



Emotion regulation among Chinese and German children and adolescents: a binational comparative study

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Accepted: 26 July 2022
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Abstract

Emotion regulation has been a central research topic in developmental psychology and psychopathology for several decades. Habitual use of adaptive (e.g., cognitive reappraisal) or maladaptive strategies (e.g., expressive suppression) may influence psychosocial adjustment in children and adolescents. Despite consensus on the influence of culture on emotion regulation, little is known about cultural differences in emotion regulation in children and adolescents. In this study, the Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA) was used and tested for its measurement invariance between Chinese and German children and adolescents. Cultural similarities and differences in the use of cognitive reappraisal and expressive suppression were examined, as well as the associations of these strategies with behavior problems and prosocial behavior. The sample consisted of 765 Chinese and 431 German students ($M_{\text{age}} = 12.46$ years, $SD = 1.12$). Multi-group confirmatory factor analysis revealed partial scalar measurement invariance of the ERQ-CA. A latent mean comparison showed more frequent use of both strategies in Chinese compared to German students. The results of the multi-group structural equation model showed similar patterns of relationships between emotion regulation strategies and youth behavior across groups. Cognitive reappraisal was associated with fewer behavior problems and more prosocial behavior, whereas expressive suppression was related to more behavior problems. In summary, the current findings indicate that the ERQ-CA allows comparisons of emotion regulation between Chinese and German children and adolescents. Furthermore, the relevance of the cultural context for emotion regulation and the promotion of adaptive regulation strategies is highlighted.

Keywords Cognitive reappraisal · Expressive suppression · Psychosocial adjustment · Cultural influences · Emotion regulation questionnaire

Emotion regulation has been widely acknowledged as a critical capacity influencing youth development (Eisenberg et al., 2010). Adaptive emotion regulation contributes to young people's social competence (Kao et al., 2020; Monopoli & Kingston, 2012) and mental health (e.g., Li et al., 2021; Teixeira et al., 2015; Verzeletti et al., 2016), whereas maladaptive emotion regulation has detrimental effects on social functioning and is associated with internalizing and externalizing problems (e.g., Daniel et al., 2020; McLaughlin et al., 2011; Morris et al., 2010). Although individuals have different ways to regulate their emotions, cognitive reappraisal and expressive suppression are regarded as two most

frequently used strategies (John & Gross, 2004), the former is typically considered to be adaptive and the latter as maladaptive (for an overview, see Aldao et al., 2010).

The growing research interest in cognitive reappraisal and expressive suppression is also reflected in their measures. Among others, the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) is well established and has been demonstrated to be a reliable measure for the assessment of these strategies in adults (e.g., Abler & Kessler, 2009; Balzarotti et al., 2010; Cabello et al., 2013). More recently, attempts have been made to adapt the ERQ to children and adolescents (ERQ-CA; Gullone & Taffe, 2012). In adult samples, the cultural and social context in which individuals reside has been documented to impact their habitual use of emotion regulation strategies (e.g., Butler et al., 2007; Soto et al., 2011). However, less is known about cultural differences in the habitual use of emotion regulation strategies in children and adolescents. To date, it remains unknown

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whether measures like the ERQ-CA allow cross-cultural comparisons of the habitual use of emotion regulation strategies between children and adolescents from collectivistically and individualistically oriented cultural contexts.

This study aims to test the measurement invariance of the ERQ-CA to provide insight into the cross-cultural validity of this questionnaire. The study further aims to examine cultural differences in the use of cognitive reappraisal and expressive suppression, as well as the relationships between these emotion regulation strategies and psychosocial adjustment in children and adolescents from different cultural contexts. For this purpose, we recruited a Chinese and a German sample. In the following sections, we review the literature on emotion regulation strategies, including their definitions, assessment, and empirical findings on their relationships with youth psychosocial adjustment. Furthermore, research relating cultural contexts to the use of emotion regulation strategies is outlined.

