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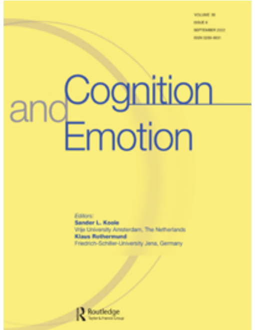
Tammilehto, Jaakko

2022-08-18

Tammilehto , J , Bosmans , G , Kuppens , P , Flykt , M , Peltonen , K , Kerns , K A &
Lindblom , J 2022 , ' Dynamics of attachment and emotion regulation in daily life : uni- and
bidirectional associations ' , Cognition and Emotion , vol. 36 , no. 6 , pp. 1109-1131 . https://doi.org/10.1080/0269993

http://hdl.handle.net/10138/351375
https://doi.org/10.1080/02699931.2022.2081534



Cognition and Emotion

Routledge
Taylor & Francis Group

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/pcem20

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To cite this article: Jaakko Tammilehto, Guy Bosmans, Peter Kuppens, Marjo Flykt, Kirsi Peltonen, Kathryn A. Kerns & Jallu Lindblom (2022) Dynamics of attachment and emotion regulation in daily life: uni- and bidirectional associations, Cognition and Emotion, 36:6, 1109-1131, DOI: 10.1080/02699931.2022.2081534

To link to this article: https://doi.org/10.1080/02699931.2022.2081534

COGNITION AND EMOTION
2022, VOL. 36, NO. 6, 1109–1131
https://doi.org/10.1080/02699931.2022.2081534

Dynamics of attachment and emotion regulation in daily life: uni- and bidirectional associations

Jaakko Tammilehto [a], Guy Bosmans [b], Peter Kuppens [c], Marjo Flykt [a,d], Kirsi Peltonen [e,f], Kathryn A. Kerns [g] and Jallu Lindblom [a,b,h]

[a]Faculty of Social Sciences / Psychology, Tampere University, Tampere, Finland; [b]Clinical Psychology, KU Leuven, Leuven, Belgium; [c]Faculty of Psychology and Educational Sciences, KU Leuven, Leuven, Belgium; [d]Department of Psychology and Logopedics, Faculty of Medicine, University of Helsinki, Helsinki, Finland; [e]Research Center for Child Psychiatry, University of Turku, Turku, Finland; [f]INVEST Research Flagship Center, University of Turku, Turku, Finland; [g]Department of Psychological Sciences, Kent State University, Kent, OH, USA; [h]Department of Clinical Medicine, University of Turku, Turku, Finland

ABSTRACT
Attachment theory proposes that the activation of the attachment system enacts emotion regulation (ER) to maintain security or cope with insecurity. However, the effects of ER on attachment states and their bidirectional influences remain poorly understood. In this ecological momentary assessment study, we examined the dynamics between attachment and ER. We hypothesised that attachment states and ER influence each other through time. Specifically, we hypothesised bidirectional short-term cycles between state attachment security and reappraisal, state attachment anxiety and rumination, and state attachment avoidance and suppression. We also tested how trait attachment is related to state attachment and ER. One hundred twenty-two participants ($M_{age} = 26.4$) completed the Experiences in Close Relationship–Revised and reported state attachment and ER seven times daily for seven days. The results were only partly consistent with our cycle hypotheses yet revealed a cycle between low state attachment security and rumination that was attenuated by reappraisal. Moreover, rumination and suppression predicted increased insecure states, and reappraisal predicted increased secure and insecure states. Finally, trait attachment showed associations with state attachment and ER. Our study suggests regulatory dynamics between attachment and ER and opens important questions about their functional relationship in maintaining attachment-related behavioural patterns and emotional well-being.

ARTICLE HISTORY
Received 2 December 2021
Revised 25 April 2022
Accepted 19 May 2022

KEYWORDS
Emotion regulation; state attachment; reappraisal; rumination; expressive suppression

Emotion regulation (ER) is a goal-directed process where people modulate the flow of their emotions (Gross, 2015). Attachment theory provides a framework to understand how attachment representations (i.e. beliefs and expectations about the worthiness of the self and the availability of others) contribute to ER in daily life. Research suggests that people's trait attachment, consisting of relatively stable representations, directs their preferences for ER strategies, such as reappraisal, rumination, and suppression (Mikulincer & Shaver, 2016). Yet, short-term fluctuations in state attachment can also play a critical role in shaping ER (Troyer & Greitemeyer, 2018). In other words, how (in)secure – in terms of being loved and cared for – someone feels at a certain moment can influence how one regulates one's emotions. ER, in turn, can alter state attachment, as maintaining security and coping with insecurity are basic goals that drive daily ER (Mikulincer & Shaver, 2016). Intriguingly, in line with the contemporary

CONTACT Jaakko Tammilehto jaakko.tammilehto@gmail.com Faculty of Social Sciences / Psychology, Tampere University, Tampere FIN-33014, Finland

Supplemental data for this article can be accessed online at https://doi.org/10.1080/02699931.2022.2081534.

models of attachment (Kobak & Bosmans, 2019; Long et al., 2020), the interplay between state attachment and ER may give rise to short-term feedback cycles in which the current state attachment shapes the use of ER strategies, which then alter subsequent state attachment. Examining such dynamic effects and the contributions of trait attachment on state attachment and ER is vital to elucidate processes maintaining attachment-related behavioural patterns and emotional well-being. In this study, we model daily dynamics between state attachment and ER and test the relations of trait attachment to state attachment and ER.

Trait attachment in adulthood

The attachment system is a motivational system that drives people to seek actual or symbolic proximity and protection from their attachment figures, such as parents and partners, throughout the life span (Ainsworth et al., 1978; Bowlby, 1982; Hazan & Shaver, 1987). Based on how sensitively attachment figures have responded to ones' attachment needs, people develop trait-like beliefs and expectations about others' availability and their own abilities to cope with threats (Bartholomew, 1990). These generalised mental representations constitute people's trait attachment that directs their homeostatic regulatory processes, involving coping, mood regulation, and ER (Mikulincer & Shaver, 2016).

Contemporary research suggests that adult trait attachment is described with two dimensions: attachment anxiety and avoidance (Mikulincer & Shaver, 2016). Attachment anxiety reflects insecurity related to fear of rejection and abandonment by others (Fraley et al., 2000). People with high trait attachment anxiety often experience uncertainty about others' availability and their own abilities to cope with threats (Fraley et al., 2000). Consequently, they have developed a socioemotional regulatory pattern characterised by high vigilance for threats and a tendency to hyperactivate the attachment system, leading to excessive support-seeking behaviours when stressed (Mikulincer & Shaver, 2016). In turn, attachment avoidance reflects a reluctance to seek or receive support and comfort from others (Fraley et al., 2000). People with high trait attachment avoidance view others as unavailable and untrustworthy (Fraley et al., 2000). Consequently, they have developed a socioemotional regulatory pattern characterised by compulsive self-reliance and defensive efforts to deactivate the attachment system (Mikulincer & Shaver, 2016). Finally, people with low attachment anxiety and avoidance have secure trait attachment and possess socioemotional regulatory patterns that promote good psychosocial well-being (Mikulincer & Shaver, 2016).

State attachment in daily life

Most research on attachment in adulthood has viewed attachment as a relatively stable trait-like part of the personality, developed in close relationships (Hazan & Shaver, 1987). However, recent theoretical advances emphasise the time- and context-specificity of attachment, distinguishing the more stable trait attachment from the more dynamic state attachment (Arriaga et al., 2018; Kobak & Bosmans, 2019). State attachment captures momentary fluctuations in the activation of the subjective attachment representations and associated cognitive scripts (Gillath et al., 2009). For example, the threat of rejection by one's partner may lead to a sense of attachment anxiety, even though one's generalised attachment representations are coloured by secure trait attachment (Baldwin et al., 1996). Importantly, even minor attachment cues, such as recalling or imagining positive or negative events in close relationships, can momentarily change people's state attachment (Gillath et al., 2009). Indeed, several studies suggest that state attachment fluctuates over time in response to daily social stressors (Davila & Sargent, 2003; Zhang, 2009) and the subtle cues of the attachment figure's availability (Bosmans et al., 2014; Vandevivere et al., 2018). In this study, we expand the prior research by inspecting the momentary self-regulatory dynamics of state attachment in daily life.

Research supports the latent structure of three state attachment dimensions: security, anxiety, and avoidance (Gillath et al., 2009). Mikulincer and Shaver's (2016) model of adult attachment depicts the regulatory dynamics related to these attachment states. According to the model, the attachment states may be triggered when a threat is subjectively perceived to be present, and the attachment system is activated. If subsequently, the subjective needs for proximity and protection are sufficiently fulfilled via the attachment figure's perceived availability, the attachment system is downregulated, and people experience state attachment security (Mikulincer & Shaver, 2016). This state is characterised by the sense of being loved and cared for (Gillath et al., 2009). It reflects the main homeostatic goal that the attachment system strives to maintain via security-based regulatory efforts (Mikulincer & Shaver, 2016).

In contrast, if this secure state cannot be achieved, the activation of the attachment system leads to insecure attachment states (Mikulincer & Shaver, 2016). When people appraise symbolic or actual proximity seeking as a viable option to cope with the subjectively perceived threat, state attachment anxiety is triggered (Mikulincer & Shaver, 2016). This state is characterised by the intense need to feel loved and cared for (Gillath et al., 2009), accompanied by the regulatory hyperactivation of the attachment system to regain proximity to the attachment figure (Arriaga et al., 2018). However, when proximity seeking is appraised not to be an option to cope due to the attachment figure's perceived unavailability, state attachment avoidance is triggered (Mikulincer & Shaver, 2016). This state is characterised by the fear of losing independence (Gillath et al., 2009), accompanied by efforts to deactivate the attachment system to avoid stress caused by the attachment figure's unavailability (Arriaga et al., 2018).

As even subtle cues can activate different attachment representations, everyone occasionally experiences all attachment states of security, anxiety, and avoidance (Bosmans et al., 2020; Gillath et al., 2009). Nonetheless, according to attachment theory, trait attachment contributes to state attachment dynamics by biasing the information processing of threats and attachment figures' availability to align with one's expectations (Dykas & Cassidy, 2011). Consistent with this, studies focusing on daily experiences show that people with high trait attachment anxiety feel more state attachment anxiety, whereas people with high trait attachment avoidance feel more state attachment avoidance and less security (Haak et al., 2017; Sadikaj et al., 2015). Yet, in these studies, about half of the variance in state attachment occurred within a given individual (i.e. within-person level). This substantial within-person variance stresses the relevance of understanding how both trait- and state-level processes contribute to state attachment dynamics, which is our focus in this study.

