Emotion Regulation Flexibility: Investigating Perseverative Thinking as a Novel Context

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Emotion Regulation Flexibility: Investigating Perseverative Thinking as a Novel Context

by

Beatris Garcia

A thesis presented to
Washington University in St. Louis
in partial fulfillment of the
requirements for the degree
of Master of Arts

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Beatris Garcia

Washington University in St. Louis

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ABSTRACT OF THE THESIS

Emotion Regulation Flexibility: Investigating Perseverative Thinking as a Novel Context

by

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Master of Arts in Psychological and Brain Sciences

Washington University in St. Louis, 2023

Professor Renee J. Thompson, Chair

Emotion regulation (ER) flexibility is a rapidly evolving field within affective science. Current advances have identified context sensitivity as a leading method for measuring ER flexibility, largely focusing on affectivity and situational control as markers of context. In this study, we propose an innovative approach to expand the list of contextual features tied to ER flexibility by using a framework based on Perseverative Thinking (PT). We examined seven PT dimensions, including pleasantness, repetitiveness, self-focus, other-focus, certainty, controllability, and temporal orientation, along with six ER strategies: reappraisal, acceptance, problem solving, expressive suppression, distraction, and cognitive avoidance. Once a day over the course of ten days, 408 (Mage=19.55) college students completed an experimental paradigm that induced PT and ER, and reported momentary levels PT and ER. ER flexibility was measured via regression analyses measuring covariation between the seven PT dimensions with the six ER strategies. Results reveal that all PT dimensions (excluding certainty) predicted flexibility across the ER strategies. At the within person level, controllability was the most common predictors of variability, predicting change in reappraisal, acceptance, problem solving, and suppression. At the between person level, repetitiveness was the most common predictor of variability, predicting change across all ER strategies (excluding acceptance). We ran secondary analyses to test
whether trait PT influenced these associations and found that elevated PT was a significant moderator of other focus. These findings highlight the need to explore novel contexts related to ER flexibility.
Introduction

Historically, research on emotion regulation (ER) has focused largely on the use of individual strategies, or the extent to which a person uses one strategy over others at a given time (Sheppes and Gross, 2011). As a result, a categorization structure was established such that strategies were then classified as adaptive if they were associated with more desirable outcomes such as decreased negative emotions, increased positive emotions, or facilitated social connection (Gross and John, 2003; McRae et al. 2012). Similarly, strategies were classified as maladaptive if they had been associated with less favorable outcomes such as increased negative emotion (Liverant et al., 2008; Brockman et al., 2017), decreased positive emotion (Wang et al., 2009; Brockman et al., 2017), or social tension (Butler et al., 2007). However, more recent work suggests that this categorization structure is not universally true across circumstances.

To illustrate how this shift in theorizing emerged, we review inconsistencies in the empirical literature on the adaptiveness of cognitive reappraisal (referred to as reappraisal for the remainder of the manuscript). Reappraisal, defined as reframing how one interprets a situation to alter its emotional impact (Gross & John, 2003), has been long considered an adaptive strategy, with a large amount of research supporting this categorization (see Webb et al., 2012 for a review). However, there is evidence that frequent use of reappraisal in social situations is related to maladaptive physiological reactivity (Christensen et al., 2017). Findings from neuroimaging work have also shown that use of reappraisal may capture reduced emotional processing rather than reduced emotional impact (Morawetz et al., 2017). Further, Troy et al. (2013) suggest that reappraisal may serve as a means of avoiding emotional experience, which can lead to reduced emotional processing. With more evidence that reappraisal can sometimes have deleterious effects, there has been a discernible shift away from rigid categorizations of ER strategies. In
particular, there is a push to move toward a more dynamic classification that can be used to
distinguish strategies on a case-by-case basis.

This notion of creating a more fluid approach is closely tied to another long-standing
body of literature, broadly known as flexibility. Under this umbrella, the construct of
psychological flexibility is considered to be one of the hallmarks of psychological health.
Psychological flexibility was first coined in Acceptance and Commitment Therapy (ACT) and is
defined as connecting one’s present experiences to their overarching values and adjusting
behavior to align with said values (Kashdan & Rottenberg, 2010). Evidenced by its mechanistic
role in ACT, greater psychological flexibility is suggested to increase life satisfaction and reduce
stress, leading to improved mental health outcomes (Lucas & Moore, 2020; Wereesebe et al.,
2018; Ciarrochi et al., 2010; Doorley et al., 2020). Similarly, cognitive flexibility refers to one’s
ability to refocus their cognitive processing strategies in response to changing environmental
conditions (Canas et al., 2003). These strategies are related to functions such as attention,
learning, and decision making (Canas et al., 2006; Laureiro-Martínez & Brusoni, 2018). Again,
greater flexibility in this domain has links to wellbeing such as decreased risk for depressive
disorders (Soltani et al., 2013; Fazeli et al., 2015). Ultimately, this evidence suggests that the
concept of flexibility is an important asset to psychological functioning.

Emotion Regulation Flexibility

The underlying thread of these frameworks highlights the adaptive nature of adapting to
changing circumstances and environment. Similarly, the new wave of research in affective
science is characterized by adaptability, known as ER flexibility. Multiple approaches targeting
ER flexibility have emerged in a relatively short period of time. One of the first instances
alluding to ER flexibility was posed by Bonnano et al. (2004) regarding expressive suppression,
suggesting that successful ER should not be based on measuring an ER strategy independently, but rather on an individual’s ability to increase or decrease their use of said strategy in correspondence with situational demands. This theorizing was momentous and appears throughout the two leading theoretical frameworks for ER flexibility.

We break down Bonnano et al. (2004)’s definition to highlight how it shaped the present conceptualization of ER flexibility. First, the increasing and decreasing of strategy use would later be known as ER variability. ER variability refers to the extent to which use of a specific ER strategy varies, measured as either across time (i.e., within strategy variability) or compared to other strategies for a single time point (i.e., between strategy variability; Aldao et al., 2015). For some time, this was one of the most prominent approaches for research on ER flexibility. For example, an experience sampling study by Eldesouky and English (2018) found that older adults compared to younger adults reported less variability of strategies across days and posited that this consistency of ER strategies used was indicative of less flexibility. More recent work has measured how correlations between historically adaptive and maladaptive ER strategies change, as use of strategies varied (Elkjaer et al., 2022).

Ultimately, however, there has been an increasing consensus that variability does not equate, but rather precedes, flexibility (English & Eldesouky, 2020; Kalokerinos & Koval, 2022). Going back to Bonnano’s (2004) initial thinking regarding a dependence on changing situation demands highlights the crucial feature that was missing from ER variability. That is, the ebb and flow of use for a specific strategy should be an adaptation to the ebb and flow of situational demands (English & Eldesouky, 2020; Elkjaer & Mikkelsen, 2022). Bonanno and Burton (2013) propose a competing conceptualization suggesting that ER flexibility can be thought of as having three stages. These stages are (a) context sensitivity, which represents an evaluation of situational demands to identify the needs of regulation, (b) repertoire, which
represents the selection of an ER strategy(ies) that can meet one’s regulatory needs, and (c) feedback, which represents the monitoring and modification of ER as the situation changes. The strategy-situation hypothesis is another name for context sensitivity, which more directly states that variability in strategy use should be an outcome of variability in context to be considered ER flexibility (Bonnano and Burton, 2013; Haines et al., 2016). A commonly used method to measure the context sensitivity stage of ER flexibility is tracking the covariation between changes in a specified context and ER strategy use (Haines et al., 2016; Goodman et al., 2021; Battaglini et al., 2023). We briefly describe current findings on context sensitivity in ER flexibility.

We begin by describing one such marker of context, affectivity. Empirical work has found that as participants rate situations, facial expressions, and stimuli as more negative, they also report greater use of expressive suppression and distraction, and less use of reappraisal (Sheppes and Levin 2013; O’Toole et al., 2017; Goubet et al., 2019; Godara et al., 2021). A proposed explanation for this association comes from Sheppes et al. (2014) who suggest increased negative affect reduces cognitive resources, which may decrease the use of cognitively taxing strategies such as reappraisal. Controllability is another contextual feature linked to ER flexibility. Specifically, variability in the perceived controllability of stressors or situations is suggested to provoke variation in ER strategy use. Several studies have found that when participants report decreased control over a situation, they also report an increased use of reappraisal (Troy et al., 2013; Haines et al. 2016) and more recently problem solving (Goodman et al., 2021). Battaglini et al. (2022) proposed a potential explanation: Strategies like reappraisal are useful for changing one’s emotion, which people may be especially inclined to pursue when they believe they have no control or power to change a situation. While this list of context...
indicators related to ER flexibility is not exhaustive, however we believe it highlights qualitative differences in context that should be considered.