Emotion regulation and psychosocial adjustment

Emotions play a crucial role in our daily lives and have important intrapersonal, interpersonal, social, and cultural functions (e.g., Abe & Izard, 1999; Fredrickson et al., 2008; Keltner & Haidt, 2001). However, emotions can also be harmful (e.g., inhibitory anxiety) if they are contextually inappropriate or occur with disproportionate intensity, duration, or frequency (Gross & Jazaieri, 2014). In cases of such dysfunctional emotions, emotion regulation can be meaningful and helpful because it enables flexible adaptation of emotional responses to short- and long-term goals (Gyurak et al., 2011) and contributes to constructive behavior (Thompson, 1991).

Emotion regulation refers to “the processes by which individuals influence which emotions they have, when they have them, and how they experience and express these emotions” (Gross, 1998b, p. 275). Individuals can pursue different motives and set different emotion regulation goals. Whereas individuals with *hedonic* motives seek to increase pleasant emotions or decrease unpleasant emotions in the moment, individuals with *instrumental* motives are motivated to increase the emotions that promote their desired outcomes (Tamir, 2016). According to Gross (1998b), individuals can regulate their emotions consciously or unconsciously in their emotion-generative process. Depending on the time point of emotion regulation, emotion regulation strategies can be divided into antecedent-focused and response-focused strategies.

Among various emotion regulation strategies, *cognitive reappraisal* and *expressive suppression* have drawn lots of research attention (Ford & Troy, 2019). According to Gross

and John (2003), cognitive reappraisal refers to changing the emotional impact of a potentially emotion-eliciting situation through cognitive reinterpretation. Cognitive reappraisal is a typical antecedent-focused strategy that occurs early in the emotion-generative process and can efficiently modify the experiential aspect of emotion response tendencies to change the entire subsequent course of emotion. Therefore, it is regarded as an adaptive strategy, particularly in down-regulating negative emotions. In comparison, expressive suppression is a typical response-focused strategy that describes the inhibition of an ongoing emotion-expressive behavior (Gross, 1998a; Gross & John, 2003; Gullone & Taffe, 2012). It occurs relatively late in the emotion-generative process, requires individual effort and costs cognitive resources to manage the emotion response tendencies, thus leading to a sense of incongruence or discrepancy (Gross & John, 2003). Therefore, expressive suppression is typically regarded as a maladaptive emotion regulation strategy.

To estimate individual differences in the habitual use of cognitive reappraisal and expressive suppression among children and adolescents, the Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA; Gullone & Taffe, 2012) has been adapted from the well-established Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) and has been translated into several languages (e.g., Liu et al., 2017; Teixeira et al., 2015). Numerous scholars have examined the relationships between these strategies and youth psychosocial adjustment using the ERQ-CA. In the literature, psychosocial adjustment in children and adolescents often refers to their functioning in social contexts, including school commitment, subjective well-being, and prosocial behavior (Rodríguez-Fernández et al., 2016), as well as the absence of behavior problems (Matsumoto et al., 2008b; Piqueras et al., 2019). The results of previous cross-sectional and longitudinal studies including various Western and Eastern samples indicate that cognitive reappraisal is related to fewer depressive symptoms (Gullone & Taffe, 2012; Liu et al., 2017; Zhao & Zhao, 2015), fewer social anxieties (Eastabrook et al., 2014; Lantaigne et al., 2014), fewer aggressive behaviors (Kokkinos & Voulgaridou, 2017), more positive emotions (Verzeletti et al., 2016), higher self-esteem and life satisfaction (Teixeira et al., 2015), and higher subjective well-being (Li et al., 2021). In these studies, reversed relationships between expressive suppression and these psychosocial constructs have been found.

