e.g., U_{2i1}, U_{2i2}) represent the consistency in responsivity. Again, these coefficients and their related concepts are summarized in Table 3.

Do ER dynamics relate to relevant outcomes? We then looked at the correlations between measures of ER tendency, variability, flexibility, and responsivity, and measures of depression and satisfaction with relationships, health, mental health, academic, and life to examine the extent to which these constructs relate to real-world outcomes.

Sensitivity analyses. In addition to the previously described analyses, we recreated a subset of our analyses using a more conventional framework. We use the intraindividual means and standard deviations (*iM*, *iSD*) to represent tendency and variability, respectively. We use Pearson correlations between measures at Wave 1 and Wave 2 to estimate the consistency of these constructs and then examine their relationships with the outcome variables listed above.

Analyses were implemented using the brms (Bürkner, 2017), rstan (Guo et al., 2020), and tidybayes (Kay & Mastny, 2021) packages in R (version 4.0.4; R Core Team, 2021), using a Hamiltonian Markov Chain sampling algorithm with weakly informative priors. We report estimates and 95% credible intervals for the relevant coefficients. Analysis code can be found at osf.io/4b3y8/.

Results

Are ER Tendency and Variability Consistent Across Time?

First, we fit MELSMs that nested wave within person – these models omit age and estimate intercepts at each wave for each person (see Model 1; U_0, U_1). After extracting the intercepts, we computed the Bayesian Pearson correlation to examine the extent to which people were consistent in their emotion regulation tendency across study waves. For both suppression and reappraisal, there was credible, albeit small-to-moderate one-year test-retest reliability ($rho_{suppression\_tendency}$ = .24, 95% credible interval [.09, .40]; $rho_{reappraisal\_tendency}$ = .37, [.22, .51]).

The random intercepts (coefficient) from the scale-level of Model 1 showed no credible test-retest reliability for either suppression or reappraisal variability ($rho_{suppression\_variability}$ = .11, [-.05, .27]; $rho_{reappraisal\_variability}$ = .15, [-.01, .31]). In other words, the one-year consistency of emotion regulation variability is low and not different from a null hypothesis of rho = 0.

Are ER Flexibility and Responsivity Consistent Across Time?

The random intercepts (coefficient) from the scale-level of Model 2 showed no credible test-retest reliability of ER flexibility ($rho_{suppression\_flexibility}$ = .11, [-.06, .28]; $rho_{reappraisal\_flexibility}$ = .06, [-.11, .23]. In other words, suppression and reappraisal flexibility did not show one-year retest reliability.

The random slopes from Model 2 were extracted and examined for longitudinal consistency. For suppression, the slopes for state negative affect were somewhat consistent ($rho_{suppression\_NA\_reactivity}$ = .29, [.13, .45]) whereas those for state positive affect and sociality were not ($rho_{suppression\_PA\_reactivity}$ =-.05, [-.21, .13]; $rho_{suppression\_social\_reactivity}$ = .06, [-.10, .24]). For reappraisal, the slopes for state sociality were somewhat consistent ($rho_{reappraisal\_social\_reactivity}$ = .28, [.13, .45]), whereas those for state negative and positive affect were not ($rho_{reappraisal\_NA\_reactivity}$ = .00, [-.17, .17]; $rho_{reappraisal\_PA\_reactivity}$ = .08, [-.09, .25]). In sum, two of the six estimates of reactivity – reactivity to negative affect by suppression and reactivity to social situations by reappraisal – were consistent across time. See Table 4 for the results from all consistency analyses and visual representations of individual-level estimates in Figure 1.

Do Measures of ER Relate to Measures of Psychosocial Well-Being?

ER dynamics were inconsistently associated with measures of psychosocial well-being. While ER tendency had the strongest associations with outcome measures, those associations failed to reach credibility at both timepoints. For example, the association between suppression tendency and depression at Wave 1 was r = 0.31 [0.22, 0.40], whereas the association at Wave 2 was r = 0.01 [-0.16, 0.17]. Suppression variability showed comparably smaller relationships with physical health satisfaction (r = 0.12 [0.02, 0.22]) while reappraisal variability was associated with family satisfaction (r = 0.10 [0.00, 0.20]) and friendship satisfaction (r = 0.10 [0.01, 0.21]), but only at Wave 1. As shown in Table 5, no associations between a given ER dynamic and outcome measure were credible at both waves.