We propose that affectivity and controllability represent two distinctive types of contexts: internal and external context, respectively. Work on affectivity often refer to the emotional experience that is induced from stimuli such as negative images (Specker et al., 2023). Research on control and ER flexibility often refer to the control around environmental characteristics such as interpersonal stressors (Battaglini et al., 2022). Given this differentiation, we believe an important extension to current understanding on ER flexibility is examining internal and external context, simultaneously.

**Perseverative Thinking as an Ideal Candidate**

To extend current work in ER flexibility, we propose a shift in focus towards phenomena that allow for the simultaneous evaluation of internal and external contextual factors. We posit one such way to be perseverative thinking (PT; also known as repetitive negative thinking), defined as a thought process that is repetitive, uncontrollable, and focused on negative content (Ehring & Watkins, 2008). PT is used as an umbrella term that refers to the shared characteristics of more specific forms of repetitive thought, namely rumination and worry (McEvoy et al., 2013; Wisco et al., 2018). Rumination is characterized by a repetitive and passive focus on past events, while worry describes a repetitive focus on future-oriented events (Watkin et al., 2005; Goring & Papageorgiou, 2008). Importantly, the repetitive and cyclical nature of PT gives rise to a range of emotional consequences that necessitate effective regulation.

Indeed, there is a substantial association between PT and negative affect (NA), a primary target of ER. A review by Watkins (2008) suggests that PT may serve to prolong the experience of NA. Further, PT is also thought to exacerbate NA at both the trait and state levels (Du et al.,
From a clinical standpoint, PT is recognized as a feature of several psychological issues, particularly for emotional disorders such as Major Depressive Disorder (MDD) and Generalized Anxiety Disorder (GAD; Spinhoven et al., 2015). These disorders are often characterized by ER difficulties, so even intervention work such as Emotion Regulation Therapy have specified PT as a treatment target (Mennin & Fresco, 2014; Renna et al., 2017). Given that both normative and pathological levels of PT have been associated with ER, PT seems to be a competitive candidate for future work on ER. However, there is an additional point of consideration that arguably makes PT the ideal candidate for exploring new contexts linked to ER flexibility.

As previously mentioned, PT encompasses a set of shared attributes that characterize various forms of repetitive thought. The most common of these being pleasantness, repetitiveness, self-focus, other-focus, certainty, controllability, and temporal orientation (Ehring & Watkins, 2008; Nolen-Hoeksema et al., 2008; McEvoy et al., 2013; Hallion et al., 2022; Stade & Ruscio, 2023). We believe that it is this diverse yet related list of qualities which make PT an optimal candidate to assess both internal and external context. For example, pleasantness, repetitiveness, and self- and other-focus exemplify one’s internal experience when they engage in PT. Specifically, they capture whether one’s thoughts are pleasant (vs. unpleasant), how much they have the same thoughts repeating over and over (vs. different thoughts), and the extent to which their thoughts are about themselves (vs. others). On the other hand, certainty, controllability and temporal orientation represent the external or environmental circumstances. That is, they measure situational elements such as how much certainty exists around a particular outcome, the degree of control or influence one has over the situation, and whether a situation has yet to occur. Therefore, by using PT as a framework for exploring new contextual features,
we have access to a set of attributes that not only have a well-established presence in PT literature but have also historically been studied in conjunction with each other.

Although these PT factors have not previously been studied through a context perspective, it can be argued they serve to contextualize the internal experience of perseveration caused by one’s external environment. For the remainder of the manuscript, we will refer to these characteristics as PT dimensions to exemplify the complexity inherent in the PT process. At a glance, there is apparent overlap between contextual features which have been previously examined under an ER flexibility framework and the PT dimensions here. First and foremost, situational controllability is common to both but often described as control over a situation in ER flexibility (Socastro et al., 2022) and a lack of control in PT (Stade & Ruscio, 2023). While affectivity describes the valence of one’s emotions (Haines et al., 2016) and pleasantness describes the valence of one’s thoughts (Rosenkranz et al., 2020), they arguably tap into a similar phenomenon (Gross, 2002). The remaining five PT dimensions reference qualities that have yet to be explored in ER flexibility research. With this in mind, pursuing the PT dimensions as features of context would not only allow for replication (e.g., controllability), but more importantly present an opportunity to identify novel features of context relevant in ER flexibility.

The Present Study

Research on ER flexibility has shown promising developments, especially in understanding the context sensitivity stage. However, recent years have witnessed a slowdown in the identification of relevant contextual factors. The current investigation seeks to extend current findings via a PT framework to determine whether widely used PT dimensions can serve as viable contexts to measure context sensitivity, and thus ER flexibility. We follow the lead of previous work on the strategy-situation fit hypothesis (Goodman et al., 2021; Paul et al., 2023)
and aim to measure covariation between change in the PT dimensions to change in ER strategy use. Research on PT often uses experimental paradigms to allow for more precise measurement when participants exhibit PT (Ruscio et al., 2011; Berenbaum et al., 2018; Rosenkranz et al., 2020). Furthermore, the use of Experience Sampling Methodology (ESM) has become increasingly essential to assess how variations in context influence ER flexibility (Elkjaer et al., 2022; Socastro et al., 2022; Specker et al., 2023; Battaglini et al., 2023). Thus, to measure context sensitivity in daily life we used an experimental induction paradigm to assess momentary PT and ER and combined it with an ESM measurement structure to capture naturally occurring variability in PT and ER. We limited our list of ER strategies to those that have previously been associated with trait PT (Boemo et al., 2022). Further, we intentionally selected an even number of engagement and disengagement strategies (Naragon-Gainey et al., 2017). A core feature of PT is described as difficulty with disengagement with negative thoughts (Ehring et al., 2011; Spinhoven et al., 2015), so we anticipated that strategies classified as engagement or disengagement would be most commonly reported following the PT induction.

We will examine how variation in the PT dimensions are associated with variation ER strategy use across time (Aim 1). We will be testing all seven PT dimensions (i.e., pleasantness, repetitiveness, self-focus, other focus, certainty, controllability, and temporal orientation), along with a combination of engagement and disengagement ER strategies (i.e., reappraisal, acceptance, problem solving, expressive suppression, distraction, cognitive avoidance). We hypothesize that the seven PT dimensions will be differentially related to the six ER strategies (see Table 1). Most of the individual PT dimensions outlined have yet to be studied with regard to ER, so our hypotheses are informed by work on PT more broadly. Broadly, we expected to find that negative internal contexts (e.g., increased repetitiveness, decreased pleasantness) would
predict more variability among disengagement strategies, while external context (e.g., certainty, temporal orientation) would predict variability among engagement strategies, at both the within and between person level. Additionally, given that PT can also be pathological (Mennin and Fresco 2014, Spinhoven et al., 2015), we believe it is important to test the influence of a tendency toward perseveration. We will investigate whether trait levels of PT impact the associations between the PT dimensions and ER strategies (Aim 2). We hypothesize that higher levels of trait PT will strengthen the association between the PT dimensions and the disengagement ER strategies.

Method

Participants and Procedure

Participants included 431 college students recruited from a private Midwestern university. The study was posted on an online platform, SONA, that advertises research studies to undergraduate students enrolled in psychology courses. Inclusion criteria required participants to be at least 18 years old. Additionally, participants were required to have a device (e.g., cell phone, laptop) that had the capability of hearing the audio presented throughout the study activities. A total of 17 participants started but did not complete (e.g., failure to complete at least one daily diary). An additional six participants withdrew from the study. The final sample included 408 participants (M\text{age}=19.55, SD\text{age}=1.61; range: 18-32). Participants reported their gender as follows: 54% women, 44% men, and 2% non-binary. Efforts were taken to recruit a gender distribution of participants that reflected the student body (i.e., 54% women, 46% men). Participants’ self-reported race/ethnicity was 42% White/European American, 29% Asian American, 14% Black/African American, 11% Hispanic/Latino, and 4% other, which is similar to that of the student body (i.e., 42% White, 20% Asian, 12% Hispanic/Latino, 9% Black/African American
American, and 17% other). On average, participants completed 6.57 (SD=2.53) surveys resulting in a 65% compliance rate, which is lower compared to other studies’ average rate reported in a meta-analysis by Wrzus and Neubauer (2023).