The habitual use of cognitive reappraisal and expressive suppression has also been linked to prosocial behavior in a few studies (e.g., Li et al., 2021). Prosocial behavior is defined as “voluntary behavior intended to benefit another” (Eisenberg et al., 2006, p. 646). It includes behaviors such as helping, sharing, or comforting (Paulus & Moore, 2012). Eisenberg and Fabes (1992) assume that individuals with better emotion-regulatory skills are more likely to exhibit

empathy and prosocial behaviors when confronted with the negative emotions or distress of others. Overall, previous findings support that cognitive reappraisal is positively associated with prosocial behavior, whereas expressive suppression is negatively associated with prosocial behavior (Lebowitz & Dovidio, 2015; Verzeletti et al., 2016).

Cultural contexts and emotion regulation

The way children understand, communicate, and regulate emotions is shaped by their interactions with the social environment embedded in a cultural context (Halberstadt & Lozada, 2011). Within a culture, behavioral norms are developed that provide a benchmark for how an individual is expected and accepted by a group; such norms include culturally prescribed rules about how emotions are appropriately expressed in specific situations (Matsumoto et al., 2008a, b).

As a major dimension of cultural variation, the concept of individualism/collectivism has been established (for a review, see Triandis et al., 1988b). Individualistic cultures are found typically in Western regions such as North America and most of Northern and Western Europe, while collectivistic cultures are typically found in Eastern regions such as Asia (Triandis et al., 1988b). In line with this suggestion, Germany emerges as a more individualistic culture and China as a more collectivistic culture (Hofstede et al., 2010). Individualistic cultures are characterized by emphasizing personal independence (i.e., independent self-construal; Eid & Diener, 2001; Markus & Kitayama, 2010; Oyserman et al., 2002). Their members view themselves as independent individuals, and it is incumbent upon them to discover and express their unique attributes (Markus & Kitayama, 2010). In contrast, collectivist cultures are characterized by bonding and obligatory group belonging (Oyserman et al., 2002). Their members have an interdependent self-construal (Eid & Diener, 2001; Markus & Kitayama, 1991); they value harmony and moderation (Triandis et al., 1988b) and subordinate their own goals and needs to those of the group (Triandis et al., 1988a).

Research on emotion regulation has increasingly considered the role of the cultural context in applying emotion regulation strategies (e.g., Butler et al., 2007; Soto et al., 2011). It has been hypothesized that overt emotion expression is encouraged or advocated in individualistic cultures, whereas self-effacement and moderate (especially negative) emotion expression are more favorable in collectivistic cultures as a way of ensuring group harmony (e.g., Eid & Diener, 2001; Kim & Sherman, 2007; Matsumoto et al., 2008a; Oyserman et al., 2002). Previous studies have revealed that expressive suppression is used to a greater extent by individuals from Eastern/collectivistic cultures than by individuals from Western/individualistic cultures (e.g., Arens et al., 2013;

English & John, 2013; Soto et al., 2011). Wei et al. (2013) found that the habitual use of expressive suppression among Chinese, but not Americans, was positively related to viewing interpersonal harmony as an important social goal. In contrast to expressive suppression, cultural differences in the use of cognitive reappraisal are less evident (Arens et al., 2013; English & John, 2013; Gross & John, 2003; Kwon et al., 2013), as also underlined by Novin et al. (2009) on comparing Dutch with Iranian children and adolescents. We assume that cognitive reappraisal, in contrast to expressive suppression, aims at the mental restructuring of a situation and acts predominantly internally. Cultural norms may primarily affect those emotion regulation strategies that have an immediate external effect.

To date, cross-cultural findings on the habitual use of cognitive reappraisal and expressive suppression have been limited to adult samples (Arens et al., 2013; Butler et al., 2007; Haga et al., 2009; Kalibatseva & Leong, 2018; Kwon et al., 2013; Matsumoto, 2006; Matsumoto et al., 2008b; Perez & Soto, 2011; Soto et al., 2011; Sun & Lau, 2018; Wei et al., 2013). So far, no attempts have been made to extend such research to examine these cultural differences in children and adolescents. This study addresses this research gap and focuses on children and adolescents from China and Germany, which are typically considered collectivist- and individualist-oriented nations, respectively (in this study, we use the term “nation” as a synonym for culture; Hofstede et al., 2010). Although the two nations differ greatly in their traditions and education systems, their children and adolescents report worrying levels of psychosocial maladjustment such as negative emotions and behavior problems in international comparative studies (Crijnen et al., 1997; Lin et al., 2019; OECD, 2013, 2018; Teuber, 2021). The findings of the present study should generate deeper insights into these young people’s emotion regulation and provide valuable empirical and practical implications.

