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Roles of recalled parenting experiences and effortful control in adult daily emotion regulation

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ABSTRACT

Research suggests that both childhood experiences with one's parents and individual differences in effortful control contribute to adult emotion regulation (ER). However, it is unclear how they associate with specific ER processes. In this adult study, we examined the roles of recalled parenting experiences and effortful control in daily ER selection and implementation. Using ecological momentary assessment (EMA), we focused on ER strategies of reappraisal, suppression, and rumination. We hypothesized recalled parental warmth, rejection, and overcontrol to predict adult ER selection and effectiveness of ER implementation and effortful control to mediate these effects. One hundred twenty-two adults answered self-reported questionnaires on their childhood experiences with their parents and effortful control. In EMA, they reported ER and emotions seven times daily for seven days. Recalled parental warmth predicted less suppression and rumination, whereas recalled overcontrol, especially in fathers, predicted greater suppression and reappraisal. However, recalled parenting experiences did not predict the effectiveness of ER implementation, and no support was found for the mediating role of effortful control between recalled parenting experiences and ER. Our findings suggest that recalled parenting experiences may guide adult ER selection rather than shape ER implementation, and these links may be largely independent of their effortful control.

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Emotion regulation; parenting style; reappraisal; rumination; suppression

Emotion regulation (ER) refers to both automatic and deliberate processes in which people use various strategies to modify their emotions (Gross, 2015). According to Gross' (2015) extended process model, ER is initiated by an explicit or implicit goal to influence one's emotions. This is followed by two processes: selection and implementation. In ER selection, the person chooses an ER strategy which to use. In ER implementation, the person executes the selected strategy to modify one's emotions (Gross, 2015). While the selection and implementation processes are the cornerstones of adult ER, little is known about their developmental antecedents. Yet, childhood experiences with one's parents and temperamental effortful control are proposed as two critical social and cognitive underpinnings of adult ER (Diaz & Eisenberg, 2015; Szepsenwol & Simpson, 2019). Research has found that the dimensions of warmth,

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rejection, and overcontrol characterise adult recollections of their own parents' parenting style (Arrindell et al., 1999). These recalled parenting experiences have been linked to how adults regulate emotions (Bahtiyar & Gençöz, 2021; Manfredi et al., 2011). Moreover, trait-like effortful control abilities of activation, attention, and inhibitory control are considered the cognitive prerequisite for goal-driven ER in childhood and adulthood (Diaz & Eisenberg, 2015; Pruessner et al., 2020). Interestingly, childhood experiences with one's parents can also shape the development of effortful control (Baker & Hoerger, 2012; Mun et al., 2018). As a result, effortful control may be one mechanism between recalled parenting experiences and ER in adulthood. However, most research has relied on global self-reports of ER, precluding the more nuanced analysis of ER selection and implementation processes. In this study, we use ecological momentary assessment (EMA) to inspect how recalled parenting experiences predict adult ER selection and effectiveness of ER implementation and whether effortful control mediates these effects.

Individual differences in adult emotion regulation

Adults differ in their tendencies to use common ER strategies, such as reappraisal, suppression, and rumination (Gross, 2015). In reappraisal, one changes the interpretations of an emotion-eliciting situation to be more positive (Gross, 2015). A tendency to use this strategy with a focus on improving one's mood has been linked to higher psychological well-being (Aldao et al., 2010). In suppression, one inhibits emotional expressions and hides them from others (Gross, 2015). While this strategy serves social goals, such as avoiding conflicts, a tendency for suppression has been linked to lower psychological well-being (Aldao et al., 2010). In rumination, one repeatedly focuses attention on negative experiences and thoughts (Nolen-Hoeksema et al., 2008). At times, rumination can indicate functional attempts to solve complex life problems, but a tendency for rumination reflects vulnerability to various emotional problems (Aldao et al., 2010).

Most studies have assessed the tendency to rely on ER strategies with single-occasion global self-reports, focusing on people's habitual strategy selection (Aldao et al., 2010). However, such study designs cannot distinguish the selection and implementation processes of ER. In the last decade, EMA studies have become more prevalent, providing some remedy for this limitation. In EMA, people report their use of ER strategies and emotions several times a day over several days. This opens a window for researchers to examine the dynamics between ER and emotions in real-time (Koval et al., 2022). Recently, Koval and colleagues developed a conceptual framework for capturing ER selection and the effectiveness of ER implementation with EMA (Koval et al., 2022). This framework operationalises ER selection as the average strategy use across EMA measurements and ER implementation as the average effect of the strategy use on emotions. Such mapping offers a valuable heuristic to inspect the complex selection and implementation processes of ER in daily life (Koval et al., 2022).

In daily life, ER is most often motivated by prohedonic goals that involve increasing positive and decreasing negative emotions (Riediger et al., 2009). While contextual factors can influence the outcomes of ER strategies (Gross, 2015), recent EMA meta-analyses suggest that the selection of the common ER strategies itself typically leads to specific emotional outcomes in adults (Boemo et al., 2022; Koval et al., 2022). The findings show that, on average, reappraisal produces an increase in positive emotions, suppression an increase in negative emotions, and rumination an increase in negative and decrease in positive emotions (Boemo et al., 2022; Koval et al., 2022). Thus, the selection of reappraisal often appears more effective than suppression and rumination for achieving prohedonic ER goals. Moreover, the same EMA research shows individual differences in the emotional outcomes of different ER strategies, implying that adults differ in their abilities to implement a particular form of ER (Koval et al., 2022). For example, after reappraisal, some adults feel a larger increase in positive emotions than others, and after suppression and rumination, some feel a more attenuated increase in negative emotions than others (Koval et al., 2022). Overall, these findings raise a question about the factors that predict individual differences in adult ER selection and effectiveness of ER implementation. This is the focus of the current study.

Childhood experiences with one's parents and adult emotion regulation

Parents' style of rearing and interacting with the child determines the emotional climate of the family that shapes children's ER and related beliefs, goals, and

skills (Morris et al., 2017). From an evolutionary perspective, the development of ER is directed by children's efforts to adapt to their local ecological challenges, involving the emotional climate of the family, which also signals cues about broader socio-ecological contexts (Szepsenwol & Simpson, 2019). Within this framework, the perceived styles of one's parents contain salient information, calibrating children's long-term ER development to enhance functioning in their later socio-ecological environments during adulthood.

Variation in parenting styles is captured by the dimensions of warmth, rejection, and overcontrol (Arrindell et al., 1999). Parental warmth refers to how supportive, affectionate, and responsive the parent is toward the child (Arrindell et al., 1999). High perceived parental warmth signals to the child that expressing and experiencing negative and positive emotions is a safe and valued part of social interactions (Morris et al., 2017). As a result, the child is likely to develop accepting and appreciating beliefs toward one's emotions, which may promote the use of reappraisal, a strategy characterised by openness to different views on emotional situations (Edwards & Wupperman, 2019). In contrast, parental rejection refers to the parent's expressions of harshness toward the child and a dismissal of the child's emotional needs (Arrindell et al., 1999). High perceived parental rejection may direct the child to develop a tendency to suppress emotions that functions to prevent parental unavailability and harshness (Gross & Cassidy, 2019). In other words, the child learns to hide one's emotions to avoid negative responses from the rejective parent (Cassidy, 1994). Finally, parental overcontrol refers to the parent's overprotection and intrusiveness, accompanied by disrespect for the child's autonomy (Arrindell et al., 1999). High perceived parental overcontrol signals to the child that the world is full of dangers and threats. Consequently, the child may develop a tendency for rumination to direct one's focus on threatening and negative information. This aligns with prevailing theoretical models that consider overcontrol the critical parental factor underlying rumination (Shaw et al., 2019; Watkins & Roberts, 2020). Overall, these types of conditional adaptations that help children thrive and cope with their parents' style may leave a long-lasting mark on later ER selection in adulthood (Szepsenwol & Simpson, 2019).

Previous ER research on parental warmth, rejection, and overcontrol has assessed ER with global self-reports and focused mainly on the mothering or general parenting styles (i.e. combined fathering and mothering). Less research exists on fathering styles (Morris et al., 2017). Yet, the available studies suggest that the perceived and recalled fathering, mothering, and general parenting styles are all linked to children's and adults' ER selection. For example, high concurrently perceived parental warmth has been associated with children's and adolescents' greater reappraisal and less suppression (Jaffe et al., 2010; Liu, 2020), whereas high concurrently perceived rejection has been linked to young adults' greater suppression (Gardner & Zimmer-Gembeck, 2018). Interestingly, in adult studies on recalled parenting experiences, high parental, paternal, and maternal overcontrol have been associated with greater rumination (Manfredi et al., 2011; Spasojević & Alloy, 2002), and high maternal warmth with less suppression (Tani et al., 2018). This suggests that childhood experiences and memories of one's parents can continue to direct preferences to select ER strategies in adulthood. However, the unique effects of each parenting style on ER selection remain unclear as no study has examined parental warmth, rejection, and overcontrol simultaneously.

Childhood experiences with one's parents can also shape how effectively adults implement ER. According to the neurodevelopmental framework, the co-regulatory interactions between the parent and the child shape the child's neurobiological emotional development (e.g. fronto-limbic circuitry, HPA-axis) with potential long-lasting impacts on processes required for ER in adulthood (Callaghan & Tottenham, 2016; Gee & Cohodes, 2021). Warm parenting involves sensitive co-regulatory support and guidance to children's emotions (Arrindell et al., 1999; Morris et al., 2017). Such parent-assisted ER enables developmentally appropriate neuromaturation, promoting basic emotional skills (e.g. identifying, differentiating, and understanding emotions) that are needed to downregulate negative and upregulate positive emotions effectively in adulthood (Gee & Cohodes, 2021). In contrast, rejective and overcontrolling parenting involves dismissing and misinterpreting children's emotional needs (Arrindell et al., 1999; Cassidy, 1994). Such stressful experiences can alter the child's neurodevelopment of emotional processing involving accelerated maturation, heightened reactivity, and threat-related processing biases (Callaghan & Tottenham, 2016; McLaughlin et al., 2019). While these alterations can confer a survival advantage for

children with insufficient ER support, they may lead to later problems in ER implementation in adulthood (Callaghan & Tottenham, 2016; McLaughlin et al., 2019). The neurodevelopmental standpoint concurs with studies on recalled parenting experiences in which high paternal and maternal warmth and low overcontrol and rejection have been linked to adults' fewer ER difficulties (Bahtiyar & Gençöz, 2021; Tani et al., 2018).