Once participants signed up for the study via SONA, they were sent to an online informed consent form, which described that the study would include a baseline session followed by nine consecutive days of daily surveys. If they consented to participate, they began the study on the following day, which consisted of a 30-minute baseline session. During this baseline session, participants completed a training of their daily task consisting of a PT and ER induction paradigm, along with a series of self-report measures (described below). The data from the training of the daily task in the baseline session was counted as Day 1 of the 10-day study procedure. Then, for the next nine days (Days 2-10), participants received an email at night that contained a hyperlink to their daily task. Participants received the link to the daily task at 9pm and had until 5am the following day to complete it. Participants were instructed to complete the daily task before they went to sleep. Given that the study required a written portion, participants were requested to complete the daily tasks on a desktop or laptop computer but had the option to indicate that they used a mobile device (e.g., cellphone, tablet). On the final day of the study (Day 10), participants were presented with a debriefing at the end of the daily task. Participants were compensated with research participation credit. Participants received full credit for the study if they completed 8 out of the 10 daily surveys and reduced credit for completing less (i.e., .5 credits for 1-3 surveys, 1 credit for 4-6 surveys, 1.5 credits for 7 surveys). Participants received an email reminder about the credit distribution when they missed their second survey, and then again when they missed their third survey. This study was approved the university institutional review board (IRB application #202203158).
Simulation methods were used to determine the sample size and number of assessments. Effect sizes for the associations of interest were unknown, so the data of ten pilot participants was used to provide estimates of means, variances, and covariances that then were used to generate simulated data sets for each simulation. Different simulations (each with 2000 simulated data sets) assessed different combinations of sample size (participants) and number of assessments (days). In each simulated data set, the pilot-data model was estimated, and significance of effects was tallied. The proportion of significant effects across the 2000 simulated data sets for a particular sample size and number of assessments is the empirical power rate. Given the nature of repeated sampling, the simulation also accounted for varying response rates (i.e., 60% - 100% compliance). A handful of analyses required sample sizes greater than 1000 which was not feasible, so the chosen N reflects the size necessary to adequately assess 80% of the associations of interest. Simulation analyses indicated that a design with 435 Level 2 units (i.e., participants) and eight Level 1 units (i.e., days) would provide sufficient power (i.e., .80 minimum; Nezlek, 2012).

Materials

Self-Report Measures (Baseline only)

**Perseverative Thinking.** Trait PT was measured using 10-item the Perseverative Thinking Questionnaire (PTQ; Ehring et al., 2011). Example items include “The same thoughts keep going through my mind again and again,” and “I keep thinking about the same issue all the time.” Items are rated on a 5-point Likert scale ranging from 0 (*Never*) to 4 (*Almost always*). The internal consistency of the PTQ was high in this sample (α=.93). Validation studies of the PTQ find it is significantly correlated with other scales measuring more specific forms of PT such as the Response Styles Questionnaire (RSQ; Nolen-Hoeksema et al., 1991) and the Penn State
Worry Questionnaire (PSWQ; Meyer et al., 1990), with correlations ranging between .52-.70 and .59-.72, respectively (Ehring et al., 2011; Devynck et al., 2017; Valencia et al., 2022).

Daily Measures (administered for ten days)

**Daily Task.** The daily task comprised a 4-minute induction paradigm adapted from Krahe et al. (2016), involving subtasks that directed participants to either engage in PT or employ ER. The original task only included the PT phase, so we added an ER phase for the purposes of this study. At the start of the daily task, participants were instructed to report a recent negative experience they had been perseverating on during the day. In the event that participants did not engage in PT during the day, they were asked to instead report any negative experience they had. They categorized the experience into one of three themes represented in the original task (Krahe et al., 2016): Social, achievement and feelings. The theme categorization was not a part of the current study so it will not be discussed further (see Table 2 for a full description of PT provided to participants). After participants reported a negative experience, they began the PT phase of the induction which was divided into two parts, PT writing and PT thinking. In the PT writing task, participants were instructed to write the negative thoughts they had about the experience for 2-minutes. Next, participants completed the PT Thinking section in which they were instructed to continue thinking about the experience for an additional minute. Following the PT phase, participants entered the ER phase, referred to as the ER period, in which they were asked to spend one minute attempting to reduce the negative emotions associated with the experience. Participants heard a chime to signal the end of each timed period. Following the PT phase participants rated the level they experienced each PT dimensions (momentary PT). After the ER period, participants rated the extent to which they utilized the six ER strategies (momentary ER). See Figure 1 for a visual representation of the task design and see appendix for
the full instructions of the Daily Task. We collected 3,239 open-responses. Before proceeding with data analysis, each open-response from the PT writing phase of the induction was coded by the author and two undergraduate research assistants to evaluate the participants' level of engagement with the task. The responses were coded as follows: 0 (excluded) = responses that were nonsensical or gibberish (e.g., asdfgjkl), responses that were unrelated to the task (e.g., grocery list), and responses stating explicitly that the participant did not perseverate, and 1 (included) = all other responses. The three raters discussed discrepancies in codes, and final decisions were made by consensus. Interrater reliability was calculated using Fleiss’ Kappa and showed very good agreement ($\kappa=.87$; McHugh, 2012). Among the 3,239 responses, 141 (4%) were excluded due to poor data quality concerns. Analyses were conducted the cleaned dataset.

**Momentary PT.** Each dimension of PT was measured using a single item for a total of seven momentary PT items. The pleasantness dimension was measured with the item “My thoughts have been” rated on a 1 (very unpleasant) to 5 (very pleasant) scale. The repetitiveness dimension was measured with the item “My thoughts have been repetitive” rated on a 1 (not at all) to 100 (very much so) visual analog scale. The self-focus dimension was measured with the item “My thoughts have been mostly focused on” using the multiple-choice responses options “myself” or “not myself.” The other-focus dimension was measured with the item “My thoughts have been mostly focused on” using the multiple-choice response options of “others” or “not others.” The certainty dimension was measured with the item “I have felt a sense of certainty about the situation” rated on a 1 (not at all) to 100 (very much so) visual analog scale. The controllability dimension was measured with the item “I have felt a sense of control about the situation” rated on a 1(not at all) to 100 (very much so) visual analog scale. The temporal orientation dimension was measured with the item “My thoughts have been mostly focused on
the” using the multiple-choice response options of “past,” “present,” or “future.” All items were taken from Kircanski et al. (2015) and adapted to refer to the present moment rather than “at the time of the beep.” The combination of these items captured 56.24% and 49.82% of the within-person variability in rumination and worry, respectively, suggesting acceptable construct validity with PT (Kircanski et al., 2015). Internal consistency for the four continuous PT dimensions (i.e., pleasantness, repetitiveness, certainty, and controllability) when summed across time points was poor to moderate (ICC = .11 - .40).

**Momentary ER.** Each ER strategy was measured using a single item for a total of six momentary ER items. ER items were modeled after existing studies measuring momentary use of the strategies of interest. Reappraisal was measured with the item “Tried to think about something more positively.” Expressive suppression (referred to as suppression for the remainder of the manuscript) was measured with the item “Tried to not let my feelings show.” Distraction was measured using “tried to think about something else to change how I was feeling [i.e., distract myself].” These three items were modeled after Eldesouky and English (2018). Acceptance was measured with the item “I tried to accept that this is the way things are.” Problem solving was measured with the item “I tried to think about a way to fix the problem.” These two items were modeled after Short et al. (2018). Experiential avoidance (referred to as avoidance for the remainder of the manuscript) was measured using “I tried to get rid of negative thoughts, feelings, or sensations” modeled after (Naragon-Gainey et al., 2017). All items were rated on a 1 (not at all) to 7 (a great deal) scale and were modified to refer to the present moment (Eledsouky and English, 2018). Internal consistency across the six ER strategies when summed across time points was fair to moderate (ICC = .33 - .46).