Current study

Although the ERQ-CA has been translated into several languages (e.g., German, Chinese), it remains unknown whether it allows cross-cultural comparisons of the use of cognitive reappraisal and expressive suppression in childhood and adolescence. Despite the consensus on the significant role of cultural context in emotion regulation, no efforts have been made to examine the difference in the habitual use of cognitive reappraisal and expressive suppression between Chinese and German children and adolescents.

The first research objective of this study was to test the measurement invariance of the ERQ-CA between both cultural groups. Measurement invariance demonstrates that a construct has the same meaning for the target groups and is

a prerequisite for valid comparisons of group means (Putnick & Bornstein, 2016); without evidence of measurement invariance, it cannot be ruled out that observed group differences actually represent measurement artifacts (Chen, 2008). Although the ERQ-CA has been tested primarily in samples from the same cultural context, there is evidence of its factorial validity among Chinese (Liu et al., 2017) and German (Klipker et al., 2017) children and adolescents, respectively. Therefore, we expected to find at least metric measurement invariance of the ERQ-CA (Hypothesis 1).

If there is evidence of measurement invariance of the ERQ-CA, differences in the habitual use of cognitive reappraisal and expressive suppression between the Chinese and German children and adolescents can be examined (Research Objective 2). In this case, we hypothesized that Chinese children and adolescents would report higher levels of expressive suppression than German children and adolescents, and that no significant group differences in cognitive reappraisal would be found (Hypothesis 2).

The third research objective of this study was to examine the relationships of cognitive reappraisal and expressive suppression with psychosocial adjustment (i.e., behavior problems and prosocial behavior) among Chinese and German children and adolescents. In addition, we were also interested in cultural similarities and differences in these relationships. For both cultural groups, we expected that more cognitive reappraisal is associated with more prosocial behavior and fewer behavior problems, and that more expressive suppression is associated with more behavior problems (Hypothesis 3). Because expressive suppression is more valued in collectivistic cultures than in individualistic cultures, we assumed that it would be positively related to prosocial behavior in Chinese children and adolescents and negatively related to prosocial behavior in German children and adolescents (Hypothesis 4).

Methods

Participants and procedure

The total sample consisted of 1196 school students (52% girls) in Grades 4–8. Their mean age was 12.46 years ($SD = 1.12$, age range = 10–15 years). Within the sample, 765 (64%) participants came from China and 431 (36%) from Germany. All Chinese participants ($M_{age} = 12.59$ years, $SD = 1.01$) attended a comprehensive school in Baoding, Hebei Province including primary and lower secondary education. The German participants ($M_{age} = 12.23$ years, $SD = 1.27$) were lower secondary school students from three schools in the state of North Rhine-Westphalia. A Welch test for independent samples showed that the mean age in the Chinese group was significantly higher than in the German

group: $t(737.74) = 5.08$, $p < .001$, Cohen's $d = .32$. The proportion of girls in the German sample (59%) was higher than in the Chinese sample (48% girls; $\chi^2 = 14.419$, $p < .001$).

The data were collected between May and November 2019. Participation in the study was voluntary and required a declaration of consent from the participants and their parents or legal guardians. Previous to the data collection, this study was reviewed and approved by the ethics committee of Bielefeld University. The survey took place during a regular school hour and was administered by trained instructors (i.e., student assistants). The participation rate was 66% and 85% for the German and Chinese samples, respectively.