Effortful control: a mediator between parenting experiences and emotion regulation?

Effortful control refers to a temperamental, top-down self-regulatory ability to employ cognitive resources in executing and monitoring goal-directed behaviours (Evans & Rothbart, 2007). It is based on activation (i.e. undertaking an action when there is a tendency to avoid it), attention (i.e. focusing and shifting attention), and inhibitory control (i.e. inhibiting inappropriate responses; Evans & Rothbart, 2007). While trait-like effortful control abilities have a genetic basis and are already manifested in early childhood, experiences with one's parents during childhood can play an important role in shaping the development of effortful control (Bridgett et al., 2015; Diaz & Eisenberg, 2015). Parental warmth can nurture children's effortful control via encouraging guidance and enriching interactions that support the optimal development of self-regulatory systems of activation, attention, and inhibition. Conversely, parental rejection and overcontrol can hinder children's effortful control development by disturbing their stress physiology and undermining opportunities to learn self-regulation skills (Bridgett et al., 2015; Diaz & Eisenberg, 2015).

Studies in different developmental stages align with such considerations suggesting that childhood experiences with one's parents can have long-term effects on effortful control. In toddlers, observed parental overcontrol predicts lower effortful control abilities one (Eisenberg et al., 2015) and three years later (Perry et al., 2018). In adolescents, concurrently perceived parental warmth predicts higher effortful control five years later (Mun et al., 2018), while parental rejection predicts lower effortful control development across adolescence (Atherton et al., 2020). Finally, in adults, the composite of recalled parental warmth, low rejection, and low overcontrol is linked to higher effortful control (Baker & Hoerger, 2012).

Effortful control can have an integral role in ER, as the related cognitive functions are likely prerequisites of goal-driven ER processes (Diaz & Eisenberg, 2015; Pruessner et al., 2020). As a result, effortful control may be one mechanism through which the organising effects of childhood experiences with one's parents are conveyed to adult ER selection and effectiveness of ER implementation, although this has not been tested. First, high effortful control may help adults to select the strategies that most often align with their prohedonic ER goals, whereas low effortful control may hamper the selection process, predisposing them to less suitable strategies. Studies with global self-reports of ER have found high effortful control to be linked to adolescents' and adults' greater reappraisal and less suppression and rumination (Lantrip et al., 2016; Yang et al., 2017). Second, high effortful control can foster effective ER implementation as it helps sustain goal-directed focus in executing ER strategies and recognise optimal contexts for each strategy. Two studies have found that inhibitory control training in adults can improve the effectiveness of reappraisal to reduce sadness (Cohen & Mor, 2018) and attenuate the effect of rumination on increased sadness (Cohen et al., 2015). Similarly, in one EMA study, adults' high inhibitory control also strengthened the effectiveness of reappraisal (i.e. larger effects on increased positive and reduced negative emotions) and attenuated the effect of rumination on negative emotions (Pe et al., 2013).

In sum, research implies that parental warmth, rejection, and overcontrol can shape the development of effortful control that, in turn, may direct adult ER selection and shape ER implementation. In this study, we provide the first test of whether effortful control could mediate the effects of recalled parenting experiences on adult daily ER.

The current study

The aim of our EMA study was to examine the roles of recalled parenting experiences and effortful control in adult ER, including reappraisal, suppression, and rumination. As shown in our conceptual model in Figure 1, the EMA design allowed us to inspect adult ER selection and effectiveness of ER implementation. Following Koval and colleagues' conceptual framework (2022), we operationalised ER selection as people's average strategy use and the effectiveness of ER implementation as their average effect of strategy

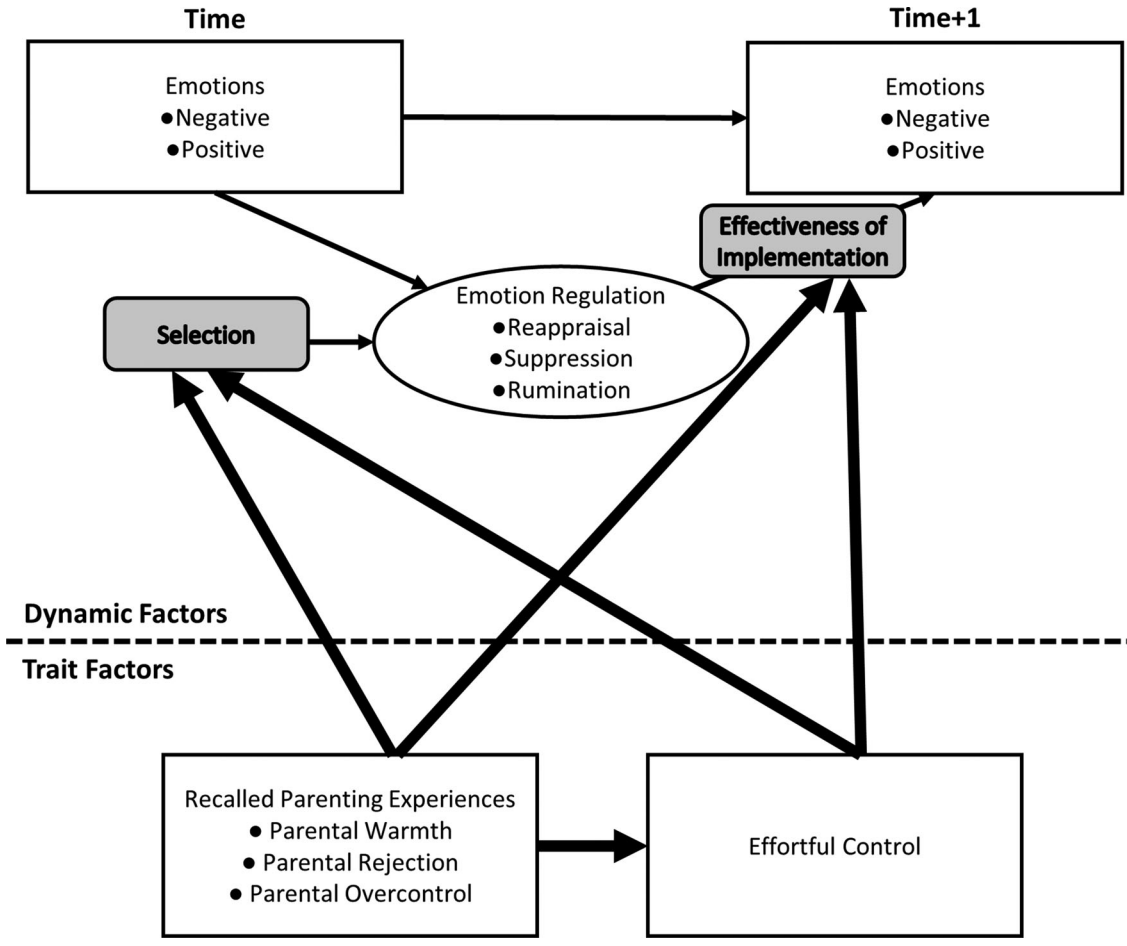

Figure 1. Conceptual model regarding roles of recalled parenting experiences and effortful control in adult daily selection and implementation of emotion regulation.

use on emotions. More effective ER implementation was indicated by (a) a larger decrease in negative emotions and (b) a larger increase in positive emotions after strategy use. In the primary analyses, our focus was on the roles of general recalled parenting styles (i.e. combined fathering and mothering) and effortful control in the ER processes. In the secondary analyses, we explored the more nuanced effects of recalled fathering and mothering styles and activation, attention, and inhibitory control.

First, we expected parenting styles to predict ER selection. While we tested all possible associations, we specifically expected parental warmth to predict greater reappraisal, rejection greater suppression, and overcontrol greater rumination. Second, we expected high warmth, low rejection, and low overcontrol to predict more effective ER implementation (i.e. cross-level interactions between the parenting style and ER strategy on negative and positive emotions). Third, we expected high effortful control to predict greater selection of reappraisal, less suppression and rumination, and more effective ER implementation. Finally, we expected high effortful control to mediate the effects of high parental warmth, low rejection, and low overcontrol on ER selection and the effectiveness of ER implementation.

Methods

Participants and procedure

The study was part of the Daily Emotions research project that recruited 125 Finnish participants via university email lists and paper flyers distributed in the campus areas. The Ethics Committee for Humanities of the Tampere Region approved the study protocol.

The inclusion criteria were (a) being over 18 years old, (b) the possibility to use a smartphone, and (c) being fluent in Finnish. The number of people who were exposed to the recruitment efforts but never contacted us is unknown. All participants provided signed informed consent and were provided information about how to contact the researchers. Moreover, before beginning the EMA phase, the participants were sent a practice questionnaire and asked to contact research assistants if any clarification or technical guidance was needed. The participants did not receive any rewards. The data, scripts, and codebook are at https://osf.io/r93sw.

The data collection consisted of two phases. First, the participants completed online questionnaires regarding their psychological traits and demographic factors. Second, in the EMA phase, two weeks later, 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 1 h and 43 min lasting blocks between 10:00 and 22:00 (e.g. 10:00–11:43). After receiving the questionnaire, the participants had 30 min to answer ($M_{\text{reaction time}} = 4$ min, $SD =$ 6 min). The questionnaire data were unavailable for one participant, and two participants had the same EMA identity number due to technical errors. These participants were excluded from the analyses. The final sample included 122 participants ($M_{\text{age}} = 26.43$, $SD = 8.33$, 88.5% women), of which 65 were university students, 49 were open university students, five were other students, and three were non-students; 82 were in a romantic relationship. EMA observations totalled 4638, with an average of 38 (77.6%, range: 15–48, 30.6%–98.0%) observations per participant. As there were no participants with only a few EMA observations, we used all observations in our analyses.