**Statistical Analyses**
All analyses were conducted using R software (V 4.3.1; R CoreTeam, 2023). Multilevel modeling (MLM) was used since our momentary data (level 1 [L1]) was nested within individuals (level 2 [L2]). MLM accounts for dependency in the data such that it simultaneously estimates both within- and between- person effects (Nezlek, 2012). We conducted linear regressions using the lmer() function from the lme4 package (Bates et al., 2015). We addressed missing data using the default method in the lme4 package which removes observations containing missing values. To test Aim 1, we entered person-mean centered versions of the four continuous (i.e., pleasantness, repetitiveness, certainty, controllability) and the original three categorical (i.e., self-focus, other focus, and temporal orientation) PT dimensions as L1 predictors with individual strategies as L1 outcomes (e.g., reappraisal) and included a random intercept. To test for between person differences, we also included mean level of each continuous PT dimension as a predictor (i.e., mean pleasantness, mean repetitiveness, mean certainty, and mean controllability). Self-focus and other focus were dummy coded with a single value (e.g., self = 0, not self = 1). Temporal orientation was dummy coded with two values (i.e., 00 = present, 10 = past, 01= future). A model was run for each individual strategy, resulting in six MLMs. To test Aim 2, we modified the initial model to include grand mean centered PTQ score as a L2 covariate. This resulted in six additional MLMs.

**Results**

We summarize descriptive information for the trait and momentary variables (see Table 3). Mean and standard deviation, standard error, internal consistency and interclass coefficient was calculated for the PTQ. Means, within and between standard errors, frequencies, internal consistencies, and interclass coefficients were calculated for the PT dimensions and ER strategies. The sample mean on the PTQ was 33.75 (SD=12.47). Recent studies conducted with
college students have found lower sample means on the PTQ, which suggests the current sample may have had particularly elevated levels of trait PT (Hager et al., 2022; Thompson et al., 2022). Within- and between person correlations were calculated for all variables using the Psych and Dplyr packages and are presented in Table 4 (Revelle, 2023; Wickham et al., 2023). Correlations between the PT dimensions did not exceed r=.60, suggesting that each PT dimension accounts for unique variance.

**Do PT dimensions predict Flexible use of ER Strategies (Aim 1)?**

We used MLM to measure whether the PT dimensions (i.e., pleasantness, repetitiveness, self-focus, other focus, certainty, controllability, and temporal orientation) predicted the use of individual ER strategies (i.e., reappraisal, acceptance, problem solving, suppression, distraction, and avoidance). We began by testing the unconditional model for all six strategies, which provides an estimation the proportion of variance accounted by the between-person level. Results showed that variance at the between-person level ranged from 35% to 46% across strategies, suggesting that majority of variability for all strategies was at the within-person level. We then tested the full model:

**Model 1**

**Level 1** (prompt level):

\[
\text{Reappraisal}_{ij} = \beta_0 + \beta_{1j}(\text{pleasantness}) + \beta_{2j}(\text{repetitiveness}) + \beta_{3j}(\text{certainty}) + \\
\beta_{4j}(\text{controllability}) + \beta_{5j}(\text{past}) + \beta_{6j}(\text{future}) + \beta_{7j}(\text{self focus}) + \beta_{8j}(\text{other focus}) + \\
\beta_{9j}(\text{mean pleasantness}) + \beta_{10j}(\text{mean repetitiveness}) + \beta_{11j}(\text{mean certainty}) + \\
\beta_{12j}(\text{mean controllability}) + r_{ij}
\]

**Level 2** (participant level):

\[
\beta_0; \gamma_{00} + u_{0j} \\
\beta_{1j}; \gamma_{10} + u_{1j} \\
\beta_{2j}; \gamma_{20} \\
\beta_{3j}; \gamma_{30} \\
\beta_{4j}; \gamma_{40}
\]
Reappraisal_{ij} represents level of reappraisal use for participant \( j \) at prompt \( i \). \( \beta_{0j} \) represents the within-person mean use of reappraisal. The four continuous PT dimensions were person-mean centered to assist with the interpretability of the intercept. \( \beta_{1j} \) represents the magnitude of change in mean reappraisal for a 1-unit increase in pleasantness, (similar interpretation for \( \beta_{1j} \) through \( \beta_{10j} \) for their respective PT dimension). \( r_{ij} \) represents the within-person random effect. \( \gamma_{00} \) represents the grand mean for reappraisal. The continuous predictors (e.g., repetitiveness) are the person-mean level and categorical predictors are at zero. \( \gamma_{10} \) through \( \gamma_{80} \) represent the change in mean reappraisal when the respective PT dimension deviates from the person-mean or zero. \( u_{0j} \) represents the between-person random effect. Given that the continuous predictors are person-mean centered, person means were tested to reflect between person differences. All PT dimensions were tested as random effects in a series of likelihood ratio tests. Only pleasantness was retained in the random effect specification. The model above was repeated for each ER strategy, resulting in a total of six MLMs. Results for models predicting the engagement strategies can be found in Table 5a and those predicting disengagement strategies in Table 5b.
We review first the results for the internal PT dimensions. Change in pleasantness significantly predicted change in reappraisal ($b = .06, SE = .03, p = .02$) and acceptance ($b = .14, SE = .03, p < .001$), in support of hypotheses 1a and 1b. As participant’s rating of pleasantness increased above their mean level of pleasantness, their use of reappraisal and acceptance also increased. There were no other significant associations between pleasantness and the other ER strategies (i.e., hypotheses 1c, 1d, 1e, 1f). The next results refer to between person differences in pleasantness. Mean pleasantness predicated acceptance ($b = .24, SE = .08, p < .001$), suppression ($b = .28, SE = .08, p < .001$), and distraction ($b = .33, SE = .08, p < .001$). Participants who reported higher overall pleasantness of their thoughts, compared to those with lower pleasantness ratings, also reported greater use of acceptance, suppression, and distraction. Change in repetitiveness significantly predicted change in reappraisal ($b = .068, SE = .02, p < .001$) and avoidance ($b = .05, SE = .02, p = .03$). Only the association with avoidance was in the expected direction, supporting hypothesis 2f. As participant’s rating of repetitiveness increased above their mean level of repetitiveness, their use of reappraisal and avoidance also increased. There were no other significant associations between repetitiveness and the other ER strategies (i.e., hypotheses 2b, 2c, 2d, 2e). Change in self-focus predicted change in acceptance ($b = -.25, SE = .02, p = .009$). When participants reported their thoughts to not be about themselves, their use of acceptance decreased. We had no a priori hypothesis about this association. There were no other significant associations between self-focus and the other ER strategies (i.e., hypotheses 3a, 3c, 3d, 3e, 3f). The next results refer to between person differences in repetitiveness. Mean repetitiveness predicated reappraisal ($b = .18, SE = .06, p < .001$), problem solving ($b = .25, SE = .06, p < .001$), suppression ($b = .20, SE = .06, p < .001$), distraction ($b = .22, SE = .06, p < .001$), and avoidance ($b = .24, SE = .06, p < .001$). Participants who reported higher mean repetitiveness of their thoughts, compared to those with lower repetitiveness ratings, also reported greater use
of reappraisal, problem solving, suppression, distraction, and avoidance. Change in other focus predicted change in reappraisal \((b = .16, SE = .06, p = .006)\) and problem solving \((b = .33, SE = .08, p < .001)\). Only the association with reappraisal was in the expected direction, supporting hypothesis 4a. When participants reported their thoughts to not be about others, their use of reappraisal and problem solving increased. There were no other significant associations between other focus and the other ER strategies (i.e., hypotheses 4b, 4d, 4e, 4f).