Attachment and emotion regulation dynamics

ER refers to a temporal, state-level process in which people use various strategies to modify their own emotions according to their goals (Gross, 2015). It is evident from attachment research that attachment representations shape the ways people experience, express, and regulate emotions (reviewed in Mikulincer & Shaver, 2016). This has been shown in both interpersonal and non-interpersonal contexts (Gentzler et al., 2010; Norman et al., 2015). Yet, most empirical evidence on attachment and ER in daily life is based on single-occasion measures on habitual ER at the trait level, prone to recall biases (Karreman & Vingerhoets, 2012; Troyer & Greitemeyer, 2018). Only one single study has focused on trait attachment and state-level ER in daily life (Somers et al., 2020). Importantly, previous studies have not tested the associations between state attachment and state ER. This lack of research is surprising, as attachment theory suggests a functional relationship between state attachment and ER. First, state attachment may shape ER as the attachment system coordinates emotions in the service of threat regulation (Mikulincer & Shaver, 2016). Second, ER may modulate state attachment as emotions downregulate, excite, and inhibit the attachment system by signalling information about threats and progress toward the system's goals (Mikulincer & Shaver, 2016). Consequently, besides their unidirectional effects, state attachment and ER may bidirectionally influence each other. In this study, we propose the novel hypothesis that the effects between state attachment and ER strategies unfold short-term regulatory cycles, motivated by the security, hyperactivation, and deactivation goals.

Considerable research has been conducted on the ER strategies of reappraisal, rumination, and suppression and their links with trait attachment and socioemotional factors. In reappraisal, people change the meaning of an emotion-eliciting situation to be more positive or less threatening (Gross, 2015). From the attachment standpoint, reappraisal may be a particularly constructive strategy for fostering state attachment security as it focuses on broadening one's perspectives and mental flexibility, heightens security-congruent positive emotions, and facilitates conflict resolution (Finkel et al., 2013; Gross, 2015; Low et al., 2019). Likewise, both the broaden-and-build model of security (Mikulincer & Shaver, 2019) and social baseline theory (Beckes & Coan, 2011) posit that state attachment security shapes the use of reappraisal. Yet, these models differ in their predictions of how this occurs. According to the broaden-and-build model, state attachment security expands people's mental resources and regulatory capacities, thereby promoting the use of constructive ER strategies, such as reappraisal, while impeding less constructive strategies, such as rumination and suppression (Mikulincer & Shaver, 2019). In line with this, research suggests that people who generally feel more secure, especially in terms of low trait attachment anxiety, tend to rely on reappraisal over rumination and suppression (Karreman & Vingerhoets, 2012; Troyer & Greitemeyer, 2018). By contrast, the social baseline theory posits a different functional role for state attachment security. Accordingly, state attachment security in itself operates as a homeostatic, bottom-up regulatory process that decreases the need for using any deliberate ER, including constructive reappraisal, to avoid spending mental resources needlessly (Beckes & Coan, 2011). In support of this, studies show that merely activating state attachment security can alleviate distress (Carnelley et al., 2016; Norman et al., 2015).

In rumination, people repeatedly focus on negative thoughts and events (Nolen-Hoeksema et al., 2008). Research indicates that rumination is a prototypical strategy of trait attachment anxiety motivated by the hyperactivation goals (Garrison et al., 2014; Troyer & Greitemeyer, 2018). Thus, in line with attachment theory, state attachment anxiety may trigger rumination to restrict people's focus on finding solutions to their unmet attachment needs (Mikulincer & Shaver, 2016). In turn, rumination may intensify state attachment anxiety by directing attention towards threats, increasing negative emotions, and deactivating other motivational systems (Kobak & Bosmans, 2019; Mikulincer & Shaver, 2016). Indeed, research suggests that rumination can hamper resolving conflicts with partners (Low et al., 2019), which may reflect its effects on increased state attachment anxiety.

Finally, in suppression (also called expressive suppression), people inhibit their expression of emotions and hide them from others (Gross, 2015). Research suggests suppression to be a prototypical strategy of trait attachment avoidance motivated by the deactivation goals (Garrison et al., 2014; Troyer & Greitemeyer, 2018). Thus, in line with attachment theory, state attachment avoidance can initiate suppression to inhibit negative emotions incongruent with the deactivation goals (Long et al., 2020; Mikulincer & Shaver, 2016). In the long run, reliance on suppression can maintain trait attachment avoidance because it hinders social opportunities to experience the benefits of intimacy (Arriaga et al., 2018). Yet, state suppression may provide some immediate relief for state attachment avoidance as it helps to hide one's needs and vulnerabilities from others, thus decreasing the psychological pain of being dependent on others perceived as unavailable (Long et al., 2020). Similar negative reinforcement processes have been described for experiential avoidance that reduces distress in the short term but increases vulnerability to distress in the long term (Hayes et al., 1996).

The current study

In this study, we examined uni- and bidirectional effects between state attachment and ER strategies of reappraisal, rumination, and suppression. We also tested the relations of trait attachment anxiety and avoidance to state attachment and ER to understand how trait attachment might influence these state-level processes. To capture daily state attachment and ER, we used ecological momentary assessment (EMA) methodology, where the participants reported their state attachment and use of ER strategies seven times daily for a week.

Table 1 sums up our hypotheses regarding the directional associations between state attachment and ER. Figure 1 depicts our hypothesised short-term secure and insecure regulatory cycles in which state attachment shapes the subsequent use of ER strategies, and the use of ER strategies alters subsequent state attachment. In the *broaden-and-build cycle of security* (Figure 1A), state attachment security increases reappraisal while reducing rumination and suppression, and the use of reappraisal further boosts security. In the *baseline security cycle* (an alternative to the broaden-and-build cycle; Figure 1B), state attachment security reduces all ER, including reappraisal, yet reappraisal still increases security. In the *hyperactivating cycle of insecurity* (Figure 1C), state attachment anxiety increases rumination, which then intensifies anxiety. In the final *deactivating cycle of insecurity* (Figure 1D), state attachment avoidance increases suppression, which then reduces avoidance. Noteworthily, the broaden-and-build and hyperactivating cycles included positive feedback loops in which the attachment state and the ER strategy mutually amplify each other. However, such loops cannot last indefinitely, and some counter processes must also exist to attenuate and eventually extinguish the self-sustaining cycles in the long run. Thus, we expected all hypothesised cycles to operate in the short term by shaping the momentary dynamics of state attachment and ER. Finally, as also summed up

Table 1. Specific hypotheses regarding the associations between state attachment, emotion regulation, and trait attachment.

	Predictor	Outcome
Secure Cycles		
Broaden-and-Build Cycle of Security	State Attachment Security	↑ Reappraisal
	Reappraisal	↑ State Attachment Security
	State Attachment Security	↓ Rumination
	State Attachment Security	↓ Suppression
Baseline Security Cycle	State Attachment Security	↓ Reappraisal
	Reappraisal	↑ State Attachment Security
	State Attachment Security	↓ Rumination
	State Attachment Security	↓ Suppression
Insecure Cycles		
Hyperactivation Cycle of Insecurity	State Attachment Anxiety	↑ Rumination
	Rumination	↑ State Attachment Anxiety
Deactivation Cycle of Insecurity	State Attachment Avoidance	↑ Suppression
	Suppression	↓ State Attachment Avoidance
The Role of Trait Attachment in Daily Dynamics		
on State Attachment	Trait Attachment Anxiety	↑ State Attachment Anxiety
	Trait Attachment Avoidance	↑ State Attachment Avoidance
	Trait Attachment Avoidance	↓ State Attachment Security
on State Emotion Regulation	Trait Attachment Anxiety	↑ Rumination
	Trait Attachment Anxiety	↓ Reappraisal
	Trait Attachment Avoidance	↑ Suppression

Note. The directions of associations are described with ↑ (increase/positive) and ↓ (decrease/negative) signs.

in Table 1, we expected that high trait attachment anxiety is linked to more state attachment anxiety and high trait attachment avoidance to more state attachment avoidance and less security. We also expected that high trait attachment anxiety is linked to more rumination and less reappraisal and high trait attachment avoidance to more suppression.

Methods

Participants and procedure

This study was part of the *Daily Emotions* project that initially recruited 125 participants via Tampere University email lists and paper flyers distributed in the campus areas. The inclusion criteria were age over 18 years old, the possibility to use a smartphone, and being fluent in Finnish. The participants signed informed consent forms, and the Ethics Committee for Humanities of Tampere Region approved the study protocol. The participants did not receive any contributions for participating. All used questionnaires were translated in Finnish using the forward–backward translation method and piloted before data collection.

The data were collected in 2017, comprising two phases. In the first phase, the participants (except one that was thus excluded) filled out an online questionnaire regarding psychological traits and demographic factors. Two weeks later, in the second (EMA) phase, the participants completed short questionnaires sent to their smartphones seven times daily for a week. Each day, the sending time for each questionnaire was randomised within seven blocks, between 10:00 and 22:00. Each block had a duration of 1-hr and 43-min. After receiving the questionnaire, the participants had to answer within 30 min; otherwise, they missed the slot to answer ($M_{reaction\ time} = 4$ min, $SD = 6$ min). The average answering time between sequential EMA questionnaires was 1-hr and 43-min ($SD = 39$ min), equalling each EMA block. Due to technical errors, two participants had the same EMA identity number and had to be excluded. Thus, the final sample consisted of 122 Finnish participants ($M_{age} = 26.4$, $SD = 8.3$, range: 19–52; 88.5% women), comprising 65 university students, 49 open university students, five other students, and three non-students. Of the participants, 19 were married, 38 were cohabiting, 25 were in romantic relationships, and 40 were single. The EMA observations totalled 4637, with an average of 38 (77.6%; $SD = 7.8$) per participant.