Measures

Recalled parenting experiences

Recalled childhood experiences with one's parents were assessed using the My Memories of Upbringing Questionnaire–Short Form (Arrindell et al., 1999). The participants reported recalled styles of their parents separately for their father (22 items) and mother (22 items) using a 4-point Likert scale (1 = *never* to 4 = *very often*). The questionnaire measures three parenting styles: warmth (6 items; e.g. "My parents showed with words and gestures that they liked me"), rejection (7 items; e.g. "My parents treated me in such a way that I felt ashamed"), and overcontrol (9 items; e.g. "I felt that my parents interfered with everything I did"). Due to the complexity of our statistical models, we decided to average the scores for the three recalled parenting styles over fathers and mothers for our primary analyses. Secondary analyses were conducted separately for recalled fathering and mothering styles. The correlations between paternal and maternal warmth, rejection, and overcontrol were 0.61, 0.68, and 0.68, respectively, justifying our rationale for primary analyses. Cronbach's alphas for parental warmth, rejection, and overcontrol were 0.92, 0.90, and 0.88; for the fathering styles 0.91, 0.85, and 0.81; and for the mothering styles 0.91, 0.84, and 0.79, respectively.

Effortful control

Effortful control was assessed using the effortful control scale of the Adult Temperament Questionnaire–Short Form (Evans & Rothbart, 2007). The validation study for the measure has been conducted in the Finnish sample (Kiuru et al., 2019). The participants used a 7-point Likert scale (1 = *describes me very badly* to 7 = *describes me very well*) to answer 19 items of the effortful control scale. The scale measures the three subdimensions of activation (7 items, "I can keep performing a task even when I would rather not do it"), attention (5 items; e.g. "When I am trying to focus my attention, I am easily distracted"), and inhibitory control (7 items; e.g. "It is easy for me to hold back my laughter in a situation where it is not appropriate"). We used the average effortful control scale in our primary analyses and conducted secondary analyses separately for activation, attention, and inhibitory control. One activation control item (i.e. reversed "When I am afraid of how a situation might turn out I usually avoid dealing with it") correlated negatively with the overall activation control scale, indicating that the item did not capture the latent construct in our data. Hence, we excluded the item before forming the scales. Cronbach's alpha for total effortful control was 0.79, and for activation, attention, and inhibitory control 0.76, 0.71, and 0.64, respectively. These reliabilities were highly similar to those reported in the prior validation studies (Evans & Rothbart, 2007; Kiuru et al., 2019). Notably, also in these studies, the inhibitory control has shown the lowest reliability among the subscales (Evans & Rothbart, 2007; Kiuru et al., 2019).

Emotion regulation strategies

In each EMA, each ER strategy was measured with one item derived loosely from Heiy and Cheavens (2014). The reappraisal item was phrased to reframe a situation more positively, and the suppression and rumination items were worded to refer to negative valence. In the instruction of each ER item, participants were asked to report to what extent they had used a particular strategy in order to influence their emotions between the current and previous EMA (or the last two hours when the EMA was the day's first), aligning with contemporary EMA standards (Koval et al., 2022). Using a 5-point Likert scale (1 = *not at all* to 5 = *very much*), the participants reported to what extent they had used reappraisal ("I thought about the situation in a more positive way"), suppression ("I avoided showing my situation-elicited negative feelings"), and rumination ("I thought over and over again about the negative situation and my feelings").

Emotions

In each EMA, participants reported how much they experienced four negative (anger, anxiety, shame, sadness) and four positive (joy, pride, satisfaction, excitement) emotions at the present moment using a 5-point Likert scale (1 = *not at all* to 5 = *very much*). We assessed the psychometric structure of emotions using multilevel confirmatory factor analyses (for details, see Supplemental Material 1). The model with two factors of negative and positive emotions at the within- and between-person levels showed adequate fit, χ^2 [38, $N_{participants} = 122$, $N_{observations} = 4628$] = 235.68, $p < .001$, CFI = .973, RMSEA = .041, $SRMR_{within/between} = .029/.077$. At the within-person level, the omega coefficients for negative and positive emotions were 0.67 and 0.83, respectively; at the between-person level, they were 0.82 and 0.89, respectively. In the analyses considering our research questions, we used the within-person level factor scores of negative and positive emotions based on the Bayesian plausible values of the estimated factor structure. Compared to more conventional mean scores, the use of within-person level factor scores allowed us to consider that the cross-level metric invariance was not achieved in negative and positive emotions (Supplemental Material 1). The factor scores of negative emotions showed high convergence with the group-mean-centred mean scores of negative emotions, $r = .95$. The same was true for positive emotions, $r = .98$.

Sociodemographic covariates

Financial strain and age were used as covariates in the analyses as these factors may play a role in ER (Aldao et al., 2010; Szepsenwol & Simpson, 2019). Financial strain was measured by averaging two 4- and 5-point Likert scale items ($r = .40$; "Do you or your family have difficulties in regularly paying coming bills?" and "How much money do you and your family have just before the next payday?"). Before averaging, the items were transformed to the same scale, ranging 0–1; higher values indicated lower strain.

Analytic strategy

To answer our research questions, we used dynamic structural equation models (DSEM; Asparouhov et al., 2018). The DSEMs were conducted in Mplus 8.5–8.8 (Muthén & Muthén, 1998–2023). Before DSEMs, the stationarity of each EMA variable for each participant was assessed by conducting the Kwiatkowski-Phillips-Schmidt-Shin tests for a mean and trend and Tsay's and Keenan's tests for nonlinearity in R.

DSEM is a novel statistical framework that integrates time-series, multilevel, and structural equation modelling (Asparouhov et al., 2018). We chose to use DSEM as it allowed us to model the predictive effects of the recalled parenting styles and effortful control on both the selection of the ER strategy and the effectiveness of its implementation within the same model. While we would ideally have modelled all ER strategy and emotion variables in one model, this was not feasible considering our between-person sample size ($N = 122$), especially due to the increased number of random effects and their covariances. Therefore, DSEMs were built separately for each ER strategy of reappraisal, suppression, and rumination and for negative and positive emotions (6 models altogether). Figure 2 presents our modelling strategy applied to all conducted models. At the within-person level of each DSEM, we estimated the effects of an ER strategy on the change in emotions. Thus, the ER strategy at the current EMA (i.e. strategy use since the previous EMA) and the emotions at the previous EMA were specified to predict the emotions at the current EMA. Moreover, the ER strategy and the emotions at the previous EMA were specified to predict the ER strategy at the current EMA. The random effects for all intercepts, slopes, and residual variances were estimated.

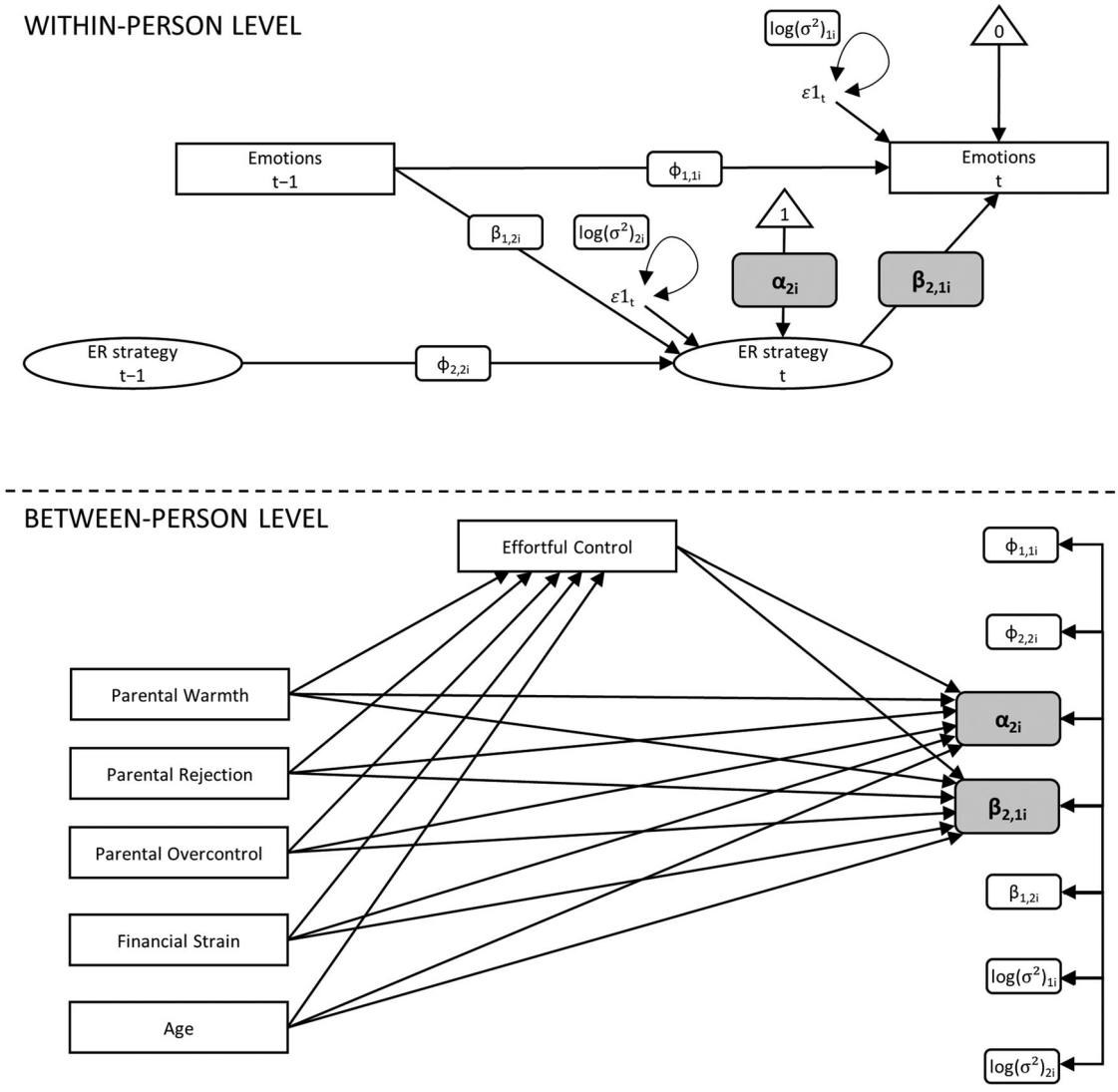

Figure 2. Dynamic structural equation model for effects of recalled parenting experiences and effortful control on selection of emotion regulation and effectiveness of its implementation.