Sensitivity Analysis

We repeated our analyses using alternative conceptualizations of ER tendency and variability. ER tendency (*iMean*) showed modest reliability for both suppression (r = .18 [.01, .33]) and reappraisal (r = .33 [.17, .47]), but showed inconsistent reliability for variability (*iSD*) ($r_{suppression}$ = .10 [-.08, .27]; $r_{reappraisal}$ = .19 [.01, .35]). As was the case with the MELSM based correlations, there were only inconsistent relationships with outcomes across times. For example, the association between suppression tendency and depression at Wave 1 is moderate and credible (r = 0.30 [0.20, 0.39]) but at Wave 2 is essentially nil (r = -0.01 [-0.18, 0.15]). These findings are largely in line with the findings estimated from the MELSMs and provide evidence that the findings are not due to the choice of analyses.

Discussion

Our findings provide mixed evidence for the trait-like nature of dynamic emotion regulation constructs. To assess the extent to which tendency, variability, flexibility, and responsivity demonstrate the basic features of psychological

Table 4. Longitudinal Consistency of ER.

Measure	Suppression	Reappraisal
Tendency	**.24 [.09, .40]**	**.37 [.22, .51]**
Variability	.11 [-.05, .27]	.15 [-.01, .31]
Flexibility	.11 [-.06, .28]	.06 [-.11, .23]
Tendency - Controlling for Context	.15 [-.02, .31]	**.34 [.19, .50]**
NA Reactivity	**.29 [.13, .45]**	.00 [-.17, .17]
PA Reactivity	-.05 [-.21, .13]	.08 [-.09, .25]
Social Reactivity	.06 [-.10, .24]	**.28 [.13, .45]**

Correlations are Bayesian Pearson correlations of coefficients at Wave 1 with coefficients at Wave 2. Brackets contain 95% credible intervals. Bold values indicate those estimates with credible intervals excluding 0.