Relying on various rules of thumb (e.g., 5 participants per item, suggested by Bentler & Chou, 1987; 10 participants per item, suggested by Nunnally, 1967; for an overview, see Kyriazos, 2018), an ad hoc allocation of a sample size of 300 for each cultural group was determined to be sufficient to perform a multi-group confirmatory factor analysis (CFA) model or a multi-group structural equation model (SEM; for details, see the analytical strategy section). Although there are other ways to determine the minimum sample size prior to data collection (e.g., Monte Carlo Simulation), rules of thumb are still preferred in the majority of empirical work because sample size requirements in CFA and SEM are influenced by numerous factors (for details, see Kline, 2015). A post-hoc power analysis based on the root-mean-square error of approximation (RMSEA; Preacher & Coffman, 2006) for the nested multi-group SEMs (for detail, see the analytical strategy section) hinted at high statistical power (approximately .99 with an alpha level of .01).

Measures

Emotion regulation strategies

To assess the habitual use of cognitive reappraisal and expressive suppression, the Chinese (Liu et al., 2017) and German versions (Klipker et al., 2017) of the ERQ-CA (Gullone & Taffe, 2012) were used. In both versions, the cognitive reappraisal subscale comprises six items (e.g., “When I want to feel happier, I think about something different”), and the expressive suppression subscale comprises four items (e.g., “I keep my feelings to myself”). However, the answer format is different in the original language versions. Whereas the German version uses a five-point Likert scale (1 = *totally disagree*, 5 = *totally agree*), the Chinese version uses a seven-point Likert scale (1 = *totally disagree*, 7 = *totally agree*). To keep its consistency, the response categories 2 and 3, as well as 5 and 6, were combined in the Chinese version (overall, the distribution of each item remained the same: changes in skewness ranged from 0 to 0.10; changes in kurtosis ranged from 0 to 0.07). In the total

sample and both cultural samples, internal consistency estimates for the cognitive reappraisal subscale (McDonald's ω and Cronbach's $\alpha = .82-.87$) and for the expressive suppression subscale (McDonald's ω and Cronbach's $\alpha = .69-.78$) were either acceptable or high.

Psychosocial adjustment

In the present study, children's and adolescents' psychosocial adjustment was operationalized by behavior problems and prosocial behavior. The German and Chinese self-report versions of the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997; translations available at <https://www.sdqinfo.org/>) were used. The SDQ consists of 25 items and includes five subscales of five items each: (1) Emotional Problems (e.g., "I worry a lot"); (2) Peer Problems (e.g., "Other children or young people pick on me or bully me"); (3) Conduct Problems (e.g., "I take things that are not mine from home, school or elsewhere"); (4) Hyperactivity (e.g., "I am restless, I cannot stay still for long"); and (5) Prosocial Behavior (e.g., "I try to be nice to other people. I care about their feelings"). Items were answered on a three-point rating scale (0 = *strongly disagree*, 1 = *partly agree*, 2 = *strongly agree*). A total of five items of Subscales 2, 3, and 4 must be recoded before performing statistical analyses because they are positively worded. A total difficulty score (range 0–40) was generated by summing the scale values of Subscales 1–4, and this score (McDonald's ω and Cronbach's $\alpha = .74-.82$) was used as a measure of behavior problems, whereas the sum score of Subscale 5 (McDonald's ω and Cronbach's $\alpha = .62-.71$) represented prosocial behavior in the present study.

Demographics

The participants were asked to disclose their gender and age. Gender was dummy-coded (0 = *boy*, 1 = *girl*).