Notes. The bolded α_{2i} and $\beta_{2.1i}$ parameters with grey background refer to the main outcome variables of random intercept of the ER strategy (i.e., selection) and the random cross-lagged slope of the ER strategy on emotions (i.e., the effectiveness of implementation), respectively. It should be noted that the effect of each between-level predictor on the random cross-lagged slope can also be interpreted as the cross-level interaction of the predictor and ER strategy on emotions. The φ_i and $\log(\sigma^2_i)$ parameters refer to the random autoregressive slopes and residual variances, respectively. The residual variances were estimated using the log transformation to guarantee all individual variances to be positive, which is a standard approach in dynamic structural modelling. Emotions (i.e., within-level factor scores of negative and positive emotions) were handled as the within-level variables because they did not have between-level variance. Moreover, as the intercepts of emotions did not differ from zero, they were fixed to zero to simplify the models. All between-level predictors were grand-mean-centred. The secondary models for recalled fathering and mothering styles and effortful control subdimensions of activation, attention, and inhibitory control used the same structure. ER = emotion regulation.

At the between-person level of each DSEM, three recalled parenting styles, effortful control, and covariates predicted ER selection (i.e. the intercept of the ER strategy) and the effectiveness of ER implementation (i.e. the effect/slope of the ER strategy on the target emotions). Further, recalled parenting styles and covariates predicted effortful control. As a result, all modelled effects represented the unique effects of each between-person predictor after controlling for other predictors. For example, the effects of parental warmth on ER selection and the effectiveness of ER implementation refer to its incremental effects after controlling for parental rejection, overcontrol, effortful control, financial strain, and age.

In all DSEMs, ER strategies were latent-mean-centred, and the between-person level predictors were grand-mean-centred to facilitate the interpretations. Regarding emotions, within-person-centred Bayesian plausible value factor scores were used (Supplemental Material 1). Finally, all covariances were estimated between the random effects.

The secondary analyses with the same structure (Figure 2) were conducted separately for (a) recalled fathering and mothering styles and (b) activation, attention, and inhibitory control. The latter analyses for effortful control subdimensions were conducted for all recalled parenting, fathering, and mothering DSEMs separately because no solid rationale existed for preferring one parenting condition over the others. Finally, recalled parenting, fathering, and mothering DSEMs with effortful control were conducted for the female sample only (88.5%) as additional sensitivity analyses.

In all DSEMs, Bayesian Markov chain Monte Carlo estimation was used with the uninformative priors of Mplus. Two unthinned chains with 100,000 iterations were used in estimation, and convergence was checked via the Gelman-Rubin Proportional Scale Reduction (PSR) and trace plots. The criterion for convergence was PSRs < 1.05 in all post-burn-in iterations. In fifteen conducted models (15/108), some post-burn-in iterations did not meet the set criterion. These results were verified by doubling the iterations. The median was used as a point estimate to summarise posterior distributions. Missing data were handled with the Kalman filter approach. The TINTERVAL command of Mplus was used to specify the time interval in line with the intervals of each EMA block to add missing data for the nighttime. Thus, the previous EMA was handled as the lagged observation of the current EMA. An effect was considered as detected if its 95% credible interval (CrI) excluded zero. We also reported the standardised estimates (β*s) and Bayesian two-tailed *p*-values.

Results

Preliminary analyses

Supplemental Material 2 summarises the stationarity tests for ER strategies and emotions, showing low rejection rates, 0.0%–12.3%. Supplemental Material 3 presents the descriptive statistics of the study variables and their histograms, density plots, and boxplots (Figures S3A–S3E). Compared to other variables, the recalled parental, paternal, and maternal rejection showed stronger skewness to the right, skewness = 1.35–1.72, and were more leptokurtic, kurtosis = 0.96–3.23 (Figure S3B).

Table 1 shows the between-person level correlations of the study variables. Supplemental Material 4 depicts the within-person level correlations of ER strategies and emotions. ER strategies correlated positively with each other at both within- and between-person levels, as typical in EMA datasets (Koval et al., 2022; Tammilehto et al., 2022). Regarding recalled parenting styles, rejection and warmth showed strong negative correlations in general parenting, fathering, and mothering. Overcontrol correlated positively with warmth in general parenting and mothering but not fathering. Overcontrol and rejection showed no correlations.

Figure 3 depicts the distributions for ER selection, and Figure 4 shows the distributions for the effectiveness of ER implementation among the participants. On average, reappraisal predicted decreased negative, $\beta = -0.11$, 95% CrI [−0.16, −0.07], and increased positive emotions, $\beta = 0.19$, 95% CrI [0.14, 0.24]; suppression predicted increased negative, $\beta = 0.18$, 95% CrI [0.14, 0.23], and decreased positive emotions, $\beta = -0.15$, 95% CrI [−0.20, −0.11]; and rumination predicted increased negative, $\beta = 0.46$, 95% CrI [0.39, 0.52], and decreased positive emotions, $\beta = -0.32$, 95% CrI [−0.37, −0.26]. Rumination tended to increase negative and decrease positive emotions in almost all participants, whereas the effects of reappraisal and suppression on the emotions showed more variation in magnitude and direction (Figure 4). The effects of emotions on ER are presented in Supplemental Material 5.

Roles of recalled parenting experiences and effortful control

Tables 2–4 present the unstandardised results of DSEMs concerning the effects of recalled parenting styles and effortful control on adult ER selection and effectiveness of ER implementation regarding reappraisal (Table 2), suppression (Table 3), and rumination (Table 4). Table 5 shows the unstandardised results on the associations of recalled parenting styles with adults' effortful control. Supplemental Material 6 presents the standardised estimates.

Table 1. Correlations between study variables at between-person level for aggregated data.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Reappraisal	–																			
2. Suppression	**0.55**	–																		
3. Rumination	**0.36**	**0.53**	–																	
4. Negative emotions	**0.**15	**0.35**	**0.68**	–																
5. Positive emotions	**0.43**	0.10	−0.12	−0.16	–															
6. Parental warmth	−0.03	−0.12	**−0.19**	**−0.20**	0.08	–														
7. Parental rejection	0.15	0.12	**0.20**	**0.23**	0.15	**−0.59**	–													
8. Parental overcontrol	**0.20**	0.15	0.17	0.17	−0.04	**0.23**	−0.01	–												
9. Effortful control	−0.03	−0.06	**−0.21**	**−0.30**	0.09	0.04	−0.03	**−0.19**	–											
10. Paternal warmth	0.03	−0.09	−0.18	−0.15	0.17	**0.90**	**−0.51**	0.16	0.09	–										
11. Paternal rejection	0.16	0.15	0.16	**0.18**	0.10	**−0.51**	**0.93**	0.05	−0.07	**−0.52**	–									
12. Paternal overcontrol	**0.31**	**0.22**	**0.20**	0.14	0.04	**0.19**	0.00	**0.92**	−0.15	0.17	0.10	–								
13. Maternal warmth	−0.07	−0.12	**−0.18**	**−0.24**	0.02	**0.90**	**−0.52**	**0.23**	0.03	**0.61**	**−0.37**	0.16	–							
14. Maternal rejection	0.12	0.07	**0.23**	**0.28**	0.15	**−0.54**	**0.92**	−0.03	−0.04	**−0.40**	**0.68**	−0.08	**−0.55**	–						
15. Maternal overcontrol	0.11	0.05	0.12	0.14	−0.09	**0.22**	0.02	**0.92**	−0.18	0.12	0.03	**0.68**	**0.26**	0.03	–					
16. Activation control	0.06	0.01	**−0.23**	**−0.25**	**0.18**	0.11	−0.03	−0.01	**0.71**	0.16	−0.10	−0.03	0.08	0.00	0.04	–				
17. Attention control	−0.04	−0.12	**−0.24**	**−0.32**	0.11	0.01	−0.02	**−0.19**	**0.78**	0.06	−0.03	−0.11	−0.02	−0.03	**−0.23**	**0.38**	–			
18. Inhibitory control	−0.10	−0.03	−0.02	−0.11	−0.09	−0.03	−0.03	**−0.23**	**0.71**	−0.02	−0.02	**−0.19**	0.00	−0.05	**−0.22**	0.14	**0.43**	–		
19. Financial strain	0.06	−0.08	**−0.18**	**−0.21**	0.14	**0.18**	−0.04	0.04	**0.19**	**0.18**	−0.07	0.04	0.15	0.01	0.04	**0.18**	0.10	0.12	–	
20. Age	−0.04	−0.02	0.01	−0.02	0.04	**−0.55**	**0.27**	**−0.18**	0.06	**−0.42**	**0.21**	−0.07	**−0.54**	**0.24**	**−0.23**	0.03	0.17	−0.05	−0.09	–

Notes. Negative and positive emotions are the between-level Bayesian plausible value factor scores based on the conducted multilevel confirmatory factor analysis (see Supplemental Material 1). The rounding is based on the IEC 60559 standard. In bolded values, $p < .050$.