Next, we review the results for the external PT dimensions. Change in certainty did not significantly predict change in any of the ER strategies (i.e., hypotheses 5a, 5b, 5c, 5d, 5e, 5f). Regarding between person differences in certainty, there were no significant associations between mean certainty and any of the ER strategies. Change in controllability significantly predicted change in reappraisal \((b = .06, SE = .02, p = .01)\), acceptance \((b = .33, SE = .08, p < .001)\), problem solving \((b = .24, SE = .03, p < .001)\), and suppression \((b = .33, SE = .08, p < .001)\). Only the associations with reappraisal, problem solving, and suppression were in the expected direction, supporting hypothesis 6a, 6c, and 6d. As participant’s rating of controllability increased above their mean level of controllability, their use of reappraisal and problem solving increased while use of acceptance and suppression decreased. There were no other significant associations between controllability and the other ER strategies (i.e., hypotheses 6e and 6f). The next results refer to between person differences in controllability. Mean controllability predicted reappraisal \((b = .21, SE = .06, p < .001)\), acceptance \((b = .32, SE = .06, p < .001)\), problem solving \((b = .42, SE = .06, p < .001)\), and suppression \((b = .13, SE = .06, p = .03)\). Participants who reported higher mean controllability of their thoughts, compared to those with lower mean controllability ratings, also reported greater use of reappraisal, acceptance, problem solving, and suppression. Past temporal orientation did not significantly predict variability in any of the ER strategies (i.e., hypotheses 7b and 7e). Future temporal orientation
significantly predicted variability in problem solving \((b = .26, SE = .02, p = .001)\). When participants rated situations as future focused, this use of problem solving increased. We did not have an a priori hypothesis of this association. There were no other significant associations between future orientation and the other ER strategies (i.e., hypotheses 7a and 7d). Altogether, we found support for new indicators of context, as denoted by the PT dimensions, that are linked to ER flexibility. That is all the internal (i.e., pleasantness, repetitiveness, self-focus and other focus) and some of the external (i.e., controllability and temporal orientation) predicted variability across the ER strategies.

**Does Trait PT Moderate the associations between the PT Dimensions and ER Strategies (Aim2)?**

We ran a secondary MLM to measuring whether any of the initial associations between the PT dimensions and ER strategies were moderated by PTQ score. That is, does the strength of these associations change at different levels of perseverative thinking? We updated the model to include an L2 predictor, PTQ score, as a moderator.

**Model 2**

Level 1 (prompt level):
\[
\text{Reappraisal}_{ij} = \beta_0 + \beta_{1j}(\text{pleasantness}) + \beta_{2j}(\text{repetitiveness}) + \beta_{3j}(\text{certainty}) + \beta_{4j}(\text{controllability}) + \beta_{5j}(\text{past}) + \beta_{6j}(\text{future}) + \beta_{7j}(\text{self focus}) + \beta_{8j}(\text{other focus}) + \beta_{9j}(\text{mean pleasantness}) + \beta_{10j}(\text{mean repetitiveness}) + \beta_{11j}(\text{mean certainty}) + \beta_{12j}(\text{mean controllability}) + r_{ij}
\]

Level 2 (participant level):
\[
\beta_0: \gamma_{00} + \gamma_{01}(\text{PTQ}) + u_0
\]
\[
\beta_{1j}: \gamma_{10} + \gamma_{11}(\text{PTQ}) + u_1
\]
\[
\beta_{2j}: \gamma_{20} + \gamma_{21}(\text{PTQ})
\]
\[
\beta_{3j}: \gamma_{30} + \gamma_{31}(\text{PTQ})
\]
\[
\beta_{4j}: \gamma_{40} + \gamma_{41}(\text{PTQ})
\]
Reappraisal_{ij} represents level of reappraisal use for participant j at prompt i. \( \beta_{0j} \) represents the within-person mean use of reappraisal. \( \beta_{1j} \) represent the magnitude of change in mean reappraisal for a 1-unit increase in pleasantness, (similar interpretation for \( \beta_{1j} \) through \( \beta_{8j} \), for their respective PT dimension). \( r_{ij} \) represents the within-person random effect. \( \gamma_{00} \) represents the grand mean for reappraisal the continuous predictors (e.g., repetitiveness) are the person-mean level and categorical predictors are at zero. \( \gamma_{10} \) through \( \gamma_{10} \), represent the change in mean reappraisal when the respective PT dimension deviates from the person-mean or zero. \( \gamma_{01} \) represents the difference in mean reappraisal use for a 1-unit increase in PTQ score (similar interpretation for \( \gamma_{02} \) through \( \gamma_{10} \)). All PT dimensions were tested as random effects in a series of likelihood ratio tests. Only pleasantness was retained in the random effect specification. \( u_{0j} \) represents the between-person random effect. PTQ score was grand mean centered to assist with interpretation of the intercept. Results for models predicting the engagement strategies can be found in Table 6a and those predicting disengagement strategies in Table 6b.

First, we review the results for the internal PT dimensions. Pleasantness interacted with PTQ score to significantly predict variability in distraction (\( b = -.06, SE = .03, p = .04 \)),
supporting **hypothesis 8e**. For participants with PTQ scores higher than the grand mean, when their rating of pleasantness increased above their mean level of pleasantness, their use of distraction decreased. That is, when PTQ score increased, the slope of the association between pleasantness and distraction decreased. There were no other significant interactions of pleasantness and PTQ score predicting variability in the other ER strategies. There were no significant interactions of repetitiveness and PTQ score predicting variability in the other ER strategies. Self-focus interacted with PTQ score to significantly predict variability in acceptance ($b = -.06, SE = .03, p = .04$). For participants with PTQ scores higher than the grand mean, when they rated their thoughts as not about themselves, their use of acceptance decreased. That is, when PTQ score increased, the slope of the association between self-focus and acceptance decreased. There was no a priori hypothesis about this association. There were no other significant interaction of self-focus and PTQ score predicting variability in the other ER strategies. Other focus interacted with PTQ score to significantly predict variability in reappraisal ($b = -.13, SE = .06, p = .03$) and acceptance ($b = -.19, SE = .07, p = .01$). For participants with PTQ scores higher than the grand mean, when they rated their thoughts as not about others, their use of reappraisal and acceptance decreased. That is, when PTQ score increased, the slope of the association between both other focus and reappraisal and other focus and acceptance decreased. There was no a priori hypothesis about this association. There were no other significant interactions of other focus and PTQ score predicting variability in the other ER strategies. None of the external PT dimensions (i.e., certainty, controllability, and temporal orientation) significantly interacted with PTQ score to predict variability in any of the ER strategies. Overall, there is some evidence that PTQ score, or trait PT, moderated the associations
between the PT dimensions and ER strategies. Specifically, greater PTQ scores were associated with decreased use of ER.

**Discussion**

Context is recognized as an important determinant of ER flexibility. As posed by theorizing around context sensitivity (Burton & Bonanno, 2013) and strategy-situation fit hypothesis (Haines et al., 2016), ER flexibility is best examined by measuring covariation between change in features of context and change in ER strategy use. Extant research has predominantly focused on situational controllability and affectivity as important features of context (Goodman et al., 2021; Battaglini et al., 2022). The goal of the current study was to identify new contextual features tied to ER flexibility. Specifically, we simultaneously examined a variety of internal (e.g., affectivity) and external (e.g., situational controllability) contexts. To guide our selection of new contexts we leaned into theory and research on PT. Specifically, our selection of new characteristics of context was guided by common dimensions used to describe the process of PT. Along with pleasantness and controllability, we also examined an additional three internal (i.e., repetitiveness, self-focus, and other focus) and two external (i.e., certainty, temporal orientation) dimensions of context. We measured flexibility of ER strategies that have historically been associated with PT. Further, we selected ER strategies that are used to either engage or disengage from one’s emotional experience, including six strategies: reappraisal, acceptance, problem solving, suppression, distraction, and avoidance. In a daily diary study, we had people complete a PT induction followed by an instructed ER period every night over the course of ten days. This combination of an experimental paradigm with a repeated measurement approach was used to measure naturally occurring variations of momentary PT and ER to exemplify context sensitivity, and thus ER flexibility, at both the within and between person level. See Table 7 for a full summary of the results.
Old and New Dimensions of Context

Our first aim in the study was to test known context (e.g., controllability) and identify additional dimensions of context that may inform ER flexibility. We used PT to frame our investigation, and identified seven PT dimensions that serve as internal (i.e., pleasantness, repetitiveness, self-focus, and other focus) and external (i.e., certainty, controllability, and temporal orientation) markers of context. The dimensions of pleasantness and controllability are analogous to that of existing contexts linked to ER flexibility, affectivity and controllability.