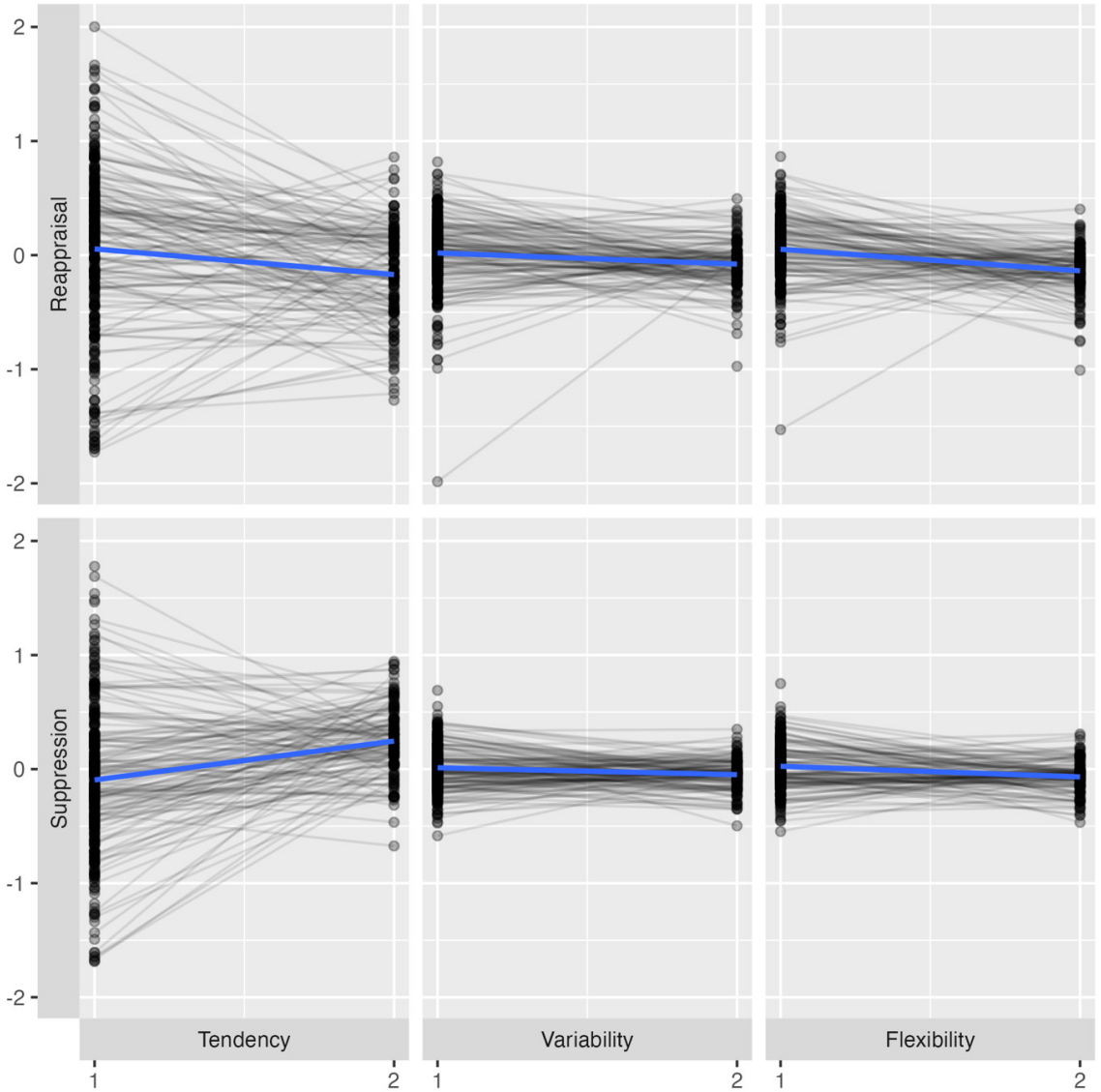

Figure 1. Emotion regulation across time.

Points represent individual's slope estimates at each wave, with lines connecting individuals. Blue line represents the line of best fit

traits, we examined their test-retest reliability across one year, and their association with outcomes. Emotion regulation tendency (i.e., average amount used) and responsivity (i.e., modulation in response to situation characteristics) were the most trait-like, as they were the most consistent across one year, and most closely associated with relevant outcomes. However, tendency and responsivity were not uniformly related to outcome measures across waves, sug-

Table 5. Associations with outcomes across time.