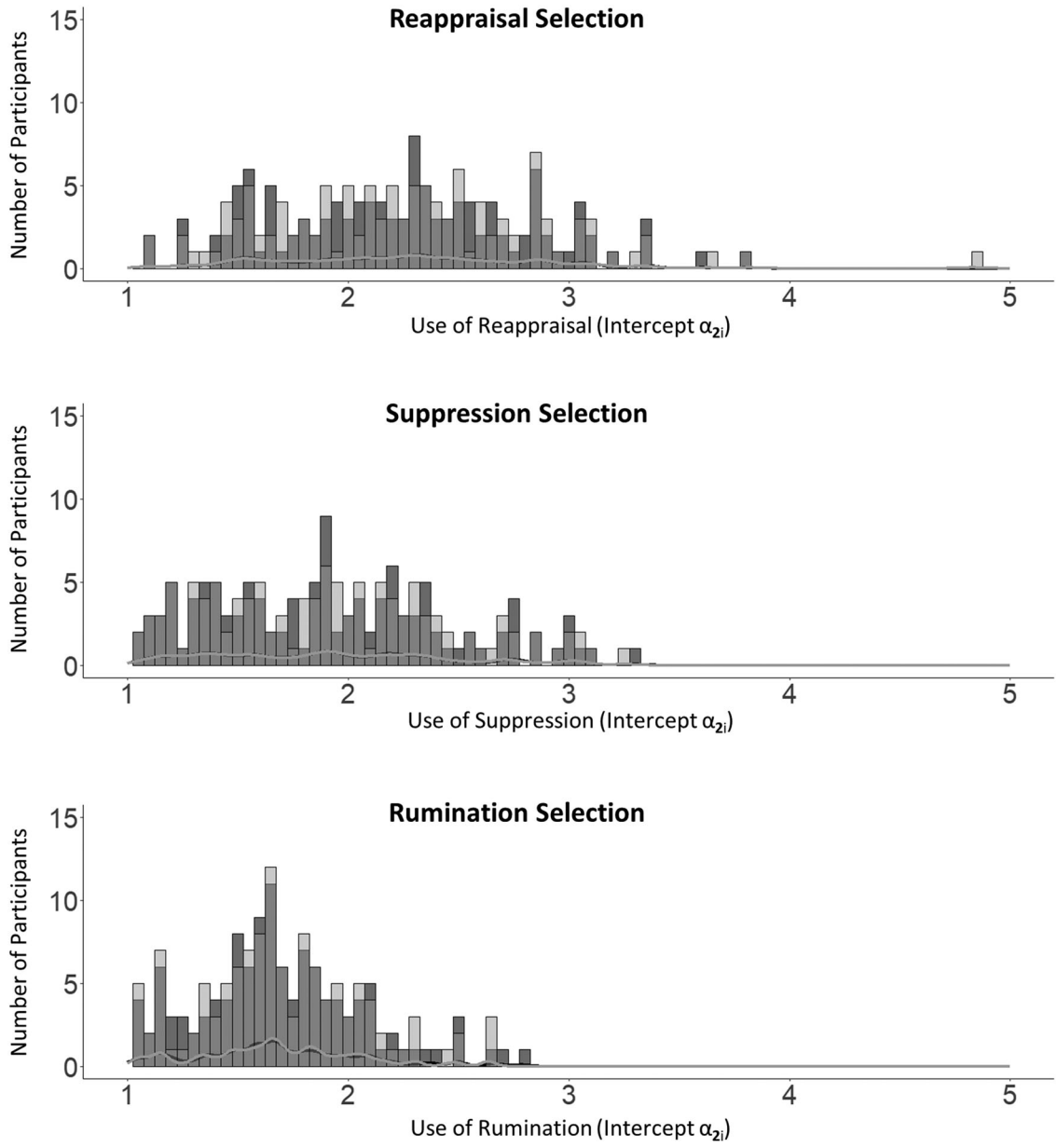

Figure 3. Distributions for selection of emotion regulation strategies between participants.

Notes. The black- and grey-colour distributions present the Bayesian plausible value factor scores of participants' emotion regulation strategy intercepts (i.e., selection parameters) in the dynamic structural equation models for negative and positive emotions, respectively. As shown by the density plot lines (black and grey colour), the estimates were highly overlapping between the models. Five hundred imputations were used to estimate the factor scores.

Regarding reappraisal selection, parental warmth (and rejection and overcontrol) did not predict the use of reappraisal in contrast to our hypothesis linking warmth to greater reappraisal. Concerning suppression selection, parental rejection did not predict the use of suppression, contrary to our hypothesis linking rejection to greater suppression. Yet, low parental warmth, $\beta^* = -0.15$, $p = .044$, and high overcontrol, $\beta^* = 0.14$, $p = .008$, predicted greater suppression. Considering rumination selection, parental overcontrol did not predict the use of rumination. This did not support our hypothesis

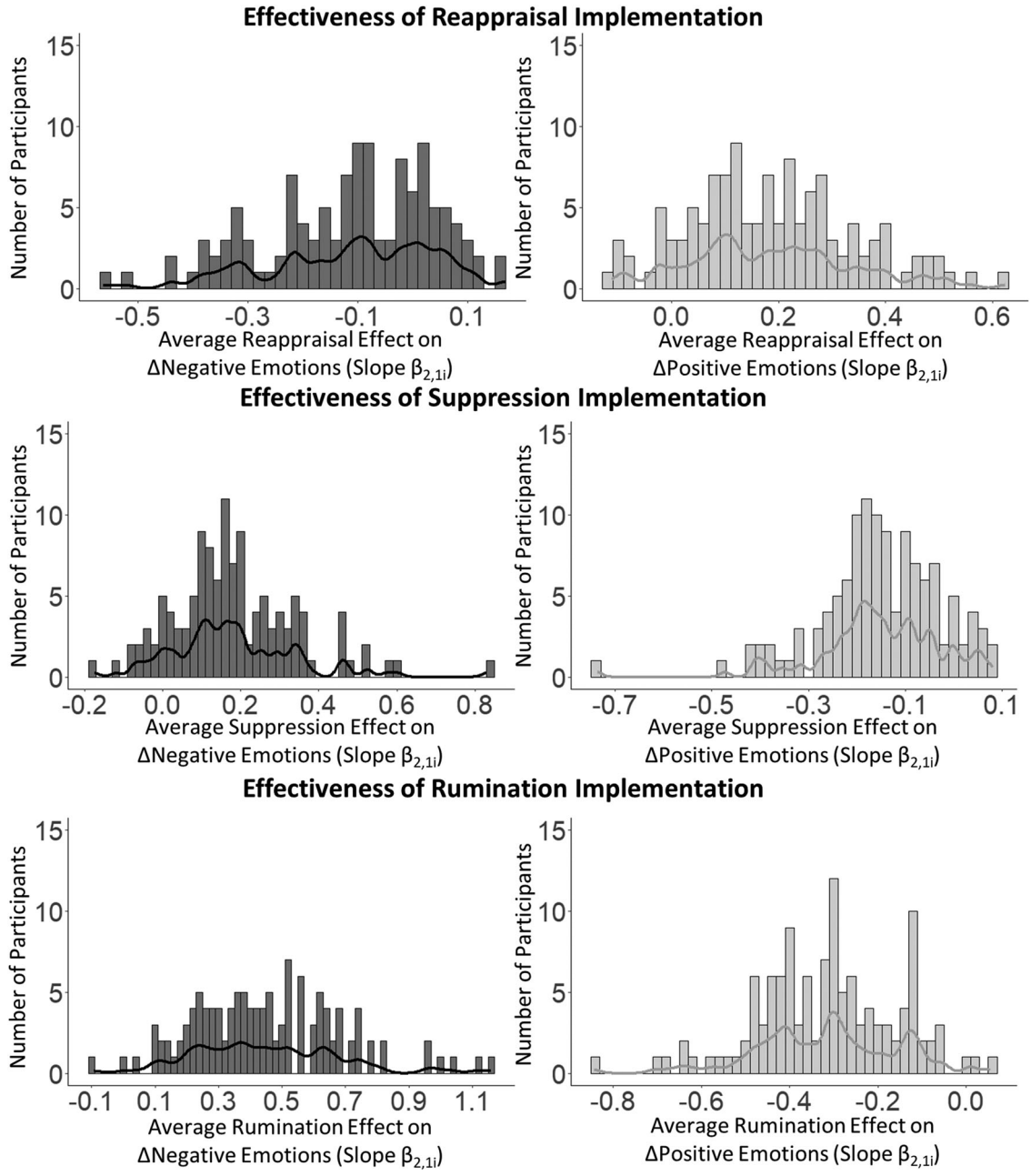

Figure 4. Distributions for effectiveness of emotion regulation implementation between participants.

Notes. The distributions present the Bayesian plausible value factor scores of participants' emotion regulation strategy slopes on the change in the target emotions (i.e., implementation effectiveness parameters) in the dynamic structural equation models for negative (left column with black colour) and positive emotions (right column with grey colour). Five hundred imputations were used to estimate the factor scores.

linking overcontrol to greater rumination. Nevertheless, whereas parental rejection also showed no effect on rumination, parental warmth predicted less rumination in the model of negative emotions, $\beta^* = -0.16$, $p = .026$. Yet, in the model of positive emotions, the 95% CrI surprisingly included zero, $\beta^* = -0.10$, $p = .174$. The comparisons of the other model parameters revealed that the random residual variance of negative emotions, $r = .43$, $p < .001$, but not positive emotions, $r = .00$, $p = .996$, correlated with the random

Table 2. Unstandardised effects of recalled parenting experiences and effortful control on selection of reappraisal and effectiveness of its implementation.

	Models for negative emotions		Models for positive emotions	
Predictors	Selection of reappraisal: Posterior *Mdn* [95% CrI]	Implementation of reappraisal: Posterior *Mdn* [95% CrI]	Selection of reappraisal: Posterior *Mdn* [95% CrI]	Implementation of reappraisal: Posterior *Mdn* [95% CrI]
Recalled parenting style model				
Effortful control	0.05 [−0.12, 0.22]	−0.02 [−0.07, 0.04]	0.04 [−0.12, 0.20]	0.00 [−0.06, 0.06]
Parental warmth	−0.07 [−0.32, 0.18]	0.08 [0.00, 0.16]	−0.06 [−0.31, 0.19]	−0.07 [−0.17, 0.03]
Parental rejection	0.15 [−0.15, 0.46]	0.04 [−0.05, 0.14]	0.20 [−0.12, 0.52]	−0.01 [−0.12, 0.10]
Parental overcontrol	0.23 [−0.05, 0.50]	−0.03 [−0.11, 0.05]	0.21 [−0.07, 0.48]	0.06 [−0.03, 0.15]
Financial strain	0.13 [−0.53, 0.80]	0.10 [−0.12, 0.32]	0.11 [−0.53, 0.76]	−0.16 [−0.42, 0.10]
Age	−0.01 [−0.03, 0.00]	0.00 [0.00, 0.01]	−0.01 [−0.03, 0.00]	0.00 [−0.01, 0.00]
R^2	0.07	0.09	0.07	0.10
Recalled fathering style model				
Effortful control	0.02 [−0.15, 0.19]	−0.02 [−0.08, 0.03]	0.02 [−0.15, 0.19]	0.01 [−0.06, 0.07]
Paternal warmth	0.02 [−0.18, 0.22]	0.05 [−0.01, 0.12]	0.00 [−0.20, 0.21]	−0.06 [−0.14, 0.03]
Paternal rejection	0.17 [−0.09, 0.44]	0.01 [−0.07, 0.10]	0.22 [−0.04, 0.48]	0.04 [−0.06, 0.14]
Paternal overcontrol	**0.32 [0.09, 0.55]**	−0.04 [−0.12, 0.03]	**0.31 [0.08, 0.54]**	0.06 [−0.02, 0.15]
Financial strain	0.06 [−0.59, 0.73]	0.11 [−0.12, 0.33]	0.05 [−0.61, 0.70]	−0.17 [−0.42, 0.09]
Age	−0.01 [−0.03, 0.00]	−0.02 [−0.08, 0.03]	−0.01 [−0.03, 0.00]	0.00 [−0.01, 0.00]
R^2	0.08	0.08	0.09	0.10
Recalled mothering style model				
Effortful control	0.03 [−0.13, 0.19]	−0.01 [−0.07, 0.04]	0.01 [−0.14, 0.16]	0.00 [−0.07, 0.06]
Maternal warmth	−0.12 [−0.33, 0.10]	0.06 [−0.01, 0.14]	−0.09 [−0.30, 0.11]	−0.05 [−0.14, 0.04]
Maternal rejection	0.05 [−0.23, 0.33]	0.04 [−0.06, 0.13]	0.07 [−0.19, 0.33]	−0.02 [−0.13, 0.08]
Maternal overcontrol	0.06 [−0.18, 0.33]	−0.01 [−0.09, 0.06]	0.00 [−0.21, 0.23]	0.03 [−0.06, 0.12]
Financial strain	0.15 [−0.49, 0.82]	0.10 [−0.12, 0.33]	0.11 [−0.49, 0.73]	−0.18 [−0.44, 0.09]
Age	−0.01 [−0.03, 0.00]	0.00 [0.00, 0.01]	−0.01 [−0.03, 0.00]	0.00 [−0.01, 0.00]
R^2	0.06	0.08	0.05	0.08