Measures

Trait attachment

Trait attachment was measured using the *Experiences in Close Relationships–Revised Questionnaire* (Fraley et al., 2000). The participants reported their trait attachment anxiety (18 items; e.g. "I worry a lot about my relationships") and avoidance (18 items;

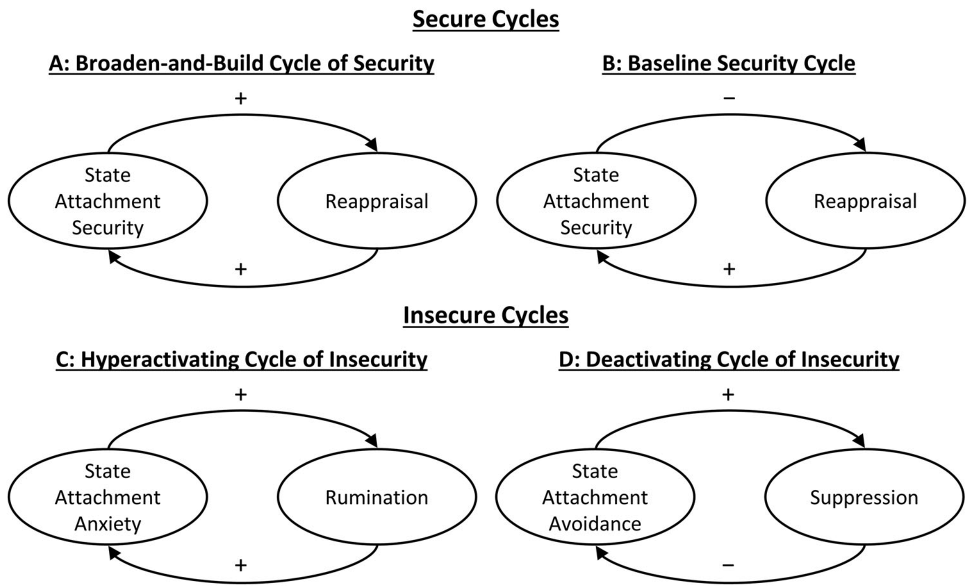

Figure 1. The hypothetical cycles between state attachment and emotion regulation strategies.
Note. The directions of associations are described with +(increase) and − (decrease) signs.

e.g. "I am nervous when partners get too close to me") using a 7-point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*). Cronbach's alphas were .92 for anxiety and .91 for avoidance, aligning with the typically reported reliability estimates (Graham & Unterschute, 2015).

State attachment

In the EMA, state attachment was measured using items from the *State Adult Attachment Measure* (SAAM), the only available standard measure of adult state attachment (Gillath et al., 2009). The full SAAM consists of 21 items. To decrease participant burden in the EMA, we selected six items to assess state attachment security ("I feel loved"; "I feel like I have someone to rely on"), anxiety ("I feel a strong need to be unconditionally loved right now"; "I want to share my feelings with someone"), and avoidance ("If someone tried to get close to me, I would try to keep my distance"; "The idea of being emotionally close to someone makes me nervous"). The two items for each dimension were selected based on (a) their high factor loadings in the original validation study (Gillath et al., 2009) and (b) the lack of strong content overlap with each other. At each EMA, the participants used a 7-point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*) to report how well the items described their state at that moment.

The full SAAM has shown adequate model fit and reliability in cross-sectional samples (Gillath et al., 2009; Trentini et al., 2015). In our EMA data, we assessed the fit of the SAAM model using multilevel confirmatory factor analyses with random intercepts (for details, see Supplemental Material 1). Figure 2 presents these results. The original model showed adequate fit apart from between-person SRMR, supporting the three-dimensional structure of the SAAM (χ^2 [18] = 177.77, $p < .001$, CFI = .949, RMSEA = .057, $SRMR_{within/between}$ = .056/.109). However, only state attachment anxiety showed cross-level metric invariance, whereas the loadings of security and avoidance at the between-person level did not align with their within-level counterparts. The latter stresses some cautiousness in the interpretations concerning our trait attachment analyses in which we aggregated the scores at the between level (for further discussion, see Supplemental Material 1). At the within-person level, omega coefficients for state attachment security, anxiety, and avoidance were .71, .47, and .72, respectively; at the between-person level, they were .92, .70, and .97, respectively. In our main analyses, we used the average scale for each attachment state.

Emotion regulation strategies

In the EMA, each ER strategy was measured with one item derived loosely from Heiy and Cheavens (2014).

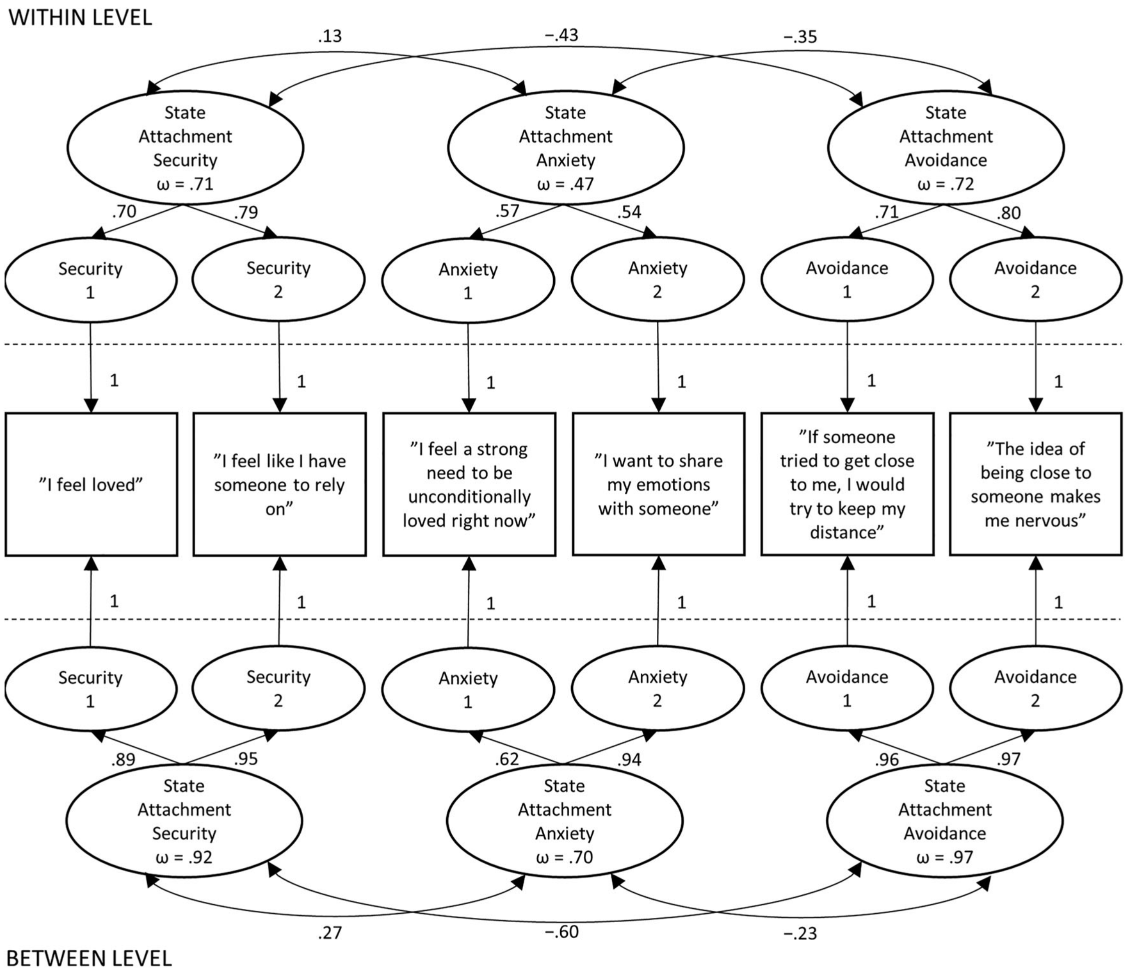

Figure 2. Multilevel measurement model of state adult attachment measure: standardised estimates.

Notes. Average scores (i.e. intercepts) and residual variances are not shown. *ω* = omega coefficient.

While single-item scales may restrict the construct validity, they are typical in EMA research as multi-item scales increase reporting burden when assessments are frequent, thus also compromising the validity of measurement (Eisele et al., 2022). The suppression and rumination items were worded to refer to negative emotional valence, and the reappraisal item was phrased to reframe a situation more positively. Using a 5-point Likert scale (1 = *not at all* to 5 = *very much*), the participants reported how much they had used reappraisal ("I thought about the situation in a more positive way"), rumination ("I thought over and over again about the negative situation and my feelings"), and suppression ("I avoided showing my situation-elicited negative feelings") to influence their emotions since the previous measurement (or for the last two hours when the measurement was the first of the day). Thus, the answers concerned the time between the current and the previously sent questionnaire. If participants had not used an ER strategy in this time frame, they were instructed to answer 1 = *not at all*.

Covariates

Regarding trait attachment analyses, we covaried a personality trait of neuroticism (i.e. susceptibility to experiencing negative emotions) as it shares phenotypic and genetic variance with attachment anxiety and avoidance (Donnellan et al., 2008) and is linked to the use of ER strategies (Barańczuk, 2019). In addition, we covaried age as well as financial strain as it reflects the features of ecological contexts that may shape both attachment and ER (Szepsenwol & Simpson, 2019). Including these covariates enabled us to test the incremental predictive value of trait attachment on state attachment and ER over general personality and demographic factors. In contrast, as the covariates lacked within-person variance, they were not included when testing the state-level effects between state attachment and ER. Finally, we took into account gender by conducting our main analyses for women only. Due to the limited number of males, this was the most appropriate way to consider gender in our analyses.

Neuroticism was measured with the neuroticism scale of the *IPIP-NEO questionnaire* (Goldberg et al., 2006). Using a 5-point Likert scale (1 = *describes me poorly* to 5 = *describes me very well*), the participants reported their tendency to experience negative emotions (9 items; e.g. "Panic easily"; $\alpha = .86$). Due to technical problems, one item ("Am often down in the dumps") of the original 10-item scale was unintentionally excluded. In the first phase, financial strain was measured by averaging two items ($r = .40$) regarding financial difficulties ("Do you or your family have difficulties in regularly paying coming bills?"; "How much money do you and your family have just before the next payday?"). These items had 5-point (1 = *extremely difficult* to 5 = *not difficult at all*) and 4-point (1 = *more than enough money* to 4 = *not enough money to cover expenses*) Likert scales, respectively. Before averaging, both scales were transformed to vary 0–1, with higher values indicating lower strain.

Analytic strategy

In our main analyses, we used the dynamic structural equation model (DSEM) and residual dynamic structural equation model (RDSEM) to test the uni- and bidirectional effects between state attachment and ER (Asparouhov & Muthén, 2020) and the random intercept model to test the links of trait attachment with state attachment and ER. These analyses were conducted in Mplus 8.3 and 8.5 (Muthén & Muthén, 2020). Before the main analyses, we assessed the stationarity of EMA variables for each participant by conducting Kwiatkowski-Phillips-Schmidt-Shin tests for a mean and trend, and Tsay's test and Keenan's test for nonlinearity in R 4.0.2. Stationarity implies that all moments are independent of time (e.g. means do not change), which was the assumption of our analyses. Descriptive statistics were also computed in R 4.0.2. The data, scripts, and outputs are found in https://osf.io/u59nd/.