	Reappraisal		Suppression	
Outcome	Wave 1	Wave 2	Wave 1	Wave 2
Tendency				
CESD	.00 [-.10, .10]	.09 [-.07, .25]	**.31 [.22, .40]**	.01 [-.16, .17]
GPA	.00 [-.12, .13]	.05 [-.12, .22]	-.10 [-.22, .03]	-.07 [-.25, .10]
Physical Health	.08 [-.01, .19]	-.01 [-.17, .15]	**-.16 [-.26, -.06]**	.08 [-.08, .24]
Satisfaction - Academics	-.01 [-.11, .09]	.03 [-.14, .20]	**-.15 [-.25, -.05]**	.06 [-.11, .22]
Satisfaction - Family	**.14 [.04, .24]**	.14 [-.02, .30]	**-.14 [-.24, -.04]**	.10 [-.06, .27]
Satisfaction - Friends	.05 [-.05, .16]	-.04 [-.20, .14]	**-.28 [-.37, -.18]**	-.08 [-.25, .09]
Satisfaction - Life	**.17 [.06, .27]**	-.03 [-.18, .15]	**-.35 [-.44, -.25]**	.08 [-.07, .26]
Satisfaction - Mental Health	.10 [.00, .19]	-.08 [-.24, .09]	-.21 [-.31, -.12]	.10 [-.06, .26]
Satisfaction - Physical Health	.09 [-.01, .19]	.01 [-.15, .18]	**-.14 [-.24, -.03]**	.02 [-.14, .19]
Satisfaction - Romantic	**.13 [.02, .22]**	-.05 [-.22, .11]	**-.11 [-.21, -.01]**	.12 [-.04, .28]
Variability				
CESD	.00 [-.10, .10]	-.03 [-.20, .12]	.06 [-.05, .16]	-.03 [-.20, .13]
GPA	.05 [-.08, .17]	-.12 [-.29, .06]	.00 [-.12, .13]	-.18 [-.35, .00]
Physical Health	.07 [-.04, .16]	-.05 [-.22, .11]	.07 [-.03, .17]	-.04 [-.21, .12]
Satisfaction - Academics	-.01 [-.11, .09]	-.07 [-.23, .10]	-.07 [-.18, .03]	-.11 [-.28, .05]
Satisfaction - Family	.10 [.00, .20]	-.15 [-.30, .03]	.03 [-.06, .14]	-.15 [-.30, .02]
Satisfaction - Friends	**.10 [.01, .21]**	-.14 [-.29, .03]	.02 [-.08, .12]	-.13 [-.29, .04]
Satisfaction - Life	.08 [-.02, .18]	-.08 [-.24, .09]	-.02 [-.12, .08]	.00 [-.18, .16]
Satisfaction - Mental Health	.04 [-.06, .14]	-.13 [-.28, .05]	.02 [-.08, .12]	.00 [-.16, .18]
Satisfaction - Physical Health	.07 [-.04, .17]	-.08 [-.24, .09]	**.12 [.02, .22]**	-.05 [-.21, .12]
Satisfaction - Romantic	.00 [-.10, .11]	.07 [-.09, .25]	.01 [-.09, .12]	.07 [-.09, .25]
Flexibility				
CESD	.03 [-.07, .14]	.10 [-.07, .27]	.05 [-.06, .15]	-.02 [-.19, .14]
GPA	.00 [-.15, .13]	-.18 [-.35, .00]	.02 [-.12, .15]	**-.19 [-.36, -.02]**
Physical Health	.06 [-.05, .17]	-.13 [-.29, .04]	.10 [-.02, .20]	-.07 [-.25, .09]
Satisfaction - Academics	-.07 [-.18, .04]	-.09 [-.26, .09]	-.06 [-.17, .05]	-.11 [-.28, .06]
Satisfaction - Family	.12 [.00, .22]	-.16 [-.33, -.01]	.05 [-.07, .15]	-.18 [-.35, -.03]
Satisfaction - Friends	.07 [-.04, .18]	**-.20 [-.36, -.04]**	.01 [-.10, .13]	-.14 [-.29, .03]
Satisfaction - Life	.01 [-.09, .12]	-.19 [-.35, -.03]	-.01 [-.11, .10]	.01 [-.15, .18]
Satisfaction - Mental Health	.02 [-.09, .12]	**-.22 [-.38, -.07]**	.03 [-.08, .13]	.01 [-.16, .17]
Satisfaction - Physical Health	.09 [-.02, .20]	**-.18 [-.33, -.01]**	**.16 [.06, .27]**	-.06 [-.22, .11]
Satisfaction - Romantic	-.01 [-.12, .10]	-.02 [-.18, .15]	-.01 [-.12, .10]	.06 [-.10, .23]

Correlations represent Bayesian Pearson correlations between model coefficients and outcomes measures at each wave of the study. Brackets contain 95% credible intervals. Bold values represent estimates with credible intervals excluding 0.

gesting these indices might be limited in their utility. On the other hand, variability and flexibility mostly did not demonstrate the characteristics of traits. Taken together, these findings suggest that the various emotion regulation constructs differ in the extent to which they demonstrate trait-like qualities. We address the findings for each ER dynamic – tendency, responsivity, variability, and flexibility – below.

Tendency

Emotion regulation tendency – or the typical amount of ER strategy a person uses – shows all the relevant qualities of a trait. Tendency to suppress and reappraise showed the highest levels of consistency among the constructs, although the effect size was only modest (r = .24 and .37, respectively). This suggests that although individuals changed somewhat in their levels of suppression and reappraisal tendency relative to one another, there was a consistent, trait-like component.

Despite the evidence of longitudinal consistency and outcomes-associations, there are some limits to the utility of ER tendency. First, although ER tendency was the most consistent of the dynamics examined in the present study, tendency was substantially less consistent than other traits in prior research (e.g., neuroticism), which tend to have effect sizes closer to r = .50 (Gnambs, 2014). Thus, ER tendency may not be suitable for describing trait-like indi-

vidual differences. Moreover, we found the associations between tendency and outcomes were inconsistent across waves. This may be due to the low consistency of tendency – if the error variance in tendency is in part due to unmodeled covariates that are associated with outcomes, fluctuations in those variables will alter the relationships with outcomes.