Notes. Parenting Style Model: $N_{participants} = 122$; Fathering Style Model: $N_{participants} = 118$; Mothering Style Model: $N_{participants} = 121$. The links of recalled parenting styles with effortful control are presented in Table 5. The selection of reappraisal refers to the random intercept of reappraisal (α_{2i}), and the implementation of reappraisal refers to the random slope of reappraisal on the target emotions ($\beta_{2,1i}$). All parameters presented in Figure 2 were also estimated but are not reported here as these do not concern our research questions. The rounding is based on the IEC 60559 standard. In bolded values, the 95% credible interval (95% CrI) does not contain zero.

Table 3. Unstandardised effects of recalled parenting experiences and effortful control on selection of suppression and effectiveness of its implementation.

	Models for negative emotions		Models for positive emotions	
Predictors	Selection of suppression: Posterior *Mdn* [95% CrI]	Implementation of suppression: Posterior *Mdn* [95% CrI]	Selection of suppression: Posterior *Mdn* [95% CrI]	Implementation of suppression: Posterior *Mdn* [95% CrI]
Recalled parenting style model				
Effortful control	0.05 [−0.07, 0.17]	0.03 [−0.03, 0.08]	0.03 [−0.10, 0.16]	−0.03 [−0.09, 0.02]
Parental warmth	**−0.19 [−0.37, 0.00]**	0.00 [−0.08, 0.09]	**−0.19 [−0.38, 0.00]**	−0.02 [−0.10, 0.06]
Parental rejection	−0.05 [−0.26, 0.17]	0.03 [−0.06, 0.13]	−0.02 [−0.24, 0.21]	−0.03 [−0.12, 0.07]
Parental overcontrol	**0.24 [0.06, 0.42]**	0.00 [−0.08, 0.07]	**0.25 [0.06, 0.43]**	0.03 [−0.05, 0.10]
Financial strain	0.02 [−0.48, 0.51]	−0.01 [−0.22, 0.21]	0.05 [−0.46, 0.56]	0.04 [−0.17, 0.25]
Age	−0.01 [−0.02, 0.01]	0.00 [−0.01, 0.00]	−0.01 [−0.02, 0.01]	0.00 [0.00, 0.01]
R^2	0.06	0.05	0.06	0.08
Recalled fathering style model				
Effortful control	0.04 [−0.08, 0.17]	0.03 [−0.03, 0.08]	0.03 [−0.10, 0.16]	−0.04 [−0.09, 0.02]
Paternal warmth	−0.11 [−0.26, 0.04]	0.03 [−0.04, 0.09]	−0.11 [−0.27, 0.05]	−0.04 [−0.11, 0.03]
Paternal rejection	−0.01 [−0.20, 0.19]	0.01 [−0.08, 0.10]	0.03 [−0.17, 0.24]	−0.01 [−0.10, 0.08]
Paternal overcontrol	**0.24 [0.07, 0.41]**	−0.02 [−0.09, 0.06]	**0.25 [0.07, 0.42]**	0.03 [−0.04, 0.10]
Financial strain	−0.03 [−0.53, 0.47]	0.00 [−0.23, 0.22]	0.00 [−0.51, 0.52]	0.04 [−0.17, 0.25]
Age	0.00 [−0.02, 0.01]	0.00 [−0.01, 0.00]	0.00 [−0.01, 0.01]	0.00 [0.00, 0.01]
R^2	0.05	0.05	0.05	0.08
Recalled mothering style model				
Effortful control	0.04 [−0.09, 0.16]	0.03 [−0.02, 0.09]	0.02 [−0.11, 0.14]	−0.04 [−0.09, 0.01]
Maternal warmth	**−0.19 [−0.35, −0.02]**	−0.03 [−0.10, 0.05]	**−0.20 [−0.37, −0.02]**	0.02 [−0.05, 0.10]
Maternal rejection	−0.09 [−0.30, 0.12]	0.04 [−0.06, 0.13]	−0.06 [−0.28, 0.16]	−0.02 [−0.11, 0.08]
Maternal overcontrol	**0.17 [0.00, 0.34]**	0.01 [−0.06, 0.09]	0.17 [0.00, 0.35]	0.01 [−0.06, 0.08]
Financial strain	0.04 [−0.47, 0.54]	0.00 [−0.22, 0.22]	0.06 [−0.45, 0.58]	0.02 [−0.19, 0.23]
Age	−0.01 [−0.02, 0.01]	0.00 [−0.01, 0.00]	−0.01 [−0.02, 0.01]	0.00 [0.00, 0.01]
R^2	0.06	0.06	0.06	0.09

Notes. Parenting Style Model: $N_{participants} = 122$; Fathering Style Model: $N_{participants} = 118$; Mothering Style Model: $N_{participants} = 121$. The links of recalled parenting styles with effortful control are presented in Table 5. The selection of suppression refers to the random intercept of suppression (α_{2i}), and the implementation of suppression refers to the random slope of suppression on the target emotions ($\beta_{2,1i}$). All parameters presented in Figure 2 were also estimated but are not reported here as these do not concern our research questions. The rounding is based on the IEC 60559 standard. In bolded values, the 95% credible interval (95% CrI) does not contain zero.

Table 4. Unstandardised effects of recalled parenting experiences and effortful control on selection of rumination and effectiveness of its implementation.

	Models for negative emotions		Models for positive emotions	
Predictors	Selection of rumination: Posterior *Mdn* [95% CrI]	Implementation of rumination: Posterior *Mdn* [95% CrI]	Selection of rumination: Posterior *Mdn* [95% CrI]	Implementation of rumination: Posterior *Mdn* [95% CrI]
Recalled parenting style model				
Effortful control	−0.03 [−0.10, 0.06]	0.02 [−0.06, 0.10]	−0.03 [−0.11, 0.05]	−0.04 [−0.10, 0.03]
Parental warmth	**−0.14 [−0.26, −0.02]**	−0.04 [−0.15, 0.07]	−0.09 [−0.21, 0.04]	0.00 [−0.10, 0.10]
Parental rejection	−0.02 [−0.17, 0.12]	−0.01 [−0.14, 0.12]	0.01 [−0.13, 0.16]	−0.02 [−0.13, 0.10]
Parental overcontrol	0.07 [−0.04, 0.19]	0.00 [−0.11, 0.11]	0.06 [−0.06, 0.18]	0.02 [−0.07, 0.11]
Financial strain	−0.26 [−0.58, 0.06]	0.04 [−0.27, 0.34]	−0.28 [−0.59, 0.04]	−0.04 [−0.30, 0.22]
Age	**−0.01 [−0.02, 0.00]**	0.00 [−0.01, 0.01]	−0.01 [−0.02, 0.00]	0.00 [0.00, 0.01]
R^2	0.07	0.04	0.06	0.06
Recalled fathering style model				
Effortful control	−0.02 [−0.10, 0.06]	0.02 [−0.06, 0.10]	−0.02 [−0.10, 0.06]	−0.03 [−0.10, 0.03]
Paternal warmth	**−0.11 [−0.21, −0.01]**	0.01 [−0.09, 0.10]	−0.08 [−0.18, 0.02]	−0.04 [−0.12, 0.05]
Paternal rejection	−0.04 [−0.16, 0.09]	0.00 [−0.12, 0.12]	0.01 [−0.12, 0.14]	−0.03 [−0.13, 0.08]
Paternal overcontrol	0.10 [−0.01, 0.20]	0.00 [−0.10, 0.11]	0.08 [−0.03, 0.19]	0.02 [−0.07, 0.11]
Financial strain	−0.26 [−0.57, 0.06]	0.02 [−0.29, 0.33]	−0.26 [−0.56, 0.05]	−0.03 [−0.30, 0.24]
Age	**−0.01 [−0.02, 0.00]**	0.00 [−0.01, 0.01]	−0.01 [−0.01, 0.00]	0.00 [0.00, 0.01]
R^2	0.07	0.03	0.06	0.06
Recalled mothering style model				
Effortful control	−0.03 [−0.11, 0.05]	0.02 [−0.06, 0.10]	−0.03 [−0.11, 0.05]	−0.04 [−0.11, 0.02]
Maternal warmth	−0.09 [−0.20, 0.02]	−0.06 [−0.17, 0.04]	−0.06 [−0.17, 0.06]	0.04 [−0.06, 0.13]
Maternal rejection	0.02 [−0.12, 0.16]	−0.03 [−0.16, 0.10]	0.02 [−0.12, 0.17]	0.00 [−0.11, 0.11]
Maternal overcontrol	0.04 [−0.07, 0.15]	0.00 [−0.10, 0.10]	0.03 [−0.09, 0.14]	0.01 [−0.07, 0.10]
Financial strain	−0.29 [−0.61, 0.04]	0.06 [−0.25, 0.37]	−0.29 [−0.61, 0.03]	−0.06 [−0.33, 0.20]
Age	−0.01 [−0.02, 0.00]	0.00 [−0.01, 0.01]	−0.01 [−0.01, 0.00]	0.00 [0.00, 0.01]
R^2	0.06	0.05	0.05	0.07

Notes. Recalled Parenting Style Model: $N_{participants} = 122$; Recalled Fathering Style Model: $N_{participants} = 118$; Recalled Mothering Style Model: $N_{participants} = 121$. The links of recalled parenting styles with effortful control are presented in Table 5. The selection of rumination refers to the random intercept of rumination (α_{2i}), and the implementation of rumination refers to the random slope of rumination on the target emotions ($\beta_{2,1i}$). All parameters presented in Figure 2 were also estimated but are not reported here as these do not concern our research questions. The rounding is based on the IEC 60559 standard. In bolded values, the 95% credible interval (95% CrI) does not contain zero.