Analytical strategy

Data analysis was conducted with RStudio (Version 2022.02.0.443; RStudio Team, 2022). The R codes can be found at <https://osf.io/5qen2>. The Chinese dataset was complete. Within the German dataset, the proportion of missing values was less than 1% for all variables. The result of a Little's test indicated that the missing values were not missing completely at random (MCAR): $\chi^2(582) = 4757.57, p < .001$. However, subsequent graphical inspection of the missing values indicated that they were not based on any determinable systematics and thus they could be classified as at least missing at random (MAR). To handle missing values, multiple imputation (e.g., Rubin, 2018) was performed using the R package

mice (van Buuren & Groothuis-Oudshoorn, 2011). Specifically, to replace the missing values with the most accurate estimators possible, 20 imputed datasets were created across 50 iterations. Each missing response to the items of the German translation of the ERQ-CA and the SDQ was then replaced with the respective mean value from the 20 imputed values for them.

Factor structure and measurement invariance of the ERQ-CA

Before testing the measurement invariance of the ERQ-CA, we examined its factor structure within the total sample using CFA with the R package *lavaan* (Rosseel, 2012). The robust maximum likelihood estimator (MLR) was used to deal with non-normality. Although a two-factor model of the ERQ has been established, there is no agreement on whether the two latent factors are orthogonal (Balzarotti et al., 2010; Cabello et al., 2013; Gross & John, 2003) or correlated (e.g., Gómez-Ortiz et al., 2016; Gullone & Taffe, 2012; Liu et al., 2017). Furthermore, in several studies, the residuals of two items of the cognitive reappraisal scale have been found to be associated with each other (Gullone & Taffe, 2012; Ng et al., 2019; Teixeira et al., 2015). Hence, we comprehensively tested the factor structure by performing four CFA models: (1) a one-factor model in which all items loaded on a single factor; (2) an orthogonal two-factor model with two uncorrelated latent factors (i.e., cognitive reappraisal and expressive suppression); (3) a correlated two-factor model; (4) a model nested within Model 3 with a residual correlation between Items 1 ("When I want to feel more cheerful, I think of something else") and 3 ("When I want to feel less bad, I think of something else"). The final CFA model was then tested separately in the German and Chinese samples as the baseline model. Measurement invariance was tested using multigroup CFA, following the forward approach (i.e., stepwise constraining model parameters; Dimitrov, 2010). In the configural invariance model, all parameters were freely estimated in the Chinese and German groups. In the metric invariance model, factor loadings were constrained across groups. In the scalar invariance model, indicator intercepts were additionally constrained (Hypothesis 1).

Model fit was evaluated using the Satorra-Bentler scaled chi-square test statistic (χ^2_{SB}), the comparative fit index (CFI), RMSEA, and the standardized root-mean-square residual (SRMR). A nonsignificant χ^2_{SB} value represents an adequate fit of the model. Due to the fact that the χ^2 test statistic is sample sensitive (Cheung & Rensvold, 2002), we relied on the recommendations of Hu and Bentler (1999): CFI $\geq .95$, RMSEA $\leq .05$, and SRMR $\leq .05$ indicate a good model fit, and CFI $\geq .90$, RMSEA $\leq .08$, and SRMR $\leq .08$ indicate an acceptable model fit. For model comparisons, the Satorra-Bentler scaled chi-square difference test ($\Delta\chi^2_{SB}$)

was used (Satorra & Bentler, 2010). We additionally followed Chen's (2007) suggestion for measurement invariance (sample size >300): a decrease of $\geq .010$ in CFI, an increase of $\geq .015$ in RMSEA, and an increase of $\geq .030$ in SRMR indicate non-invariance.

Latent mean comparisons

Cultural differences in the use of emotion regulation strategies were evaluated by comparing the latent means of cognitive reappraisal and expressive suppression between the Chinese and German samples (Hypothesis 2). On the basis of the final model of measurement invariance, we applied the reference group method recommended by Little et al. (2006). In doing so, the latent mean was fixed to 0 and the latent variance to 1 in the reference group. The corresponding latent mean in the other group was estimated as the difference in the two latent means between the cultural groups, with Wald's z test was used for testing the significance of this difference (Thompson & Green, 2013).