Dynamic structural equation models

The effects between state attachment and ER were modelled using DSEM and RDSEM. DSEM is a novel statistical framework that integrates time-series, multilevel, and structural equation modelling (Asparouhov & Muthén, 2020). This framework is especially suitable for inspecting temporal within-person effects of time-varying variables in intensive longitudinal data, like the EMA (Asparouhov & Muthén, 2020). RDSEM, in turn, is an extension of DSEM focusing on inspecting within-person effects between time-varying variables measured at the same time (Asparouhov & Muthén, 2020). Both DSEM and RDSEM use latent centring to decompose the total variance into within-person and between-person components that are modelled separately. The difference between DSEM and RDSEM is that, in RDSEM, autoregressive and other temporal effects are modelled on the residual side of the model. Thus, the DSEM focuses on the temporal within-person effects of predictors on an outcome at the subsequent moment. RDSEM, in turn, preserves the focus on contemporaneous within-person effects of predictors while also modelling the time-series nature of the data (Asparouhov & Muthén, 2020). In our DSEMs and RDSEMs, we focused on the within-person variance of state attachment and ER strategies.

We first built three DSEMs and three RDSEMs to examine the unidirectional effects between state attachment and ER. This was because modelling all state attachment and ER variables in the same model would have been computationally infeasible due to too many estimated random effects. Figure 3 presents our modelling strategy that enabled us to inspect the incremental predictive effects of attachment states and ER strategies on each other. This strategy also allowed us to control the bias due to the exogeneity by modelling all autoregressive effects of the predictors (Asparouhov & Muthén, 2020). In the three DSEMs (Figure 3A), each ER strategy was treated as the outcome variable predicted by state attachment security, anxiety, and avoidance at the previous time point. In the three RDSEMs (Figure 3B), each attachment state was treated as the outcome variable predicted by reappraisal, rumination, and suppression assessed at the same time point (i.e. strategy use since the previous EMA). In all models, random effects were estimated for all

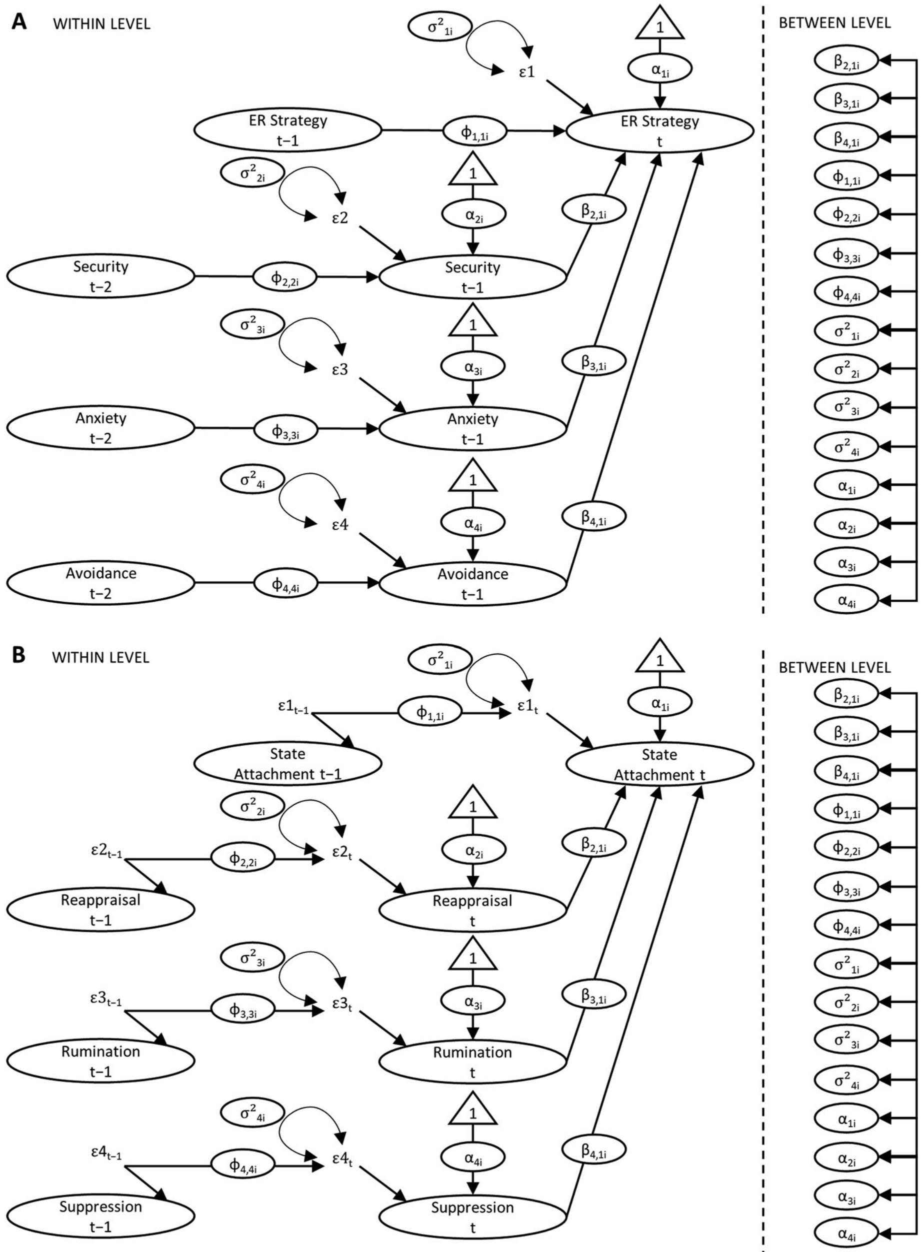

Figure 3. Testing the effects of state attachment on emotion regulation and vice versa: dynamic structural equation models (A) and residual dynamic structural equation models (B).

Notes. Due to item formulation, each emotion regulation strategy at t and t−1 represents the strategy use between the current and the previous assessments or during the last two hours when the assessment was the first of the day. The circles around the parameters of β, φ, α, and σ^2 indicate random parameters for the cross-lagged predictive effects (i.e. slopes), autoregressive predictive effects (i.e. slopes), average scores (i.e. intercepts), and residual variances (i.e. innovation variances), respectively. The arrows between ε parameters in panel B refer to the autoregressive effects of the variables on the residual side. Finally, the arrows without parameter labels at the within level are fixed to one. ER = emotion regulation.

predictive effects (i.e. slopes), residual variances (i.e. innovation variances), and average scores (i.e. intercepts) of state attachment and ER; that is, the parameters were allowed to vary between the participants. Notably, all state attachment and ER variables were treated as continuous variables. Alternatively, especially ER strategies could also have been modelled as categorical variables. However, the random effects cannot currently be modelled for the residual variances of categorical variables in Mplus. This shortcoming was critical for our study as excluding random residual variances when they differ from zero may also bias the estimates of the predictive effects (Jongerling et al., 2015). To assess the importance of including the random effects, we compared each DSEM/RDSEM to its simplified versions in which predictive effects and residual variances were modelled without random effects. The significance of the random predictive and residual effects was tested using the Bayes Wald test (Asparouhov & Muthén, 2021). We also reported deviation information criterion (DIC) for each model, with a smaller DIC indicating a better fit.

Finally, we modelled the cycles between state attachment and ER in separate RDSEMs. In each model, we included only the ER strategy and state attachment variables showing unidirectional effects on each other. Thus, the attachment state was predicted by the ER strategy at the same time point while estimating the autoregressive effect of the attachment state on the residual side. The ER strategy was predicted on the residual side by both the attachment state and the ER strategy at the previous time point. All random parameters for the predictive effects, residual variances, and average scores were estimated.

In all DSEM/RDSEMs, Bayesian Markov chain Monte Carlo estimation was used with the uninformative priors of Mplus. Thus, the results were asymptotically equivalent to maximum likelihood estimation. Two unthinned chains with 100,000 iterations were used in estimation, and convergence was checked via the Potential Scale Reduction (PSR) and trace plots. The median was used as a point estimate to summarise posterior distributions. Missing data were handled with the Kalman filter, and the TINTERVAL command of Mplus was used to specify a 1-hr and 43-min interval for lag interpretation, equalling each EMA block. This enabled us to use all data and consider unequal time distances of sequential assessments (e.g. due to nighttime). Before handling the data, our Monte Carlo simulations with 250 replications for the unidirectional DSEMs and RDSEMs suggested that the power to detect effects of .10–.20 ranged .82–1.00 when 95% credible intervals (CrIs) were used. The simulations only provided preliminary indications of power as several assumptions differed from our data. Importantly, the number of participants was higher (N = 128), and the number of observations was lower (N = 4174). Yet, as the simulations indicated sufficient power, we made the a priori decision of using 99% CrIs in interpreting the results. We also reported standardised within-person detected effects ($\beta^*_{\text{posterior}}$) and their two-tailed Bayesian *p*-values.

Random intercept model

The relations of trait attachment to state attachment and ER were tested with two random intercept models. In the models, the average scores (i.e. intercepts) of state attachment security, anxiety, and avoidance, and reappraisal, rumination, and suppression were between-person level outcome variables. In the first model, trait attachment anxiety and avoidance were included as predictors. In the second model, neuroticism, financial strain, and age were also included. Full information maximum likelihood estimation with robust standard errors was used as an estimator. In Monte Carlo simulations with 1000 replications, the power for the trait attachment effects of .30–.40 ranged .85–.99 using the 95% confidence intervals. Thus, we decided to use α = .050 for the standardised effects with the Benjamini–Hochberg procedure (Benjamini & Hochberg, 1995) to decrease the false discovery rate.

Results

Preliminary analyses

Supplemental Material 2 summarises the stationarity tests for the state attachment and ER variables. The rejection rates for stationarity were low in the Kwiatkowski-Phillips-Schmidt-Shin tests for a mean (2.5%–8.2%) and trend (0.8%–4.9%) and Tsay's (0.8%–4.9%) and Keenan's (2.6%–10.1%) tests for nonlinearity. Thus, most participants showed no firm evidence of non-stationarity in state attachment and ER. Supplemental Material 3 shows the descriptive statistics. Intraclass correlations (*ICC*) for state attachment security (*ICC* = .71), anxiety (*ICC* = .48), and avoidance (*ICC* = .55) were moderate to high, being similar to or even higher than those reported in studies with less frequent measurement (Haak et al., 2017; Sadikaj et al., 2015). In reappraisal (*ICC* = .32), rumination (*ICC* = .20), and suppression (*ICC* = .26), most variances were explained at the within-person level, corresponding to previous findings (Koval et al., 2021).