Alternatively, inconsistent associations may reflect shifting demands of emerging adulthood. For example, suppression tendency was negatively associated with depression at Wave 1 but not at Wave 2. It may be that during transitions – for example, starting college – suppression is more adaptive. Because of the many new responsibilities that emerging adults incur and relationships that are formed during this time, people may choose to suppress their emotions while they learn what is an appropriate level of emotional expression in these new contexts and relationships. Moreover, if suppression is adaptive during a transition period, we may expect to see increases following the transition, as the behavior is rewarded. In other words, if young adults suppress their emotions and are successful at forming friendships, they may implicitly or explicitly learn that it was the suppression of emotions that supported their efforts and, in turn, become more likely to use suppression in the future. This would explain why depression was negatively associated with suppression in the first wave of our study.

In sum, the trait-like nature of ER tendency was unsurprising given prior work documenting its consistency across time. Moreover, these results fit with and extend findings that broader measures of affect dynamics (in the current research, tendency) show more utility for predicting outcomes, and more complex measures (in the current research, flexibility) provide little incremental predictive power (Dejonckheere et al., 2019).

Variability

Contrary to expectations, emotion regulation variability did not show trait-like qualities. It was not consistent across waves and showed limited associations with outcomes, with only two credible relationships each for suppression and reappraisal. Taken together, these findings do not support the notion that variability is a trait-like construct within individuals.

One reason for these findings could be that variability operates on a narrower timescale than was measured in the current study. For example, it could be the case that individual differences in variability are best measured over the course of hours rather than days if that is the timescale within which the variability of strategy use most strongly impacts a person's emotional experience. In that case, the variability that is observed in less granular timescales contains less meaningful variability than when observed on a narrower timescale. However, researchers have routinely used daily diary studies to measure ER variability and flexibility (Battaglini et al., 2022; Eldesouky & English, 2018), and research has demonstrated that dynamic measures derived from daily diary studies are comparable with those derived from more intensive ecological momentary assessments (Schneider et al., 2020). On the other hand, most prior work on ER dynamics focused on variability in a single time-window (e.g., within a single week), which does not allow for assessments of consistency over time as in the current study (however, see Blanke, Kalokerinos, et al., 2020). Nonetheless, the question of the ideal measurement interval for dynamic measures is an important one that likely depends on the nature of the construct being measured and warrants future empirical work (Wright & Hopwood, 2016).

The operationalization of variability in the current study was estimated in the context of mixed-effects location-scale models, in contrast to the intra-individual standard deviations (iSD; e.g., Blanke, Brose, et al., 2020; Eldesouky & English, 2018) which is commonly used. As a result, our measure of ER variability was regularized, resulting in less spread between participants – this may attenuate correlations with ER variability, including test-retest reliability. However, in sensitivity analyses we show that *iSD* is inconsistently stable across waves and has limited and inconsistent correlations with outcomes. Thus, we are confident that our results generalize across methods of person-level variability estimation.

Flexibility

Emotion regulation flexibility did not show trait-like qualities. There was no credible consistency across one year for either suppression or reappraisal nor were there consistent correlations with outcome measures. Such inconsistent associations may be related to the low longitudinal consistency of these indices and suggest correlations with outcomes at a single time-point should be interpreted with caution.

As with variability, it may be the case that flexibility operates on a narrower timescale than was measured in the current study. Given these findings, future work should examine the optimal timescales in which to assess both variability and flexibility. Another possible explanation for these findings is that the contextual features included in the current study – affect and sociability – are not the ideal features for either suppression or reappraisal flexibility. However, affect and sociability were chosen because are commonly used in other studies of flexibility (Brockman et al., 2017; Colombo et al., 2020; Greenaway et al., 2018). Additionally, it may be that suppression and reappraisal respond to different contextual features and should be modeled accordingly. While the ideal contextual features for modeling emotion regulation flexibility have yet to be empirically demonstrated, there are increasing calls for this work to be done (for more information see: English & Eldesouky, 2020; Springstein, Growney, et al., 2022). Future work should investigate the contextual features most associated with the flexible use of suppression and reappraisal.

It is also possible that a reason for the limited consistency is due to features of location scale models. Coefficients at the scale level will potentially be more susceptible to measurement error than those at the location level. However, prior simulation based research has demonstrated that the models provide unbiased estimates when true scale

effects are present (Leckie et al., 2014; Walters et al., 2018). This suggests that if biased estimates are present, it may be evidence for limited true variability or flexibility.