Path coefficient invariance

For investigating the relationships of both emotion regulation strategies with behavior problems and prosocial behavior, a multigroup SEM (e.g., Wang & Wang, 2020) based on the final measurement invariance model of the ERQ-CA was conducted using *lavaan*. In this SEM, behavior problems (the total problem score of the SDQ) and prosocial behavior (scale sum of the prosocial behavior subscale of the SDQ) were regressed on cognitive reappraisal and expressive suppression. Due to the fact that the students' age and gender were different between both cultural groups, we included these variables in the SEM as control variables (i.e., as predictor of emotion regulation and youth behavior). To investigate the cultural similarities and differences (Hypotheses 3 and 4), we first performed a configural path coefficient invariance SEM using the Chinese and German samples simultaneously (i.e., all path coefficients were

freely estimated across groups). In the next step, all path coefficients were constrained across groups. If the model fit became significantly less well than the configural path coefficient invariance SEM, constraints on path coefficients would be gradually released based on the parameter estimates from the configural SEM.

Results

Table 1 presents the mean values and standardized deviations of all variables for the total sample and both cultural groups. Significant Pearson correlations were found between cognitive reappraisal and behavior problems for the Chinese ($r = -.29, p < .001$) and German ($r = -.39, p < .001$) samples. Cognitive reappraisal was positively associated with prosocial behavior (Chinese: $r = .36, p < .001$; German: $r = .30, p < .001$). In both samples, expressive suppression was positively associated with behavior problems (Chinese: $r = .16, p < .001$; German: $r = .29, p < .001$) but not with prosocial behavior (Chinese: $r = .01, p = .379$; German: $r = -.07, p = .914$).

Factor structure of the ERQ-CA

Following the outlined analytical plan, we performed a one-factor CFA (Model 1), an orthogonal two-factor CFA (Model 2), a correlated two-factor CFA (Model 3), and a correlated two-factor CFA with a residual correlation between Items 1 and 3 (Model 4). Table 2 presents the CFA results, which suggest that Model 4 had the soundest model fit to the total data ($\chi^2_{SB} = 167.148, df = 33, p < .001, CFI = .954, RMSEA = .066, 90\% CI$ for RMSEA $[.056, .076], SRMR = .053$). Satorra-Bentler scaled χ^2 difference tests for the nested Models 2, 3, and 4 supported this result (Model 2 vs. Model 3: $\Delta\chi^2_{SB} = 32.92, \Delta df = 1, p < .001$; Model 3 vs. Model 4: $\Delta\chi^2_{SB} = 29.44, \Delta df = 1, p < .001$). Model 4 also showed good fit indices for the Chinese data ($\chi^2_{SB} = 89.083, df = 33, p < .001$,

Table 1 Descriptive statistics of all observed variables and mean comparisons

Scale	Total ($N = 1196$)		Chinese ($n = 765$)		German ($n = 431$)		t -tests for independent samples			
	M	SD	M	SD	M	SD	t	df	p	d
ERQ-CA										
Cognitive reappraisal	20.80	5.11	22.20	4.78	18.33	4.73	13.50	1194	< .001	.81
Expressive suppression	11.75	3.62	12.63	3.64	10.20	3.01	11.74	1194	< .001	.71
SDQ										
Behavior problems	10.61	5.51	10.39	5.77	11.00	4.99	-1.85	1194	.065	.11
Prosocial behavior	7.96	1.80	7.85	1.88	8.15	1.63	-2.74	1194	.006	.17

ERQ-CA Emotion Regulation Questionnaire for Children and Adolescents, SDQ Strengths and Difficulties Questionnaire. t = t -value; df = degree of freedom; d = Cohen's d

Table 2 Results of confirmatory factor analyses for the ERQ-CA in the total ($N = 1196$), Chinese, ($n = 765$) and German ($n = 431$) Sample