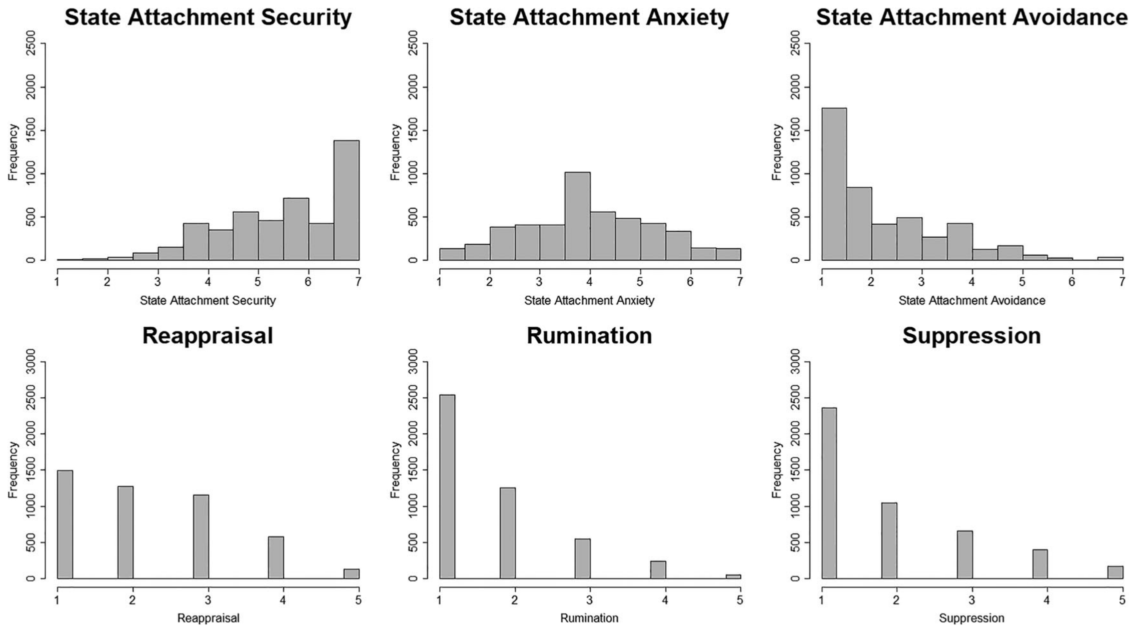

Figure 4. Frequency distributions of state attachment and emotion regulation strategy variables.

Notes. In state attachment variables, the labels of values were 1 = disagree strongly, 4 = neutral, 7 = agree strongly. Note that state attachment variables represent the average of their two items. In emotion regulation strategy variables, the labels of values were 1 = not at all, 2 = slightly, 3 = to some extent, 4 = quite much, 5 = very much.

Figure 4 shows the frequency distributions of attachment states and ER strategies across all observations. The state attachment distributions corresponded with previous studies using the same state attachment measure (Gillath et al., 2009; Trentini et al., 2015): Participants generally reported high state attachment security and more anxiety than avoidance. The distribution of each ER strategy was skewed to the right, with the mode of 1 (i.e. *not at all*) that was reported in 32.3–54.9% of the time. Thus, most often, the participants reported that they had not used the particular ER strategy. Notably, similar right-skewed distributions and modes can be consistently found in four publicly available EMA datasets that have measured reappraisal, rumination, and suppression using similar items (Koval et al., 2021, see the datasets in https://osf.io/q5dz6/ and the distributions in Supplemental Material 4).

The within-person (EMA reports) and between-person level (trait assessments and aggregated EMA reports) correlations are shown in Table 2. ER strategies correlated positively with each other at both within- (r = .04–.23) and between-person (r = .36–.56) levels. These findings align with the four available EMA datasets (Koval et al., 2021), in which ER strategies consistently correlate positively at within- (r = .09–.36) and between-person (r = .30–.78) levels (Supplemental Material 4). Thus, people tend to use multiple strategies when regulating emotions and possess a trait-level tendency to use multiple strategies. Moreover, Supplemental Material 5 presents the within- and between-person correlations at the level of each EMA item. Each pair of state attachment security (r_{within} = .55, $r_{between}$ = .84), anxiety (r_{within} = .31, $r_{between}$ = .53), and avoidance (r_{within} = .57, $r_{between}$ = .92) items showed substantially higher correlations to each other than to any ER strategy ($|r|_{within}$ = .00–.21, $|r|_{between}$ = .01–.37), providing evidence on the discriminant validity of our state attachment (SAAM) and ER measures.

Effects between state attachment and emotion regulation

Regarding the main analyses, we first assessed the necessity of including random effects in the unidirectional DSEMs and RDSEMs. This was done by comparing the models with all random predictive effects, residual variances, and average scores to their simplified versions without all or some predictive effects and residual variances. Supplemental Material 6 presents these results. The Bayes Wald tests showed

Table 2. Correlations between variables at within-person and between-person levels.

	1	2	3	4	5	6	7	8	9	10	11	12	13
Within-Person Level													
1. Reappraisal$_t$	–												
2. Rumination$_t$	.04*	–											
3. Suppression$_t$	.19***	.23***	–										
4. State Attachment Security$_t$	.10***	−.21***	−.11***	–									
5. State Attachment Anxiety$_t$	.07***	.14***	.07***	.08***	–								
6. State Attachment Avoidance$_t$	−.06**	.16***	.08***	−.32***	−.23***	–							
7. Reappraisal$_{t-1}$	.21***	−.04*	.06***	.05**	.01	−.04*	–						
8. Rumination$_{t-1}$	.07***	.31***	.12***	−.09***	.10***	.04*	.04*	–					
9. Suppression$_{t-1}$	.09***	.12***	.24***	−.06***	.05**	.03	.19***	.23***	–				
10. State Attachment Security$_{t-1}$	−.01	−.15***	−.05**	.41***	−.03	−.14***	.10***	−.21***	−.11***	–			
11. State Attachment Anxiety$_{t-1}$	.00	.09***	.05**	.03	.34***	−.10***	.07***	.14***	.07***	.08***	–		
12. State Attachment Avoidance$_{t-1}$	.03	.06***	.05**	−.12***	−.03*	.28***	−.06***	.16***	.08***	−.32***	−.23***	–	
13. Time	−.01	.00	−.03*	−.05**	−.03*	.01	−.01	.00	−.03	−.05**	−.03*	.01	–
Between-Person Level													
1. Reappraisal	–												
2. Rumination	.36***	–											
3. Suppression	.56***	.53***	–										
4. State Attachment Security	.14	−.30***	−.20*	–									
5. State Attachment Anxiety	.27**	.34***	.30***	.03	–								
6. State Attachment Avoidance	.02	.23*	.27**	−.54***	−.09	–							
7. Trait Attachment Anxiety	.07	.38***	.25**	−.44***	.25**	.33***	–						
8. Trait Attachment Avoidance	−.12	.05	−.01	−.47***	−.14	.44***	.44***	–					
9. Neuroticism	−.18*	.29**	.06	−.33***	.13	.41***	.61***	.33***	–				
10. Financial Strain	.06	−.18	−.08	.23*	.03	−.32***	−.15	.01	−.18*	–			
11. Age	−.04	.01	−.02	.03	.16	−.05	−.09	−.03	.02	−.09	–		

Notes. The correlations at the within-person level are for the person-mean-centered data. For the reported between-person level correlations, the within-person level variables (reappraisal, rumination, suppression, state attachment security, state attachment anxiety, and state attachment avoidance) were aggregated by averaging. * $p < .05$; ** $p < .01$; *** $p < .001$.

that all random predictive effects and residual variances improved the fit of all DSEMs and RDSEMs substantially (Table S6A). Moreover, DSEMs and RDSEMs with all random effects consistently showed lower DIC values compared to the simpler models (Table S6B). The only exception was the RDSEM regarding the effects on state attachment avoidance, in which the model without the random autoregressive effects of ER showed the smallest DIC. Thus, here we report the DSEMs and the RDSEMs with all predictive effects, residual variances, and average scores. In these models, PSRs for the post-burn-in iterations ranged 1.026–1.001, and the trace plots showed no trends or irregularities. The results of the simplified models are provided in Supplemental Material 7.

Table 3 shows the results of three unidirectional DSEMs concerning the effects of state attachment on ER. In line with the broaden-and-build cycle of security and the baseline security cycle, security predicted decreased rumination ($\beta^*_{posterior} = -0.10$, $SD_{\beta^*posterior} = 0.02$, $p < .001$). Moreover, as hypothesised in the hyperactivating cycle of insecurity, anxiety predicted increased rumination ($\beta^*_{posterior} = 0.07$, $SD_{\beta^*posterior} = 0.02$, $p < .001$). Both detected effects were small but robust ($p < .001$). However, against our broaden-and-build cycle of security, baseline security cycle, and deactivating cycle of insecurity, state attachment showed no effects on reappraisal and suppression. In all models, 99% CrIs for all random effects excluded zero, stressing individual differences in the state attachment effects on ER.

Table 4 presents the results of three unidirectional RDSEMs concerning the effects of ER on state attachment. As hypothesised in the broaden-and-build cycle of security and the baseline security cycle, reappraisal predicted increased security ($\beta^*_{posterior} = 0.09$, $SD_{\beta^*posterior} = 0.01$, $p < .001$). It also predicted decreased avoidance ($\beta^*_{posterior} = -0.06$, $SD_{\beta^*posterior} = 0.01$, $p < .001$) and, surprisingly, increased anxiety ($\beta^*_{posterior} = 0.07$, $SD_{\beta^*posterior} = 0.01$, $p < .001$). In line with the hyperactivating cycle of insecurity, rumination predicted increased anxiety ($\beta^*_{posterior} = 0.10$, $SD_{\beta^*posterior} = 0.02$, $p < .001$). It also predicted decreased security ($\beta^*_{posterior} = -0.11$, $SD_{\beta^*posterior} = 0.02$, $p < .001$) and increased avoidance ($\beta^*_{posterior} = 0.15$, $SD_{\beta^*posterior} = 0.02$, $p < .001$). Contrary to the deactivating cycle of insecurity, suppression predicted increased (not decreased) avoidance ($\beta^*_{posterior} = 0.08$, $SD_{\beta^*posterior} = 0.01$, $p < .001$). It also

Table 3. Dynamic structural equation models: effects of state attachment on emotion regulation.