Responsivity

Emotion regulation responsivity – modulation in response to situation characteristics – exhibited some trait-like qualities. More specifically, suppression responsivity to negative affect and reappraisal responsibility to sociality were both relatively consistent across time. Put another way, people were consistent in the degree to which they suppressed negative affect and reappraised in social situations. One explanation of these findings is that these emotion regulation behaviors are reinforced in these instances. For example, there may be social or emotional benefits to reappraising emotions in social situations that encourage individuals to adopt a pattern of reappraisal in future social situations. These findings may provide support for the concept of interpretation biases, or trait-like individual differences that characterize people's typical way of interpreting emotion eliciting situations (Huppert et al., 2007). ER responsivity may also speak to individual differences in attachment. Indeed, prior work suggests that avoidantly attached individuals are more likely to suppress sadness (Brenning & Braet, 2013), although this work relied on cross-sectional questionnaires. We suggest that future work may investigate the relationship between ER dynamics, especially responsivity, and attachment.

While responsivity may be longitudinally consistent – and findings are consistent with related work conducted at the trait level – the associations between responsivity and outcomes were not consistent across time. This limits the extent to which responsivity may drive the emotional outcomes observed during emerging adulthood. As was the case with tendency, this could be related to the changing demands of the participants' environments.

Methodological Concerns Regarding the Study of Emotion Regulation

Taken together, these findings suggest that while emotion regulation tendency and, to some extent, responsivity demonstrate the properties of a trait, variability and flexibility do not. In light of this outcome, researchers should be cautious when interpreting contemporaneous correlations between these constructs and outcome variables.

Perhaps the measurement of flexibility could be improved by including situation features that are tailored to the strategy at hand, rather than assessing the same set of features for all strategies. However, it is commonplace to use the same covariates for multiple strategies. For example, emotion regulation goals have been shown to impact the selection and use of emotion regulation strategies (Ortner et al., 2021). Alternatively, future research would benefit from a more frequent sampling of emotion regulation, as the time scale of flexibility might only emerge in shorter intervals.

It is unclear whether these findings are generalizable beyond the population of emerging adults in college. Because of the changes in socioemotional skills and emotional experience that take place during emerging adulthoodhe consistency of variability and flexibility may emerge later in life (Benson et al., 2019; Carstensen et al., 2011; Zimmermann & Iwanski, 2014).

Limitations and Future Directions

While the contextual features we included in our study are among the most studied, they do not represent a comprehensive list of factors that play a role in the selection of ER strategies. Future work should consider the contributions of features of emotion regulation goals (English et al., 2017; Wilms et al., 2020) and other situational affordances (Suri et al., 2018; Tamir, 2016). Because daily measures were assessed with a limited number of items per construct, understanding the properties of those items and how responses are impacted by response options is particularly important, and future research should consider the effect of item characteristics on patterns of responses in experience sampling (Kulas et al., 2008; Nadler et al., 2015; Simms et al., 2019). Additionally, daily measurements may not be the ideal interval at which to sample dynamic measures of emotion regulation, although there is limited research to guide sampling decisions (Hopwood et al., 2022). Future research would benefit from an investigation of the proper timeframe and frequency at which to measure emotion regulation in daily life.

Conclusions

Our study used a novel method and burst design to test the extent to which various measures of emotion regulation dynamics are consistent, trait-like individual differences across one year. The current research provides support for the notion that emotion regulation tendency and, to some extent, responsivity, represent longitudinally consistent, trait-like individual differences. However, emotion regulation variability and flexibility to not exhibit these qualities. This work extends prior findings by suggesting that simpler dynamics like tendency show more consistency than complex metrics like flexibility and variability.

Author Contributions

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Methodology: Ian Shryock.
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Supervision: Sara J. Weston.
Visualization: Ian Shryock.
Writing — original draft: Ian Shryock.
Writing — review & editing: Ian Shryock, David M. Condon, and Sara J. Weston
Approved the submitted version for publication: Ian Shryock, David M. Condon, and Sara J. Weston

Competing Interests

We have no financial interests to disclose or conflicts of interest.

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Data Accessibility Statement

The authorship team does not have permission to share the current data but those interested in using the data are encouraged to reach out to the senior author. All R scripts have been uploaded as a part of the supplementary material that can be found at: https://osf.io/4b3y8/

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