Table 5. Unstandardised effects of recalled parenting experiences on effortful control.

Predictors	Effortful control: Posterior *Mdn* [95% CrI]
Recalled parenting style model	
Parental warmth	0.13 [−0.15, 0.40]
Parental rejection	0.02 [−0.30, 0.34]
Parental overcontrol	**−0.28 [−0.55, −0.02]**
Financial strain	**0.74 [0.01, 1.46]**
Age	0.01 [−0.01, 0.03]
R^2	0.07
Recalled fathering style model	
Paternal warmth	0.13 [−0.10, 0.36]
Paternal rejection	0.01 [−0.27, 0.30]
Paternal overcontrol	−0.22 [−0.46, 0.02]
Financial strain	0.62 [−0.12, 1.35]
Age	0.01 [−0.01, 0.03]
R^2	0.06
Recalled mothering style model	
Maternal warmth	0.09 [−0.16, 0.34]
Maternal rejection	0.00 [−0.31, 0.31]
Maternal overcontrol	−0.25 [−0.50, 0.00]
Financial strain	**0.76 [0.03, 1.49]**
Age	0.01 [−0.01, 0.03]
R^2	0.06

Notes. Parenting Style Model: $N_{participants} = 122$; Fathering Style Model: $N_{participants} = 118$; Mothering Style Model: $N_{participants} = 121$. These results were identical for the models concerning each ER strategy and negative and positive emotions. The rounding is based on the IEC 60559 standard. In bolded values, the 95% credible interval (95% CrI) does not contain zero.

intercept of rumination. Thus, the model for negative emotions had more statistical information to estimate the selection parameter of rumination, alluding some tentative support for its validity over the model for positive emotions.

None of the parenting styles predicted the effects of reappraisal, suppression, and rumination on negative and positive emotions. This provided no support for our hypothesis linking parenting styles to the effectiveness of ER implementation. Finally, contrary to our hypotheses on effortful control, it predicted neither ER selection nor the effectiveness of ER implementation. Thus, no further tests were conducted for the mediating role of effortful control between parenting styles and ER. Nevertheless, parental overcontrol was linked to lower effortful control, $\beta^* = -0.14$, $p = .034$. Parental warmth and rejection showed no links with effortful control.

Roles of recalled fathering and mothering experiences

The secondary analyses for recalled fathering and mothering styles revealed some additional effects on ER selection. Regarding fathering, paternal overcontrol predicted greater reappraisal, $\beta^* = 0.19$, $p = .008$, and suppression, $\beta^* = 0.15$, $p = .004$. Moreover, as in the models on general parenting styles, paternal warmth predicted less rumination in the model for negative emotions, $\beta^* = -0.16$, $p = .024$, whereas the 95% CrI included zero in the model for positive emotions, $\beta^* = -0.11$, $p = .104$. Again, one plausible reason for this difference was that the model on negative emotions had more statistical information to estimate the selection parameter.

Regarding mothering, maternal warmth predicted less suppression, $\beta^* = -0.15$, $p = .030$. Moreover, maternal overcontrol predicted greater suppression, $\beta^* = 0.11$, $p = .046$, although the 95% CrI slightly included zero in the model for positive emotions $\beta^* = 0.11$, $p = .056$. No effects were found on reappraisal and rumination.

Regarding the effectiveness of ER implementation, none of the fathering and mothering styles predicted the effects of reappraisal, suppression, and rumination on negative and positive emotions. Similarly, fathering and mothering styles showed no associations with effortful control.

Roles of activation, attention, and inhibitory control

Supplemental Materials 7–9 present the unstandardised and standardised results of the secondary analyses concerning activation (Supplemental Material 7), attention (Supplemental Material 8), and inhibitory (Supplemental Material 9) control. None of the effortful control subdimensions predicted ER selection. Yet, two preliminary indications were found regarding the effectiveness of ER implementation. First, in the fathering model, participants with high activation control experienced a larger decrease in negative emotions after reappraisal compared to participants with low activation control, $\beta^* = -0.22$, $p = .032$ (Figure S7). However, in the parenting and mothering models, the 95% CrIs exceeded zero, $ps = .070–.080$. Second, in the mothering model, participants with high inhibitory control experienced a larger increase in negative emotions after suppression compared to participants with low inhibitory control, $\beta^* = 0.19$, $p = .048$ (Figure S9). However, in the parenting and fathering models, the 95% CrIs exceeded zero, $ps = .072–.106$.

The secondary analyses on activation control showed no support for our mediation hypothesis, as the parenting styles were not linked to activation control. Yet, parental, $\beta^* = -0.16$, $p = .014$, and

maternal, $\beta^* = -0.16$, $p = .016$, overcontrol were linked to lower inhibitory control. Thus, we tested the indirect path from maternal overcontrol to the suppression effect on negative emotions via low inhibitory control. However, no support was found for this indirect effect, $\beta = -0.01$, 95% CrI [−0.04, 0.00], $p = .064$. Finally, parental, $\beta^* = -0.13$, $p = .042$, and maternal, $\beta^* = -0.15$, $p = .022$, overcontrol were linked to lower attention control.

Sensitivity analyses for females only

Supplemental Material 10 presents the results of the sensitivity analyses for the female sample. Compared to our main analyses, the results were highly similar. Yet, three unexpected effects emerged. Parental, paternal, and maternal warmth attenuated the reappraisal effect on decreased negative emotions. As these effects were not detected at the level of the whole sample, we deemed them to require replications before any interpretations.

Simulations concerning statistical power

Lastly, we conducted Monte Carlo simulations to assess the smallest effect sizes our study design could detect. In the simulations, we used the same DSEM, sample, and missing data structure as in our study. The population correlations between parenting styles and covariates were specified using the correlation structure in our data. The population effects for all random effects and their covariances were based on the estimates of our conducted DSEMs. The simulations with 500 replications suggested that the smallest standardised effects exceeding 0.80 power were |0.26|–|0.27| on effortful control, |0.23|–|0.37| on ER selection, and |0.29|–|0.34| on the effectiveness of ER implementation.

Discussion

Both childhood experiences with one's parents and individual differences in effortful control are considered critical social and cognitive underpinnings of ER (Diaz & Eisenberg, 2015; Morris et al., 2017; Szepsenwol & Simpson, 2019). However, their roles in the more specific ER processes have remained unclear. Our EMA study examined the role of recalled childhood experiences with one's parents in adult ER selection and effectiveness of ER implementation. Contrary to our specific hypotheses on recalled parenting experiences and ER selection, parental warmth did not predict the use of reappraisal, rejection did not predict suppression, and overcontrol did not predict rumination. Moreover, recalled parenting experiences did not predict the effectiveness of ER implementation. Nevertheless, parental warmth predicted less suppression and rumination, whereas overcontrol predicted greater suppression. Finally, although parental overcontrol was linked to lower effortful control, effortful control did not predict the ER processes. Thus, we found no support for our hypothesis that effortful control would be one mediating factor between experiences with one's parents and adult ER. Interestingly, our secondary analyses revealed that some effects might occur at the more fine-grained conceptual level of recalled fathering and mothering styles and activation and inhibitory control. Overall, our findings suggest that the recollections of childhood experiences with one's parents may guide adult ER selection rather than shape ER implementation, and these links seem to occur largely independent of their effortful control.

Recalled parenting experiences and adult emotion regulation selection

Research with global self-reports of ER suggests that concurrently perceived parental warmth may promote children's and adolescents' reappraisal use, characterised by openness to different views on emotional situations (Jaffe et al., 2010; Liu, 2020). Thus, it was surprising that recalled parental warmth did not predict adult reappraisal. While the exact reason for this null finding is unclear, it may relate to the positive beliefs and attitudes toward one's emotions among those adults who have memories of growing up with warm and supportive parents. Accepting one's own emotions and viewing them as intrinsically valuable, whether positive or negative, can reduce these adults' intense negative emotions and the urge to regulate their emotions in general (Edwards & Wupperman, 2019; Leahy, 2016). This may lessen their need for reappraisal, leading to its balanced rather than elevated use despite the prohedonic outcomes. Although the explanation is speculative, it aligns with our other findings showing recalled parental warmth to predict less suppression (general and maternal) and rumination (general and paternal). In childhood interactions with warm parents, people may have internalised beliefs that they do not need to hide negative emotions with suppression or

intensify them with rumination to get others' attention (Cassidy, 1994; Tammilehto et al., 2022).

Surprisingly, recalled parental rejection did not predict the selection of any ER strategies. These null findings provided no support for our hypothesis that people would develop a tendency for suppression as a response to their childhood experiences with harsh and unavailable parents (Gross & Cassidy, 2019). It is noteworthy that, as in other low-risk samples (Arrindell et al., 1999; Bahtiyar & Gençöz, 2021), high recalled parental rejection and low warmth correlated substantially in our student sample, but rejection had less variance and showed more skewness to the right. In other words, the students generally reported low levels of recalled parental rejection. Thus, in such low-risk populations, the rejection dimension may have limited capacity to characterise developmentally meaningful variance for ER selection. Instead, recalled parental warmth may be more significant in guiding ER selection, as suggested by our findings and some previous ones (Jaffe et al., 2010; Tani et al., 2018). Alternatively, the null findings on recalled parental rejection might imply that perceived rejection hampers adults' accuracy of self-reporting ER, as recalled childhood experiences of emotional neglect are linked to adults' problems describing emotional experiences (Kajanoja et al., 2021). Future studies with high-risk samples and observational measures of ER may reveal a different view on the role of recalled parental rejection in adult ER selection.