	Model 1: Effects on reappraisal ($R^2 = .15$)		Model 2: Effects on rumination ($R^2 = .23$)		Model 3: Effects on suppression ($R^2 = .17$)	
Predictive Effect	Fixed effects Posterior *Mdn* [99% CrI]	Random effects Posterior *Mdn* [99% CrI]	Fixed effects Posterior *Mdn* [99% CrI]	Random effects Posterior *Mdn* [99% CrI]	Fixed effects Posterior *Mdn* [99% CrI]	Random effects Posterior *Mdn* [99% CrI]
$\beta_{2,1i}$: $Security_{t-1} \rightarrow ER\ Strategy_t$	0.02 [−0.13, 0.16]	**0.08 [0.03, 0.19]**	**−0.12 [−0.23, −0.01]**	**0.04 [0.01, 0.09]**	−0.01 [−0.13, 0.11]	**0.04 [0.01, 0.11]**
$\beta_{3,1i}$: $Anxiety_{t-1} \rightarrow ER\ Strategy_t$	0.01 [−0.05, 0.08]	**0.03 [0.01, 0.07]**	**0.07 [0.02, 0.13]**	**0.02 [0.01, 0.04]**	0.06 [−0.01, 0.12]	**0.02 [0.01, 0.06]**
$\beta_{4,1i}$: $Avoidance_{t-1} \rightarrow ER\ Strategy_t$	0.04 [−0.05, 0.13]	**0.03 [0.01, 0.08]**	0.03 [−0.05, 0.11]	**0.03 [0.01, 0.07]**	0.08 [−0.00, 0.16]	**0.03 [0.01, 0.08]**
$\varphi_{1,1i}$: $ER\ Strategy_{t-1} \rightarrow ER\ Strategy_t$	**0.22 [0.15, 0.28]**	**0.04 [0.02, 0.08]**	**0.28 [0.21, 0.35]**	**0.05 [0.02, 0.09]**	**0.21 [0.12, 0.29]**	**0.07 [0.04, 0.13]**
$\varphi_{2,2i}$: $Security_{t-2} \rightarrow Security_{t-1}$	**0.36 [0.27, 0.43]**	**0.08 [0.04, 0.13]**	**0.36 [0.28, 0.44]**	**0.08 [0.05, 0.13]**	**0.35 [0.26, 0.43]**	**0.08 [0.05, 0.14]**
$\varphi_{3,3i}$: $Anxiety_{t-2} \rightarrow Anxiety_{t-1}$	**0.31 [0.24, 0.39]**	**0.07 [0.04, 0.11]**	**0.32 [0.24, 0.39]**	**0.06 [0.04, 0.11]**	**0.32 [0.24, 0.39]**	**0.06 [0.04, 0.11]**
$\varphi_{4,4i}$: $Avoidance_{t-2} \rightarrow Avoidance_{t-1}$	**0.32 [0.24, 0.40]**	**0.07 [0.04, 0.11]**	**0.33 [0.25, 0.40]**	**0.07 [0.04, 0.12]**	**0.32 [0.24, 0.40]**	**0.07 [0.04, 0.12]**

Notes. $N_{participants} = 122$, $N_{observations} = 4637$. Random residual variances, average scores, and all correlations among the parameters at the between-person level were also estimated but are not reported here as these do not concern our research questions (for random residual variances and average scores, see TableS7A in Supplemental Material 7). In bolded values, the 99% credible interval (99% CrI) does not contain zero. The reported R^2s represent the within-person level R^2s averaged across participants. ER = emotion regulation.

Table 4. Residual dynamic structural equation models: effects of emotion regulation on state attachment

Predictive Effect	Model 1: Effects on state attachment security ($R^2 = .26$)		Model 2: Effects on state attachment anxiety ($R^2 = .21$)		Model 3: Effects on state attachment avoidance ($R^2 = .26$)	
	Fixed effects Posterior *Mdn* [99% CrI]	Random effects Posterior *Mdn* [99% CrI]	Fixed effects Posterior *Mdn* [99% CrI]	Random effects Posterior *Mdn* [99% CrI]	Fixed effects Posterior *Mdn* [99% CrI]	Random effects Posterior *Mdn* [99% CrI]
$\beta_{2,1i}$: $Reappraisal_t \rightarrow State\ Attachment_t$	**0.07 [0.04, 0.11]**	**0.01 [0.00, 0.02]**	**0.07 [0.01, 0.12]**	**0.03 [0.01, 0.05]**	**−0.06 [−0.11, −0.01]**	**0.02 [0.01, 0.04]**
$\beta_{3,1i}$: $Rumination_t \rightarrow State\ Attachment_t$	**−0.09 [−0.15, −0.04]**	**0.03 [0.02, 0.06]**	**0.12 [0.05, 0.19]**	**0.04 [0.02, 0.09]**	**0.17 [0.09, 0.24]**	**0.06 [0.03, 0.11]**
$\beta_{4,1i}$: $Suppression_t \rightarrow State\ Attachment_t$	**−0.07 [−0.11, −0.03]**	**0.01 [0.01, 0.03]**	0.01 [−0.05, 0.07]	**0.02 [0.01, 0.04]**	**0.09 [0.03, 0.15]**	**0.04 [0.02, 0.08]**
$\varphi_{1,1i}$: $State\ Attachment_{t-1} \rightarrow State\ Attachment_t$	**0.32 [0.23, 0.40]**	**0.09 [0.05 0.15]**	**0.30 [0.22, 0.37]**	**0.07 [0.04, 0.11]**	**0.29 [0.21, 0.37]**	**0.08 [0.05, 0.14]**
$\varphi_{2,2i}$: $Reappraisal_{t-1} \rightarrow Reappraisal_t$	**0.23 [0.17, 0.30]**	**0.04 [0.02, 0.07]**	**0.23 [0.17, 0.29]**	**0.04 [0.02, 0.07]**	**0.23 [0.17, 0.30]**	**0.04 [0.02, 0.08]**
$\varphi_{3,3i}$: $Rumination_{t-1} \rightarrow Rumination_t$	**0.35 [0.28, 0.42]**	**0.05 [0.03, 0.09]**	**0.35 [0.28, 0.41]**	**0.05 [0.03, 0.09]**	**0.35 [0.28, 0.42]**	**0.05 [0.03, 0.09]**
$\varphi_{4,4i}$: $Suppression_{t-1} \rightarrow Suppression_t$	**0.25 [0.16, 0.32]**	**0.08 [0.05, 0.13]**	**0.24 [0.16, 0.32]**	**0.08 [0.05, 0.13]**	**0.25 [0.16, 0.33]**	**0.08 [0.05, 0.13]**

Notes. $N_{participants} = 122$, $N_{observations} = 4637$. Random residual variances, average scores, and all correlations among the parameters at the between-person level were also estimated but are not reported here as these do not concern our research questions (for random residual variances and average scores, see TableS7H in Supplemental Material 7). In bolded values, the 99% credible interval (99% CrI) does not contain zero. The reported R^2s represent the within-person level R^2s averaged across participants.

predicted decreased security ($\beta^*_{posterior} = -0.08$, $SD_{\beta^*posterior} = 0.01$, $p < .001$). Again, all these detected effects were small but robust ($p < .001$), and 99% CrIs of all random effects excluded zero.

Next, we modelled the cyclic effects between attachment states and ER if they showed unidirectional effects on each other in the previous analyses. Two pairs of variables met this criterion: (a) state attachment anxiety and rumination (in line with the hyperactivating cycle of insecurity) and (b) state attachment security and rumination. In the first cycle, rumination predicted increased anxiety ($\beta_{posterior} = 0.13$, 99% CrI [0.06, 0.19]), but the 99% CrI for the effect of anxiety on rumination contained zero ($\beta_{posterior} = 0.04$, 99% CrI [−0.01, 0.09]). Thus, we found no full support for the hyperactivating cycle of insecurity. Further inspections revealed that the discrepancy between unidirectional and cyclic models might indicate a suppressor effect, where the predictive value of anxiety on rumination increased when controlling for other attachment states. However, the 99% CrIs overlapped in both unidirectional and cyclic models, providing no clear support for this statistical suppressor effect. In the second cycle, low security predicted increased rumination ($\beta_{posterior} = -0.12$, 99% CrI [−0.22, −0.01]), and rumination predicted decreased security ($\beta_{posterior} = -0.11$, 99% CrI [−0.16, −0.05]). These results suggest a cycle between low state attachment security and high rumination depicted in Figure 5A with standardised estimates.

The detected cycle suggests dynamics between low state attachment security and high rumination in which both amplify each other over time. At the same time, our stationarity analyses indicated that the mean levels of these constructs did not change over time among most participants. Together these results imply that some counter processes must attenuate and eventually extinguish the detected cycle over the long run. As reappraisal (a) predicted increased state attachment security and (b) correlated positively with rumination, we decided to explore further a possibility that reappraisal might operate as one counter process that attenuates the cycle of low state attachment security and high rumination. Thus, we replicated the cycle between security and rumination in an additional RDSEM while adding rumination at the previous time point to predict reappraisal and reappraisal to predict security (the autoregression effect of reappraisal was also modelled). Figure 5B presents the main results with standardised estimates.

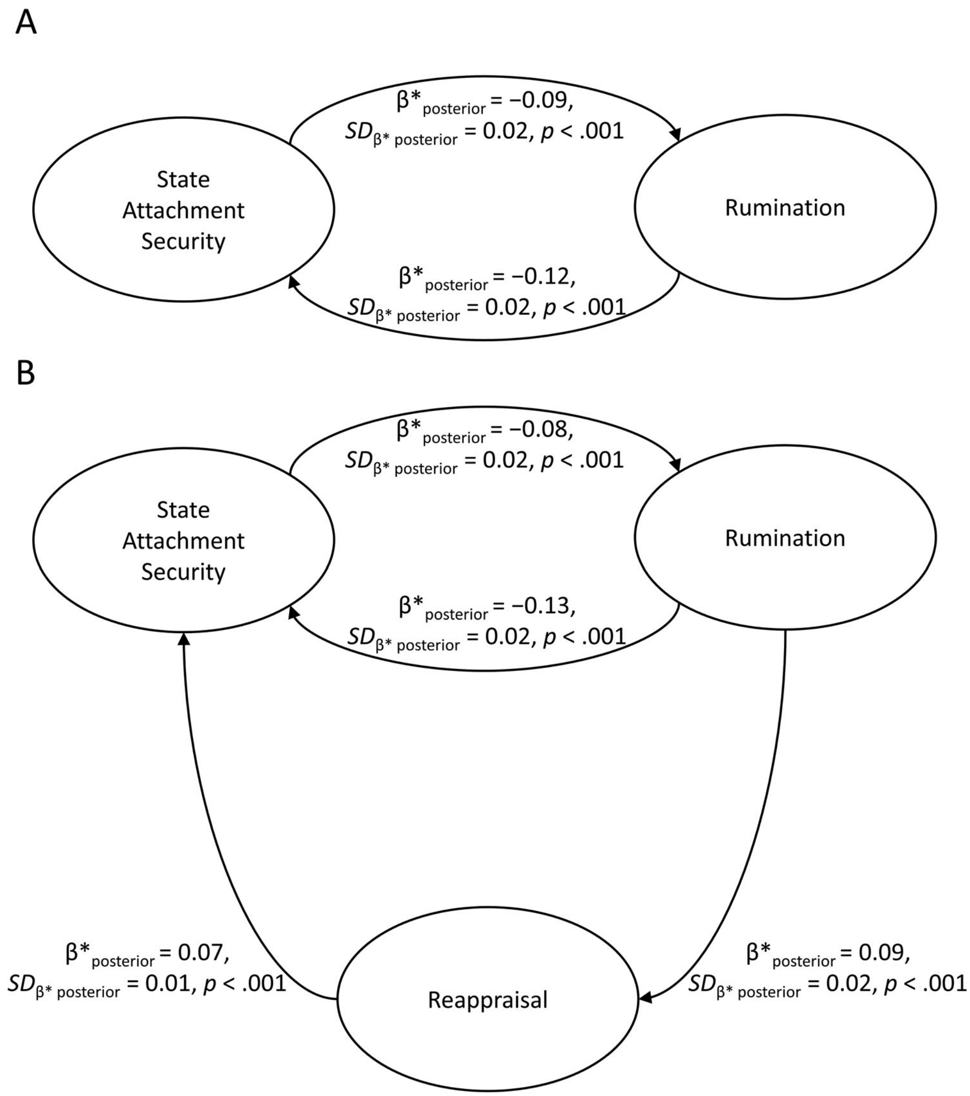

Figure 5. A cycle between state attachment security and rumination (A) and role of reappraisal in attenuating this cycle (B).