Greater negative affectivity has previously been associated with variability in ER, specifically increases in strategies such as suppression and distraction and decreases in reappraisal (Sheppes and Levin 2013; O’Toole et al., 2017; Gordara et al., 2021). Our findings replicate associations with reappraisal, but not with suppression or distraction. In line with our hypotheses, we found significant covariation between pleasantness and ER such that increases in pleasantness significantly predicted increases in use of reappraisal as well as acceptance. On days when a person rated their thoughts as particularly pleasant (above their average level of pleasantness), they reported using reappraisal and acceptance to a greater extent. Further, when looking at between-person differences in pleasantness, we found the more people reported their thoughts to be pleasant on average the more they reported using acceptance, suppression, and distraction. These findings partially support theorizing by Sheppes et al. (2014) stating that increased negative affect reduces cognitive resources available for cognitively taxing strategies like reappraisal. However, pleasantness did not significantly predict change in problem solving, another cognitively taxing strategy (Schirda et al., 2016), so the validity of this notion remains unclear. Our results show that variability in pleasantness was not linked to variability in strategy use for majority of the ER strategies. This is surprising as we would expect pleasantness (or
affectivity) to be a common predictor of variability in ER given that it is one of the more widely studied features of context. One potential explanation may be that pleasantness should be examined under more specific conditions. In line with our hypotheses for our secondary analysis, individuals with elevated trait PT (compared to the group average) reported a decreased use of distraction when their thoughts were more pleasant. Put another way, those with a tendency toward perseveration were more likely to use distraction when their thoughts were especially unpleasant compared those with normative engagement in PT (see Figure 3 for illustration). This finding suggests that pleasantness may an important indicator of context for individuals with pathological, rather than normative, levels of PT.

Reduced controllability has been linked to variability in ER, specifically with increases in reappraisal and problem solving (Troy et al., Haines et al., 2016; Goodman et al., 2021). Our results show significant covariation between controllability and reappraisal, acceptance, problem solving, and suppression. The association between controllability and acceptance was contrary to our hypothesis. On days when a person reported having more control over a situation (above their average level of control), they reported using reappraisal and problem solving to a greater extent, while using acceptance and suppression to a lesser extent. Regarding between-person differences in controllability, we found that individuals who on average perceived situations as more controllable also reported an increased used of reappraisal, acceptance, problem solving, and suppression. We did not expect to find a negative association between controllability and acceptance. Work by Battaglini et al. (2022) suggests that the association between controllability and ER flexibility may be due to an individual’s desire to change their emotions when they can’t change their situation. However, given our mixed findings with controllability and emotion altering strategies (e.g., reappraisal, acceptance), there is still a need to clarify function of
control. One alternative explanation may be that control is a more representative of an individual’s perceived self-efficacy around regulation. For example, we find that when control was especially high, people reported greater use of problem solving, perhaps suggesting that greater control allows for more effective problem solving. Future research may benefit from further testing this idea.

Regarding the three new internal contexts, repetitiveness, self-focus and other focus, our findings suggest covariation between all three of these PT dimensions and some of the ER strategies. Specifically, increased repetitiveness was associated with increases in use of reappraisal and avoidance. When an individual rated their thoughts as especially repetitive (above their average level of repetitiveness), they reported greater use of reappraisal and avoidance. Further, when looking at between-person differences in repetitiveness, we found the more people reported their thoughts to be repetitive the more they also reported using almost all (excluding acceptance) the ER strategies. These results show that individual differences in repetitiveness was the most common PT dimension to covary with the ER strategies, highlighting it as an especially important feature of context. We did not expect to find a positive association between repetitiveness and reappraisal. A recent meta-analysis of ESM studies finds that rumination and worry, as forms of PT, tend to be negatively associated with reappraisal (Boemo et al., 2022). PT is also thought to monopolize cognitive resources (Komacka et al., 2019), which would seem to be incompatible with a highly cognitive strategy like reappraisal. One potential explanation for the current finding may be that repetitiveness may serve as a signal for regulation. For example, as a person’s thoughts become more repetitive, they may be more inclined to pursue strategies like reappraisal which serves to reframe one’s thinking. Additionally, self-focus was associated with increases in use of problem solving. Consistent with
our hypothesis, when an individual rated their thoughts not about themselves, they reported
greater use of problem solving. In our secondary analysis, we find that individuals with elevated
trait PT (compared to the group average) reported decreased use of acceptance when they rated
their thoughts to not be about themselves. Given that these are engagement strategies, these
results may suggest that people are less likely to use engagement strategies when their thoughts
are not related to themselves. Lastly, other focus was associated with decreases in reappraisal
and solving. As expected, when individuals rated their thoughts as not about others, they
reported a decreased use of reappraisal and problem solving. Conversely, in our secondary
analysis we find that for individuals with elevated trait PT, when their thoughts are not about
others they report increased use of reappraisal. The inconsistency regarding reappraisal suggest
that the role of other focus may be dependent on additional factors, such as trait PT. One possible
explanation may be that individuals that tend to engage in PT to direct their attention inward
(Mennin and Fresco, 2014) which may have regulatory consequences.

Regarding the two new external contexts, certainty and temporal orientation, our findings
only show evidence of temporal orientation having significant covariation with some of the ER
strategies. Situations that were rated as having a future orientation were associated with increases
in problem solving and avoidance. We did not expect a future orientation to be positively
associated with problem solving or avoidance. At face value, these two strategies seemed to be in
opposition to each other, particularly because problem solving involves moving toward, or
approaching a stressor, while avoidance involves distancing oneself from a stressor (Aldao and
Nolen-Hoeksema, 2010). Additionally, problem solving is considered a strategy associated with
long-term benefits (e.g., improved coping skills), while avoidance is associated with short-term
benefits (e.g., relief from negative affect; Lennarz et al., 2019). To further unpack how future
orientation predicts variability in both of these strategies, it may be helpful to measure additional aspects of a situation. One avenue may be examining whether these associations hold for different situations. As part of our larger study, we asked participants to report on either a social, achievement, or feeling focused experience. A next step of the current work could be whether future orientation is differentially predictive of problem solving and avoidance based on the type of situation (e.g., social, achievement). We expected to find significant associations between certainty and the ER strategies. It may be the case that our measurement of certainty was not ideal for the current investigation. In our analysis we accounted for the influence of the other PT dimensions when we measured certainty as a predictor. However, at the within-person level, certainty was significantly correlated with controllability (r=.56). Thus, it is possible that when we factored out the influence of controllability, we removed important variability in certainty. Future research may consider using alternative methods to measure certainty.

Overall, these findings are promising as we show support for the newly proposed internal features of context. However, due to some of the mixed associations, it is essential to continue testing these contexts in future studies. We found less support for the external contexts measured here. Nonetheless, we highlight some directions for future research to continue testing these external contexts.

**Engagement and Disengagement ER Strategies**

While the primary objective of the study was to uncover novel internal and external contexts associated with ER flexibility, we also observed intriguing patterns pertaining to the type of ER strategy. First, there was a greater diversity of PT dimensions predicting the engagement strategies. Although nearly all of the PT dimensions (excluding the certainty dimension) significantly covaried with the engagement strategies, only the repetitiveness,
control, and temporal orientation dimensions significantly covaried with the disengagement strategies. This finding may signal that engagement strategies can be used more flexibly given that they are more susceptible to changes in context. Additionally, we found that trait PT was a significant moderator primarily for engagement strategies (e.g., reappraisal and acceptance). That is, individuals who exhibited a greater tendency towards perseveration were especially less likely to use engagement strategies. Clinically elevated levels of PT have been related to psychological disorders such as MDD and GAD which are marked by ER difficulties, such as unsuccessful regulation (Spinhoven et al., 2018). Given the pattern in strategy use for individuals with elevated trait PT found in this study, future research should consider examining whether unsuccessful regulation is linked to decreased reliance on engagement strategies.