Finally, we found no support for our hypothesis that recalled parental overcontrol would predict greater rumination. These null findings deviate from the previous studies using global self-reports of ER that have reported the associations of recalled parental overcontrol with adults' greater rumination (Manfredi et al., 2011; Spasojević & Alloy, 2002). The differences may be partly explained by the fact that global self-reports and EMA measures of rumination show only medium-size correlations ($r = .40$), thus capturing somewhat different phenomena (Koval et al., 2022). Nevertheless, parental, paternal, and maternal overcontrol did predict greater suppression, while paternal overcontrol also predicted greater reappraisal. These findings indicate that childhood experiences and memories of overprotective and intrusive parents may have predisposed adults to believe that experiencing and expressing emotions is unacceptable or even harmful and dangerous (Cassidy, 1994; Edwards & Wupperman, 2019; Szepsenwol & Simpson, 2019). Such beliefs can lead to over-regulation of emotions, manifested in the adults' frequent attempts to use suppression with more contra-hedonic outcomes but also reappraisal with more prohedonic outcomes.

No effects of recalled parenting experiences on emotion regulation implementation

We found no support for our hypothesis that recalled parenting experiences would predict the effectiveness of ER implementation. These null findings are surprising from the neurodevelopmental standpoint, posing that the co-regulatory experiences with one's parents may have long-term impacts on emotional processes and skills required for ER in adulthood (Callaghan & Tottenham, 2016; Gee & Cohodes, 2021). Our EMA findings also deviate from research with traditional ER measures that have linked recalled parenting experiences to how effectively adults regulate emotions (Bahtiyar & Gençöz, 2021; Tani et al., 2018). Yet, one plausible explanation for our null findings is that parenting styles, especially when assessed retrospectively, may be too general to capture the aspects most influential for emotional development. Arguably, both more extreme (e.g. maltreatment) and specific emotion-related (e.g. emotion coaching) experiences with one's parents can be more influential on later ER in adulthood (McLaughlin et al., 2019; Morris et al., 2017). Future prospective and retrospective studies using a broader range of assessments are needed to scrutinise this issue.

Alternatively, the effects of recalled parenting experiences on the effectiveness of adult ER implementation may have been too small to be detected in our study. Our simulations suggested that we could have detected medium-to-large effects. Yet, the impacts of childhood experiences with one's parents on the effectiveness of adult ER implementation may be smaller. This is because the developmental plasticity of ER can remain high into adulthood, especially in young adults our sample mainly consisted of (Gee & Cohodes, 2021; Tammilehto et al., 2021). At the same time, other close relationships with romantic partners and friends are becoming increasingly important (Gee & Cohodes, 2021). This highlights the need for future EMA studies that inspect the roles of other close relationships in adult ER. In the future, another core challenge is translating the predictions of the neurodevelopmental framework into precise effect size estimates.

Collecting larger samples that can detect even small effects can help the field move forward in this task.

No support for mediating role of effortful control

We found no support for the hypothesis that effortful control would mediate the links between recalled parenting experiences and adult daily ER. Whereas recalled parental overcontrol was linked to lower effortful control, effortful control did not predict adult ER selection or effectiveness of ER implementation. At first glance, the null findings could imply that an alternative conceptual model is needed to explain the relations between the study variables. For example, effortful control might moderate the effects of parenting styles on ER (Shaw et al., 2019). However, our explorative post hoc analyses showed no support for the moderating role of effortful control in the effects of recalled parenting styles on the ER processes (Supplemental Material 11). Thus, our findings suggest that the links of recalled parenting experiences to adult ER may be largely independent of their effortful control.

The detected link of recalled parental overcontrol with lower effortful control aligns with developmental research suggesting that intrusive and autonomy-limiting parents may hamper effortful control development by heightening stress and undermining opportunities to learn self-regulation skills (Bridgett et al., 2015; Eisenberg et al., 2015). Alternatively, this link may also reflect bidirectional developmental effects between parental overcontrol and low effortful control that also involve the evocative effects of child characteristics on parental overcontrol. In other words, parents may respond to the child's self-regulation problems with increased control and restrictions (Bridgett et al., 2015; Eisenberg et al., 2015). Finally, it is also possible that the detected link reflects the common genetic influences on parental overcontrol and low effortful control (Bridgett et al., 2015).

The lack of associations between effortful control and the ER processes was surprising as effortful control has been suggested to contribute to how often and successfully a person uses a particular ER strategy (Diaz & Eisenberg, 2015). Yet, several tentative explanations exist for the null findings. First, the role of effortful control in ER can strongly depend on one's developmental stage. One recent study supports this, suggesting that the link of effortful control to adolescents' rumination is stronger in middle than early adolescence (Lindblom & Bosmans, 2022). It has also been hypothesized that at some point in adulthood, the variance in effortful control may diminish due to maturation, reducing the role of effortful control in explaining individual differences in ER (Diaz & Eisenberg, 2015). Thus, our null findings may generalise only to adulthood. Longitudinal research is warranted to test the moderative role of developmental stages in the associations of effortful control with ER.

Second, we used a recently developed framework to operationalise the selection of ER strategies and the effectiveness of their implementation with EMA (Koval et al., 2022). This approach captures both automatic and deliberate ER processes, which differs from experimental research that typically focuses on deliberate ER processes in laboratory contexts (Sheppes, 2020). As effortful control abilities reflect top-down cognitive functions, they may be more evident when examining deliberate ER processes in laboratory contexts. Yet, the evidence for this hypothesis is controversial. While some studies have shown that inhibitory control training is linked to ER selection and implementation (Cohen et al., 2015; Cohen & Mor, 2018), a recent study with a larger sample found no links between inhibitory control and reappraisal implementation in laboratory contexts (Gärtner et al., 2022).

Finally, we found some preliminary hints that among the subdimensions of effortful control, activation and inhibitory control may have some role in the effectiveness of adult ER implementation. High activation control predicted the effect of reappraisal on a larger decrease in negative emotions, implying that it may help adults to achieve their prohedonic ER goals. This finding aligns with EMA research, linking effortful control abilities to effective reappraisal implementation (Pe et al., 2013). The more puzzling finding was that high inhibitory control predicted the effect of suppression on a larger increase in negative emotions. This unexpected effect might imply that high inhibitory control and related cognitive resources enable people to suppress the expression of their intense negative emotions despite the internal experience being strengthened simultaneously. However, as these preliminary findings were only detected in one of the three modelling conditions, future studies must replicate them before stronger interpretations.

General discussion

Overall, our findings suggest that recalled parenting experiences may guide adult ER selection rather

than shape ER implementation, and these links may be largely independent of their effortful control. The null findings on ER implementation and effortful control tentatively suggest that neither neurodevelopmental alterations of emotional processing nor cognitive abilities are the main processes underlying the link between recalled parenting experiences and adult ER. Particularly, this can apply to relatively low-risk populations, which our student sample reflects. In contrast, in high-risk populations, the pattern of findings can well be substantially different as developmental research indicates that exposure to severe parental maltreatment and deprivation alters the basic emotional and cognitive processes (Gee & Cohodes, 2021; McLaughlin et al., 2019).

The unexpected pattern of our findings, emphasizing the role of recalled parenting experiences in adult ER selection, necessitates a theoretical explanation. As we have discussed, recalled parental warmth and overcontrol seem to have oppositive effects on how much adults regulate their emotions with different strategies (i.e. less versus more ER). While speculative, we deem it possible that the childhood experiences and memories of their warm and overcontrolling parents have shaped adults' meta-beliefs on their emotions and related goals that guide ER selection (Edwards & Wupperman, 2019; Leahy, 2016). Positive childhood experiences and memories of warm and supportive parents may have increased adults' appreciation and acceptance of their emotions. Such meta-beliefs can guide them to calmly observe and utilise contextual information about their emotions without the urge to intervene in them (Leahy, 2016). In contrast, negative childhood experiences and memories of overcontrolling and intrusive parents may have predisposed adults to view their emotions as nonacceptable and potentially dangerous. Such meta-beliefs can heighten their vigilance and need to be in control of their emotions, leading to emotion over-regulation.

Finally, although more research is clearly required, increasing acceptance and appreciation of one's emotions may be a key target of interventions for adults who carry negative childhood experiences and memories of their parents. Indeed, transforming people's beliefs about their emotions is a central focus in several therapeutic interventions, such as emotional schema therapy (Leahy, 2016). Such therapeutic approaches may help adults reduce their reliance on rumination and suppression with undesirable emotional outcomes.

Limitations

Our study has several limitations. First, regarding the design, our correlative study could not exclude numerous alternative explanations for the detected links. One important step for future research is to consider whether children's preference for a particular ER strategy in childhood (e.g. suppression) is a common cause that explains the links of parenting styles (e.g. low warmth) to ER selection in adulthood (e.g. high suppression). Moreover, our simulations suggested that our sample could only detect medium-to-large effects. Relatedly, our 95% CrI criterion for the detected effects can be considered liberal. Thus, our findings necessitate replications in larger samples with stricter tests. Our sample also comprised mostly university students and women. In addition to high-risk samples, the generalizability is especially unclear for males and non-Western cultures.

Second, we focused on recalled parenting experiences, which reflect the mechanism by which childhood experiences and memories of one's parents are carried forward. In future longitudinal studies, the comparisons between the recalled parenting experiences and observed parenting are warranted to understand their relative significance in predicting daily ER, involving both overlapping and unique effects. We also did not control for the childhood household's structure (e.g. whether one's parents were divorced) that may have played a role in the parenting of one's parents or the current psychopathology symptoms that may have biased participants' recalled parenting experiences.

Finally, although our ER measures aligned with contemporary EMA standards (Koval et al., 2022), the use of single-item scales may have limited their construct validity. Relatedly, while our operationalisation regarding the effectiveness of ER implementation strictly followed the recently developed conceptual framework for EMA (Koval et al., 2022), it assumed that people most often regulate their emotions with the prohedonic goals of increasing positive and decreasing negative emotions. Albeit research supports this assumption, people also have other goals when regulating emotions in different contexts (Riediger et al., 2009). Future studies asking people about their contextual ER goals can therefore refine the operationalisation regarding the effectiveness of ER implementation.

Conclusions

In this EMA study, we examined the roles of recalled parenting experiences and effortful control in adult

ER selection and effectiveness of ER implementation. Our findings suggest that recalled parental warmth and overcontrol may guide how adults select rather than implement ER, and these links may be largely independent of their effortful control. We hope our findings encourage future research to inspect meta-beliefs regarding one's emotions as one link between childhood experiences with one's parents and adult ER. Such studies can take the next steps toward integrating the developmental and process frameworks of ER.

Data availability statement

The data that support the findings of this study are openly available in https://doi.org/10.17605/OSF.IO/R93SW.

Disclosure statement

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

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