Notes. The presented estimates are standardised. The predictive autoregressive effects (i.e. slopes), residual variances (i.e. innovation variances), and average scores (i.e. intercepts) are not shown.

The model replicated the cycle between low security and high rumination. Interestingly, rumination also predicted increased reappraisal ($\beta_{posterior} = 0.13$, 99% CrI [0.06, 0.21]), and as in the unidirectional models, reappraisal predicted increased security ($\beta_{posterior} = 0.06$, 99% CrI [0.04, 0.10]). These results align with the idea that rumination may eventually initiate reappraisal that attenuates the self-sustaining cycle between low state attachment security and high rumination. Lastly, we verified all our RDSEMs in the DSEM framework and vice versa. The absolute differences were marginal, and interpretations of all effects between state attachment and ER remain the same.

Relations of trait attachment to state attachment and emotion regulation

Finally, we tested the relations of trait attachment to the average scores of state attachment and ER. Table 5 shows the standardised results. As hypothesised, trait attachment anxiety was linked to more state attachment anxiety, and trait attachment

Table 5. Random intercept models: standardised effects of trait attachment on state attachment and emotion regulation strategies.

	State Attachment Security		State Attachment Anxiety		State Attachment Avoidance		Reappraisal		Rumination		Suppression	
Predictor	β* [95% CI]	*p*	β* [95% CI]	*p*	β* [95% CI]	*p*	β* [95% CI]	*p*	β* [95% CI]	*p*	β* [95% CI]	*p*
Model 1												
Trait Attachment Anxiety	**−0.30** **[−0.46 −0.14]**	<**.001***	**0.39** **[0.23, 0.56]**	<**.001***	**0.17** **[0.01, 0.33]**	**.036**	0.16 [−0.05, 0.36]	.128	**0.48** **[0.31, 0.64]**	<**.001***	**0.33** **[0.15, 0.51]**	<**.001***
Trait Attachment Avoidance	**−0.34** **[−0.51, −0.17]**	<**.001***	**−0.31** **[−0.49, −0.14]**	<**.001***	**0.37** **[0.22, 0.53]**	<**.001***	−0.19 [−0.39, 0.01]	.056	−0.15 [−0.34, 0.05]	.142	−0.15 [−0.35, 0.04]	.127
Model 2												
Trait Attachment Anxiety	**−0.23** **[−0.42, −0.04]**	**.017***	**0.44** **[0.25, 0.62]**	<**.001***	−0.04 [−0.26, 0.18]	.704	**0.37** **[0.15, 0.58]**	**.001***	**0.40** **[0.19, 0.62]**	<**.001***	**0.41** **[0.19, 0.64]**	<**.001***
Trait Attachment Avoidance	**−0.35** **[−0.52, −0.19]**	<**.001***	**−0.33** **[−0.50, −0.15]**	<**.001***	**0.38** **[0.23, 0.54]**	<**.001***	−0.17 [−0.36, 0.02]	.072	−0.14 [−0.33, 0.05]	.141	−0.14 [−0.34, 0.06]	.172
Neuroticism	−0.05 [−0.22, 0.12]	.567	−0.01 [−0.19, 0.17]	.925	**0.26** **[0.05, 0.47]**	**.014**	**−0.34** **[−0.54, −0.15]**	<**.001**	0.10 [−0.08, 0.27]	.272	−0.15 [−0.37, 0.06]	.163
Financial Strain	**0.19** **[0.03, 0.35]**	**.023**	0.12 [−0.10, 0.32]	.282	**−0.29** **[−0.45, −0.13]**	**.001**	0.05 [−0.12, 0.22]	.562	−0.10 [−0.28, 0.07]	.245	−0.05 [−0.24, 0.15]	.635
Age	0.02 [−0.12, 0.16]	.776	**0.20** **[0.05, 0.35]**	**.010**	−0.08 [−0.21, 0.06]	.285	−0.01 [−0.17, 0.15]	.889	0.03 [−0.11, 0.16]	.702	0.02 [−0.15, 0.18]	.852

Notes. $N_{participants}$ = 122, $N_{observations}$ = 4637. In bolded values, *p* <.050. * = significant after Benjamini–Hochberg correction with alpha level = .050 and the total number of tests = 12. CI = confidence interval.

avoidance was related to more state attachment avoidance and less state attachment security. Trait attachment anxiety was also linked to less state attachment security, and trait attachment avoidance was linked to less state attachment anxiety. Regarding ER, as hypothesised, trait attachment anxiety was linked to more rumination. It was also linked to more suppression and, against our hypothesis, to more (not less) reappraisal. The latter was only detected after neuroticism was covaried, suggesting that controlling for neuroticism raised the predictive value of trait attachment anxiety on reappraisal. A Sobel test confirmed this statistical suppressor effect ($z = -3.17$, $p = .002$). Against our hypotheses, trait attachment avoidance did not predict ER. Most detected effects were small to moderate and robust.

Additional analyses for women sample only

As 88.5% of our sample were women, we yet performed additional analyses to check whether the results changed after excluding men. Supplemental Material 8 presents these results. Compared to our main results, the absolute differences were marginal, and few differences in the detected effects reflected decreased power due to the smaller sample.

Discussion

According to attachment theory, on one hand, state attachment may influence ER, and on the other hand, ER may influence state attachment. In this EMA study, we were the first to model these bidirectional effects, allowing us to formulate and test novel hypotheses about short-term secure and insecure regulatory cycles between state attachment and ER. To our surprise, the results did not provide complete support for any of our four hypothesised cycles as state attachment did not show the expected effects on ER. Yet, ER strategies predicted subsequent changes in all attachment states. Partially supporting the secure cycle hypotheses, reappraisal predicted increased security, yet it also predicted increased anxiety and decreased avoidance. Partially supporting the hyperactivation cycle of insecurity hypothesis, rumination predicted increased anxiety, yet it also predicted increased avoidance and decreased security. Against the deactivation cycle of insecurity hypothesis, suppression predicted increased avoidance; it also predicted decreased security. Intriguingly, a not hypothesised cycle was detected between state attachment security and rumination: Low security predicted increased rumination that, in turn, predicted decreased security. Moreover, additional explorations indicated that rumination might eventually initiate reappraisal, which then attenuates the detected self-sustaining cycle. Finally, we tested the relations of trait attachment to state attachment and ER. As hypothesised, trait attachment anxiety was linked to both state attachment and ER. Trait attachment avoidance was, in turn, related to state attachment but, surprisingly, not to ER. Overall, our novel findings suggest complex regulatory dynamics between attachment and ER and raise several important questions about their functional relationship in maintaining attachment-related behavioural patterns and emotional well-being.

Dynamics between state attachment and emotion regulation

The lack of complete support for our hypotheses regarding secure and insecure cycles was because the hypothesised effects of state attachment on ER strategies were not found. Against the broaden-and-build cycle of security and the baseline security cycle hypotheses, state attachment security showed no effect on reappraisal. This null finding supported neither (a) the broaden-and-build model of security positing that state security would expand people's self-regulation capacities and resources into constructive ER (Mikulincer & Shaver, 2019) nor (b) the social baseline theory positing that state security would reduce all deliberate ER efforts to avoid spending mental resources needlessly (Beckes & Coan, 2011). Nevertheless, we found that reappraisal can have an important role in shaping all attachment states. On one hand, reappraisal predicted increased security and decreased avoidance, suggesting that reappraisal promotes the sense of security. On the other hand, reappraisal predicted increased state attachment anxiety, indicating that it may also intensify the sense of insecurity. While preliminary, this unexpected finding raises an interesting puzzle as robust ER research shows that reappraisal typically alleviates negative emotional states (Gross, 2015). Yet, it is noteworthy that momentary experiences of attachment anxiety are by no means dysfunctional. Instead, these states can foster support-seeking behaviours that effectively mitigate distress (Mikulincer & Shaver, 2016). Thus, we tentatively propose that reappraisal may increase state attachment anxiety by means of seeking support from others, especially because it may increase security and decrease avoidance simultaneously.

Regarding the hyperactivating cycle of insecurity, the results were mixed. In the unidirectional models, state attachment anxiety predicted increased rumination that, in turn, predicted increased anxiety, supporting the hyperactivation hypothesis. Surprisingly, no effect of state attachment anxiety on rumination was detected in the model testing the cyclic effects. This difference between the results may hint at a statistical suppressor effect that, however, needs to be established in studies with high power for testing such suppressor effects. Thus, in our EMA study focusing on the ongoing flow of state attachment and ER, we found no full support for the proposition that state attachment anxiety would initiate rumination to serve the hyperactivation goals (Mikulincer & Shaver, 2016). Yet, it should be noted that we might have detected these effects more robustly if we had narrowed our focus on the specific contexts relevant for attachment anxiety (e.g. rejection cues). In sum, research on the topic is still warranted before drawing more decisive conclusions from these findings.