**Limitations and Future Directions**

We review limitations of the current investigation and offer directions for future research. First, there are a few drawbacks to having run this study online. We cannot verify whether the participants were fully engaged when completing the daily survey. For example, participants may have found themselves in environments with distractions (e.g., being in a public vs. private setting) during the time of the survey which may have affected their level of attention during the PT induction or ER period. We built in aids (i.e., audible tone at the end of different sections) to re-orient participants back to each task in the case their attention did stray from the study. We expected each survey to take around 10 minutes to complete and found an average completion time of 12.03 minutes (SD=3.79), so we believe this to be a minor issue in the current study. However, future research using a similar approach may consider having participants report whether distractors are present at the time of the survey, which can later be referenced when checking the quality of the data. Additionally, participants were allowed to complete the daily
survey using any device (e.g., cell phone, laptop, tablet), so the extent to which they were able to engage with the PT writing task may have differenced across device types. Although we urged participants to complete daily surveys on a desktop or laptop, it was up to their discretion which device to use. Future research may consider restricting study completion to desktop and laptop computers to increase consistency across surveys.

In this study, we experimentally induced PT rather than having participants report on instances when PT occurred naturally. Previous ESM research by Kircanski et al. (2015) did not find support for characteristics of PT (e.g., abstractness, certainty) that have previously been identified in laboratory studies. Although we had participants complete the PT induction over multiple days, meant to increase generalizability to daily life, it may be that it was still an artificial measurement of PT. Replication research should consider measuring the PT dimensions as PT unfolds naturally. Additionally, we chose to measure ER following the PT induction period; however, it is possible that participants spontaneously engaged in ER during this time. A study by Kalokerinos et al (2017) suggests that ER naturally occurs during an emotion eliciting episode, and particularly in the beginning of a negatively valanced episode. It may be that it is not feasible to completely constrain a person’s ER to just the instructed ER period, so future research may consider adding a question after the PT induction tracking whether ER has occurred. Further, due to limitations in the functionality of Qualtrics, we were unable to assess the temporal order in which participants used the ER strategies. As noted by Burton and Bonanno (2013), an important aspect of ER flexibility is one’s ability to monitor and adjust their ER based on changing emotional demands. Future research may benefit from a design that allows prompts participants to report on ER throughout the ER period rather than waiting until the end of the ER period.
Although our focus was on measuring the use of engagement and disengagement strategies, we only included a handful of strategies in our analysis. There are undoubtedly additional relevant strategies that better capture the full range of regulation techniques that participants may have used. Future work would benefit from incorporating a more exhaustive list of ER, perhaps with a greater diversity of cognitive, behavioral, and social basis. Further, the ER strategies measured may have different levels of applicability which may limit how often certain strategies were used. For example, we included suppression as on the of the disengagement strategies, however this strategy is often used in the presence of others (Butler et al. 2003). Thus, the extent to which a participant reported using suppression may be influenced by their social environment. Future work may should consider testing the use of the ER strategies to have a balanced level of applicability. Lastly, it may be argued that the one-minute ER period may not have been long enough for participants to successfully implement the ER strategies. We were unable to increase the length of the study procedures, but future research may consider integrating a longer ER period.

An important future direction to consider is replicating this study with different samples of interest. First, we did not assess for mental health conditions in the current sample, but PT is a construct that is considered transdiagnostic, particularly amongst depressive and anxiety disorders (Ehring & Watkins, 2008). It would be interesting to see whether these findings replicate in the types of samples that include both healthy controls and participants that meet criteria for syndromes such as Major Depressive Disorder (MDD) and/or Generalized Anxiety Disorders (GAD). For example, past research has found that levels of trait PT are particularly elevated in individuals with comorbid diagnoses (Spinhoven et al., 2015). Thus, one potential difference we may see is a greater variation in levels of PT endorsed such that we would expect
the MDD/GAD groups to report elevated rates of PT across the PT dimensions. Such differences may provide more insight as to our findings from aim 2 which highlights differences for individuals with higher PTQ scores.

Moreover, given that this investigation included only a college sample, it is essential to measure these associations across the adult lifespan. For example, research has found that older adults, compared to younger adults, exhibit greater consistency in strategy use in daily life which may be indicative of decreased flexibility (Eldesouky & English, 2018). In a future study with a more age diverse sample, we may expect to find that the PT dimensions are predictive of a smaller set of ER strategies. These findings may inform which ER strategies are impacted by fluctuations in the PT dimensions.

**Conclusion**

The present findings extend current work on ER flexibility. We based our investigation on the theory of PT, a normative process that can become pathological, to guide our selection of new context. Specifically, we identify several internal (e.g., pleasantness, repetitiveness, and other-focus) and external (e.g., certainty, controllability, and temporal orientation) features of context that predicted the flexible use of ER strategies. We find that at the within person level, controllability is the most common PT dimension to covary ER with strategy use. Furthermore, at the between person level it is one’s mean level of repetitiveness was the most common predictor of ER strategy use. These findings exemplify that contextual features beyond affectivity and controllability are important in understanding ER flexibility and highlight a new avenue in which to extend the current ER flexibility literature. We also find qualitative differences between which PT dimensions predict flexible use of the ER strategies. Specifically, the PT dimensions were more often predictive of engagement compared to disengagement.
strategies. These findings may be beneficial for understanding how to support successful regulation. This work was limited to a non-clinical, college sample so it remains unclear whether these findings are applicable to other populations. Since PT also has ties to psychopathology, future research will benefit from pursuing a more diverse sample population, such as those with and without clinical diagnoses.
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### Tables

#### Table 1. Hypothesized Associations between PT dimensions & ER Strategies

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<th>Problem Solving (c)</th>
<th>Suppression (d)</th>
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</table>

*Note.* + = hypothesized positive association; - = hypothesized negative association. Additional notation is included in the table to refer back to individual hypotheses in which the PT dimension are denoted with a numeric value and the ER strategies with a letter (e.g., pleasantness x reappraisal would be 1a). Temporal orientation was defined by three categories which will be represented as past (PA), present (PR), and future (F). NA listed for associations we did not propose a hypothesized direction. Arrows indicate an increase in association when PTQ is a moderator.
<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
</table>
| Broad PT        | We all have negative experiences or problems and have a variety of responses to them. We sometimes think about the details or consequences of, or our feelings about these experiences or problems. For example, one might worry about a problem they will have in the future. One might also ruminate about a negative experience that occurred in the past. Sometimes, these thoughts may occur so frequently they feel stuck in our minds. We may also find that these thoughts become repetitive, uncontrollable, and may be distressing. This process is called PERSEVERATING. | ● You have an upcoming test in a class that you are struggling in and don’t feel prepared. You’ve started worrying so much about failing the test that you can’t concentrate on anything else. (written by BG & RJT)  
● The last time you went to a party with your friend, you overheard them talking to someone about how they thought you were annoying. You have been ruminating about this since it happened, repeatedly thinking ‘Everyone thinks I’m annoying’ and ‘Why doesn’t anyone like me?’ (written by BG & RJT)  
● Lately you find yourself feeling sad all the time, even when you do things you used to enjoy. You’ve been ruminating a lot on how sad you feel, repeatedly thinking ‘I’m never going to be happy.’ (original) |
| Abilities Theme | Sometimes people PERSEVERATE on their Abilities, such as experiences or problems related to one’s ability to achieve or perform well on something. These situations may also be related to one's feelings or relationships, but the primary focus is around their Ability.                                                                 | ● Your soccer team lost the championship game last semester, and you blame yourself for playing poorly. Even though you’ve done well in recent games, you can’t stop yourself from thinking about how your team could have won if you had played better. (written by BG & RJT)  
● You worked really hard on the college application to your top choice school, but found out that you didn’t get in. You’ve been thinking that you won’t get in anywhere good so often that it’s become distressing. (written by BG & RJT)  
● You overhear someone at work saying that the company is laying off some people. You start thinking about the contribution you have made to the team since you started working at the company, and as you think it over, you suspect that you will be laid off. (original) |
<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
</table>
| Feelings Theme      | Sometimes people PERSEVERATE on their Feelings, such as experiences or problems that are related to the feelings and emotions one experiences. These situations may also be related to one's abilities or relationships, but the primary focus is their Feelings. | ● You are struggling to adjust to the new school year and have been falling behind on classwork, seeing your friends, and joining clubs. You feel like you are wasting your time and are always thinking about how worthless you feel for falling behind. (written by BG & RJT)  
● You feel guilty because you recently cheated on an exam that you didn’t feel prepared for. You think it is extremely unethical to cheat and have always been against cheating. You keep telling yourself that you won’t do it again, but you still can’t stop ruminating about how guilty you feel. (written by BG & RJT)  
● You are feeling quite exhausted. On social media, you see a photo of you when you felt better. As you think back to that time, you wonder whether in the future there will be times when you will feel less exhausted. (original) |
| Relationships Theme | Sometimes people PERSEVERATE on their Relationships, such as experiences or problems that are related to situations which involve other people. These situations may also be related to one's feelings or abilities, but the primary focus is around their Relationships.                                      | ● You just found out that a family member has been diagnosed with a terminal illness, and it’s unclear how long they’ll live. You’ve been thinking about how little control you have over the situation so much that you haven’t been able to think about anything else. (written by BG & RJT)  
● You broke up with your significant other after you found out that they had been cheating on you for several months. Your new partner reassures you that you can trust them, but you still can’t stop yourself from thinking about getting cheated on again. (written by BG & RJT)  
● You haven’t socialized much with the other members of your fitness class but following a good workout, you all go out for lunch. Later, when you are walking out of the restaurant, you overhear two members of the class talking about you. As you listen, you hear them saying that they think you are boring. You are concerned that the other team members dislike you. (original) |
Table 3  
Descriptive Statistics

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Table 4.
Correlations Between PT Dimensions, ER Strategies, and Trait PT (within person correlations above the diagonal)

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<th>Certainty</th>
<th>Control</th>
<th>Reappraisal</th>
<th>Acceptance</th>
<th>Problem Solving</th>
<th>Suppression</th>
<th>Distraction</th>
<th>Avoidance</th>
<th>PTQ</th>
<th>Between M (SE)</th>
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<td>65.39 (.39)</td>
</tr>
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<td>0.31</td>
<td>0.28</td>
<td>0.05</td>
<td>3.52 (.03)</td>
</tr>
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<td>-0.03</td>
<td>-0.03</td>
<td>-0.15</td>
<td>0.12</td>
<td>-0.04</td>
<td>0.38</td>
<td>1</td>
<td>0.29</td>
<td>0.09</td>
<td>4.38 (.03)</td>
</tr>
<tr>
<td>Avoidance</td>
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<td>0.18</td>
<td>0.05</td>
<td>0</td>
<td>0.35</td>
<td>0.16</td>
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<td>0.07</td>
<td>0.10</td>
<td>0.05</td>
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<td>39.69</td>
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<td>(.06)</td>
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<td>(.07)</td>
<td>(.07)</td>
<td>(.74)</td>
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</tr>
</tbody>
</table>

*Note. Between-person correlations listed above the diagonal and within-person correlations listed below the diagonal. Significant correlations are bolded. The following PT dimensions were excluded from the correlation table as they are categorical, rather than continuous, variables: Self Focus, Other Focus, Temporal Orientation*
Table 5a
Results for PT Dimensions Predicting Engagement Strategies (Aim 1)

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<th></th>
<th></th>
<th></th>
<th>Acceptance</th>
<th></th>
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<th>Problem Solving</th>
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<tr>
<td></td>
<td>b</td>
<td>SE</td>
<td>t</td>
<td>p</td>
<td>b</td>
<td>SE</td>
<td>t</td>
<td>p</td>
<td>b</td>
<td>SE</td>
<td>t</td>
</tr>
<tr>
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<td>62.00 &lt; 2e-16</td>
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<td>43.76 &lt; 2e-16</td>
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<td>0.09</td>
<td>45.24 &lt; 2e-16</td>
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<td>4.30</td>
<td>0.00***</td>
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<td>-0.87</td>
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<td>0.03</td>
<td>0.81</td>
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<td>0.00</td>
<td>0.03</td>
<td>0.13</td>
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<td>0.68</td>
<td>0.14</td>
<td>0.09</td>
<td>1.52</td>
<td>0.13</td>
<td>-0.25</td>
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<td>-2.62</td>
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<td>0.00***</td>
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<td>0.06</td>
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*Note. b = standardized estimate; SE = standard error; *p < .05; **p < .01; ***p < .001*
Table 5b  
Results for PT Dimensions Predicting Disengagement Strategies (Aim 1)

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<th>Avoidance</th>
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<td>SE</td>
<td>t</td>
<td>p</td>
<td>b</td>
<td>SE</td>
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<td>1.64</td>
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<td>0.03</td>
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<td>-4.17</td>
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</tr>
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Note. b = standardized estimate; SE = standard error; *p < .05; **p < .01; ***p < .001
### Table 6a

*Results for disengagement Strategies with trait PT (Aim 2)*

<table>
<thead>
<tr>
<th>Engagement Strategies</th>
<th>Reappraisal</th>
<th>Acceptance</th>
<th>Problem Solving</th>
</tr>
</thead>
<tbody>
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*Note. $b =$ standardized estimate; $SE =$ standard error; $^* p < .05$; $^{**} p < .01$; $^{***} p < .001$*
Table 6a
*Results for disengagement Strategies with trait PT (Aim 2, continued)*

<table>
<thead>
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<th></th>
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<th>Problem Solving</th>
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<td>$SE$</td>
<td>$t$</td>
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*Note. b = standardized estimate; SE = standard error; *$ p < .05$; **$ p < .01$; ***$ p < .001$*
Table 6b
Results for disengagement Strategies with trait PT (Aim 2)

<table>
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Note: $b$ = standardized estimate; SE = standard error; *$p < .05$; **$p < .01$; ***$p < .001$
### Table 6b

*Results for disengagement Strategies with trait PT (Aim 2, continued)*

<table>
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*Note. $b =$ standardized estimate; $SE =$ standard error; $^* p < .05; ^{*}* p < .01; ^{***} p < .001$*
Table 7  
Aim 1 Results Overview 

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<th>Control</th>
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<th>OtherFocus</th>
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<td>Hyp Result</td>
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<tr>
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<td>- +</td>
<td>- NS</td>
<td>+ NS</td>
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<td>- NS</td>
<td>+ +</td>
<td>+ NS</td>
<td>(PA) NS</td>
<td>NA NS</td>
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<td>- NS</td>
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</tbody>
</table>

**Engagement Strategies**

**Disengagement Strategies**

*Temporal Orientation denoted as PA (past), PR (present), F (future). NS = non-significant, NA = No prior hypothesis.*
Participants were asked to participate in the study for 10 days. Below is a depiction of the timeline of the study.

**Figure 2.** Overview of PT induction task
Figure 3. PTQ x Pleasantness Interaction predicting Distraction
Appendix

2. Daily Task

The daily paradigm starts with participants identifying a negative event from earlier that day. Then they began the PT induction tasks (i.e., PT writing and PT thinking), followed by a period of instructed ER. The daily paradigm took ten minutes or less. The two induction tasks instructed participants to directly engage in two minutes of writing followed by a one-minute thinking on the event they reported. After the PT induction tasks, participants completed a timed ER task in which were instructed to feel less negative. Following the PT induction tasks participants reported their current levels of the seven PT dimensions. After the ER instructed task, participants rated the extent they used the six ER strategies.

Instructions for PT induction tasks and instructed ER task are listed below.

PT Writing:
Now you will write down the negative thoughts you usually have when you PERSEVERATE about this Negative Situation for a total of two minutes.

- You don't need to provide any background information; just start with the first thought that comes to mind.
- Allow your thoughts to either stay on one topic or change to another topic, how they do when you normally perseverate.
- Write for the full two minutes.
- After two minutes, the screen will change automatically. The two minutes will begin as soon as you go onto the next page. Please press ‘Next’ to begin.

PT Thinking:
Now you will continue to think as you usually would about the Negative Situation for one minute.

- You can close your eyes to do this.
- If you notice your mind wandering to thoughts that are not distressing, please try to bring your mind back to perseverating about the Negative Situation.

The one minute will begin as soon as you go onto the next page. Please press ‘Next’ to begin.

Instructed ER:
For the next one minute you will be asked to try to change your feelings so that you feel less negative about the Negative Situation.

- Please try your best to feel less negative, even if you feel like you want to continue perseverating.
- Use as many strategies as you normally do to change your feelings when you want to feel less negative.
- Try to change your feelings for the full one minute. After one minute, the screen will change automatically.

The one minute will begin as soon as you go onto the next page. Please press ‘Next’ to begin.