Interestingly, we found a not hypothesised cycle between low state attachment security and rumination. Moreover, of all ER strategies, rumination showed the strongest effects on increased insecurities in all attachment states. Together these novel findings suggest that low state attachment security may narrow people's self-regulatory capacities and flexibility, initiating rumination even before state attachment anxiety is triggered. Furthermore, rumination seems to organise cognitive and emotional processes to intensify various insecure states, likely by directing attention to threats, increasing negative emotions, and deactivating other motivational systems (Kobak & Bosmans, 2019; Mikulincer & Shaver, 2016). Thus, our findings may indicate an insecure cycle, in which low state attachment security initiates rumination, which will then accelerate the functioning of the attachment system to find a solution for the lack of security. Notably, our additional analysis suggests that rumination may eventually initiate reappraisal that then subsequently increases security. This intriguing yet preliminary finding implies that reappraisal might operate as a counter process that attenuates the insecure cycle. It may be that the initiation of reappraisal broadens one's perspective to reflect upon one's insecurities and thus help find solutions to restore the sense of security (Kobak & Bosmans, 2019). Replications of our novel findings regarding complex dynamics between state attachment security, rumination, and reappraisal are critical questions for future research.

Finally, against the deactivating cycle of insecurity hypothesis, we found no effect of state attachment avoidance on suppression. For this hypothesis, it was even more puzzling that suppression predicted increased (not decreased) state attachment avoidance. These findings call into question the proposed negative short-term reinforcement mechanism where state attachment avoidance initiates suppression to lower the psychological pain underlying avoidance. Instead, the findings that suppression predicted both increased state attachment avoidance and decreased security align with the wealth of ER literature, indicating that a habitual tendency to suppress emotions hampers people's emotional well-being (Chervonsky & Hunt, 2017). Yet, for future research, the question remains open about the benefits of suppression that reinforce its use. Notably, suppression is mainly motivated by social goals (e.g. avoiding conflicts; English et al., 2017), and it has been linked to less verbal aggression in females (Rogier et al., 2019). Thus, the effects of suppression on insecurities in our study might reflect a regulatory trade-off where suppression protects people from detrimental interpersonal outcomes but simultaneously leads to personal costs in emotional well-being.

In general, our findings are important in showing that ER strategies can alter state attachment. In contrast, state attachment showed modest effects on ER, limited only for rumination. Three explanations may account for this unexpected asymmetry, related to (a) attachment-triggering contexts, (b) the role of trait attachment, and (c) the temporal EMA resolution. First, according to dominant theoretical views, attachment-related ER is activated when the presence of threats triggers the attachment system (Bowlby, 1982; Mikulincer & Shaver, 2016). While we observed substantial within-person variance, indicating genuine daily fluctuation in state attachment, we did not measure the nature of the triggering contexts. Arguably, attachment states can initiate ER merely in response to attachment-relevant events (e.g. conflicts with partners), whereas in less relevant events (e.g. frustration at work), non-attachment goals may often drive ER. Thus, examining the moderating role of contexts for state attachment and ER dynamics is an important next step for EMA research. However, this can be challenging as such statistical models can become exhaustively complex. For example, in our models, the inclusion of just one binary moderator would have added at least 48 effects to be estimated. One solution for this problem would be to study the moderation effects of contexts in narrow designs (e.g. focusing only on state attachment anxiety and rumination).

Second, it is notable that all effects of state attachment on ER (and vice versa) varied substantially among participants. This may be explained by individual differences in trait attachment that can lead to very different regulatory goals when experiencing specific attachment states (Arriaga et al., 2018; Bosmans et al., 2020). For example, in people with high trait attachment anxiety, high state attachment anxiety can trigger rumination to serve their hyperactivation goals, whereas, in people with low trait attachment anxiety, high state attachment anxiety may initiate reappraisal to serve their security goals. As such complex moderation effects fell outside the scope of our study, we hope future studies scrutinise the role of trait attachment in state attachment and ER dynamics.

Finally, it is critical to consider the temporal resolution of our EMA. Currently, research on the intervals in which the effects of state attachment on ER are most prominent is widely lacking. In our design, the state attachment effects on ER (i.e. state $\text{attachment}_{t-1} \rightarrow \text{ER}_t$) were modelled using the average interval of 1-hr and 43-min. Especially utilising a shorter interval (e.g. from minutes to even seconds) might have provided a very different picture of the phenomena. Thus, the topic of optimal measurement resolution is a vital question to be resolved in future EMA studies.

Relations of trait attachment to state attachment and emotion regulation

In line with our hypotheses and previous studies (Haak et al., 2017; Sadikaj et al., 2015), trait attachment anxiety was linked to more state attachment anxiety, and trait attachment avoidance was related to more state attachment avoidance and less security. Trait attachment anxiety was also linked to less state attachment security, and trait attachment avoidance was associated with less state attachment anxiety, differing from the previous null findings with less frequent measurement (Haak et al., 2017; Sadikaj et al., 2015). Thus, our EMA findings with denser measurement revealed a broader role of trait attachment in state attachment than previous research, supporting the view that trait attachment biases people's subjective appraisals of threats and attachment figures' availability (Dykas & Cassidy, 2011). These findings also support the convergent validity of our state attachment measure (SAAM).

Regarding ER strategies, trait attachment anxiety was linked to more rumination, supporting our hypothesis. It was also related to more suppression and reappraisal. Together, these findings suggest that the hyperactivation of anxiously attached people manifests in their greater use of rumination, but they also tend to use other ER strategies more frequently. However, it should be noted that particularly the effect of trait attachment anxiety on higher use of reappraisal contradicts previous studies with single-occasion measures on habitual ER showing the opposite effect (Karreman & Vingerhoets, 2012; Troyer & Greitemeyer, 2018). Notably, we detected this unexpected effect only when neuroticism was covaried. Thus, replications concerning the effect are warranted before stronger conclusions. Yet, our findings might imply that controlling for neuroticism and its shared genetic variance with trait attachment anxiety (Donnellan et al., 2008) reveals a crisper view of how anxiously attached people have learned to regulate their emotions based on experiences in close relationships. Alternatively, our EMA measurement can explain the differences between our study and the previous ones. In fact, a recent large-scale study showed only modest correlations between the EMA and single-occasion habitual ER measures, implying that these mostly capture separate ER processes (e.g. selection and implementation; Koval et al., 2021).

Against our hypothesis, trait attachment avoidance did not predict any ER. These findings are not in line with previous studies with single-occasion habitual ER measures tending to show the link between trait attachment avoidance and greater suppression (Garrison et al., 2014; Troyer & Greitemeyer, 2018). One explanation for this may be that avoidantly attached people defensively eschew and block daily stressful experiences, thus reducing their need for deliberate ER (Dykas & Cassidy, 2011). Yet, according to this explanation, trait attachment avoidance should have predicted less ER, which did not occur. Alternatively, the null findings may reflect avoidantly attached people's inabilities to monitor and describe their daily emotional processes (Mikulincer & Shaver, 2016). In sum, the differences between our study and the previous ones emphasise the importance of future research to clarify the role of ER measurement (EMA vs single-occasion) in the links of trait attachment with daily ER.

Strengths and limitations

Our study has clear strengths. First, the EMA design and statistical techniques allowed us to quantitatively examine unique and theoretically relevant issues, revealing new insights on attachment and ER dynamics that more traditional designs cannot obtain. Second, while the detected effects were relatively small, they were robust. Thus, our findings contribute to the contemporary attachment models that highlight the importance of dynamic attachment processes in well-being and therapeutic interventions (Arriaga et al., 2018; Kobak & Bosmans, 2019). Particularly, interventions targeting rumination (Watkins & Roberts, 2020) may prove effective in reducing insecure attachment states in people's daily lives. Third, while our design could not demonstrate causality due to potential unmeasured third variables, we showed several temporal associations between ER and state attachment. We hope that our findings encourage researchers to design further experimental and EMA studies to exclude, for example, the possibility that threatening contexts are common causes that solely explain the associations between state attachment and ER. As these contexts can also act as moderators, researchers must pay attention to properly controlling the confounding effects without missing the genuine effects. Fourth, we showed support for the three-dimensionality and discriminant and convergent validity of the SAAM. Further, our invariance analyses in Supplemental Material 1 alluded that state attachment at the between-person level might be an emergent property that cannot be fully reduced to its within-person counterpart. This stresses cautiousness in the interpretations when aggregating state attachment scores at the between level. Overall, the provided psychometric knowledge is valuable for future studies on state attachment.

Our study has yet three main limitations. First, our sample comprised mostly women and students. Thus, more heterogeneous samples are required to replicate and clarify our findings. Particularly, the generalizability of our findings to males remains uncertain as some research implies that some ER strategies (e.g. reappraisal, suppression) may be more strongly linked to socioemotional outcomes in females than in males (Rogier et al., 2019). Similarly, the generalizability is especially unclear for non-Western populations, in which the attachment and ER processes may manifest differently (Thompson et al., 2022). Second, although our ER measures complied with the current EMA standards (Koval et al., 2021), we had limited possibilities to evaluate the psychometric properties of these measures as we used only single items. The use of single-item scales may have limited the construct validity of ER measurement, which might have restricted the statistical power in our analyses. Finally, while we utilised the continuous EMA measurement of ER, an alternative approach would have been to assess ER only after identifying an emotion-evoking situation. Arguably, when the participants reported not using the ER strategy, our measurement could not distinguish the moments where they (a) did not experience stress and (b) did experience stress. Yet, the several detected effects of ER strategies on state attachment were robust, suggesting that our measurement meaningfully reflected ER.

Conclusion

In this study, we examined dynamics between state attachment and ER and proposed hypothetical short-term secure and insecure regulatory cycles, where state attachment would shape the use of ER strategies that, in turn, would alter state attachment. Although none of our cycle hypotheses were fully supported, a not hypothesised cycle was found between low state attachment security and high rumination, involving reappraisal as an attenuating mechanism. Our findings suggest that (a) trait attachment can shape daily state attachment and ER, (b) low state attachment security can initiate ER, especially rumination, and (c) the use of ER strategies can shape state attachment. We hope our findings stimulate more research to elucidate how both trait and state processes maintain attachment-related behavioural patterns and emotional well-being.

Acknowledgment

We thank Noora Hyysalo for her comments on earlier drafts and an anonymous referee for pointing out the idea of modelling the attenuating role of reappraisal in the cycle between low state attachment security and rumination.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by Academy of Finland [grant number 323845]; Finnish Academy of Science and Letters, Jutikkala Fund; Finnish Cultural Foundation.

Data availability statement

The data that support the findings of this study are openly available in Open Science Framework at https://www.doi.org/10.17605/OSF.IO/U59ND.

ORCID

Jaakko Tammilehto http://orcid.org/0000-0002-6920-4322
Guy Bosmans http://orcid.org/0000-0001-9057-6027
Peter Kuppens http://orcid.org/0000-0002-2363-2356
Marjo Flykt http://orcid.org/0000-0003-0874-4357
Kirsi Peltonen http://orcid.org/0000-0002-5112-3823
Kathryn A. Kerns http://orcid.org/0000-0001-9579-0188
Jallu Lindblom http://orcid.org/0000-0003-4636-1226

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