Model	χ^2_{SB}	df	RMSEA [90% CI]	CFI	SRMR
Model 1: 1-factor CFA	768.252***	35	.152 [.142, .161]	.745	.113
Model 2: orthogonal 2-factor CFA	248.766***	35	.081 [.072, .091]	.927	.085
Model 3: correlated 2-factor CFA	213.978***	34	.076 [.066, .086]	.938	.056
Model 4: correlated 2-factor CFA with a residual correlation between Items 1 and 3 (final CFA model)	167.148***	33	.066 [.056, .076]	.954	.053
Model 4 – China	89.083***	33	.053 [.040, .066]	.963	.034
Model 4 – Germany	59.127**	33	.049 [.028, .069]	.978	.039

ERQ-CA Emotion Regulation Questionnaire for Children and Adolescents, χ^2_{SB} Satorra-Bentler scaled chi-square test statistic, df degree of freedom, RMSEA root-mean-square error of approximation, CI confidence interval, CFI comparative fit index, SRMR standardized root-mean-square residual, CFA confirmatory factor analysis

** $p < .01$. *** $p < .001$

CFI = .963, RMSEA = .053, 90% CI for RMSEA [.040, .066], SRMR = .034) and the German data ($\chi^2_{SB} = 59.127$, $df = 33$, $p < .001$, CFI = .978, RMSEA = .049, 90% CI for RMSEA [.028, .069], SRMR = .049). Therefore, Model 4 was retained for further analysis. The estimated parameters of Model 4 for both samples are shown in Fig. 1.

Measurement invariance of the ERQ-CA

The results of measurement invariance tests of the ERQ-CA are shown in Table 3. The configural measurement invariance model fitted the data well. Accordingly, the basic factor structure of the ERQ-CA was invariant between the two cultural groups. A Satorra-Bentler scaled χ^2 difference test showed that the metric measurement invariance model fitted the data significantly less well than the configural measurement invariance model. In addition, the CFI (considered as the main criterion) decreased substantially ($\Delta CFI \leq -.010$). Hence, complete metric measurement invariance was not supported (i.e., not all factor loadings were invariant between the Chinese and German samples).

To test whether at least partial measurement invariance could be found (Byrne et al., 1989), the constraints on factor loadings across groups were progressively released until the change in model fit was no longer substantial. This was done starting with the factor loading of the item for which a modification index indicated the largest significant change estimate of the χ^2 value if its equality restriction was released. Thus, the constraint on the (unstandardized) factor loading of Item 4 (“When I am feeling happy, I am careful not to show it”) was removed. In comparison to the configural model, this model of partial metric invariance did not fit the data significantly less well. Hence, partial metric measurement invariance could be assumed.

Next, scalar measurement invariance was tested, where the item intercepts were restricted to be equal across groups. This model fitted the data substantially less well than the

partial metric measurement invariance model. Analogous to the procedure described above, the modification indices were considered first. In the partial scalar measurement invariance model, the intercepts of Items 2 (“I keep my feelings to myself”), 5 (“When I’m worried about something, I make myself think about it in a way that helps me feel better”), and 8 (“I control my feelings about things by changing the way I think about them”) were released step by step. Despite a significant chi-square difference test ($\Delta \chi^2_{SB} = 34.86$, $\Delta df = 5$, $p < .001$), the criteria suggested by Chen (2007) indicate that the fit of this model of partial scalar invariance did not differ substantially from the partial metric invariance model ($\Delta CFI = -.009$, $\Delta RMSEA = .005$, $\Delta SRMR = .005$). This partial scalar measurement invariance model was seen as the final measurement invariance model and used in further analysis.

Cultural similarities and differences in emotion regulation strategies

The partial scalar measurement invariance of the ERQ-CA enabled sufficient latent mean comparisons (Steenkamp & Baumgartner, 1998). Therefore, we used the reference-group method based on the final measurement invariance model by choosing the German sample as the reference group. The results showed that the latent mean of the expressive suppression factor was 1.32 standard deviation units larger in the Chinese compared to the German sample. This difference was statistically significant: $z = 12.26$, $p < .001$, Cohen’s $d = .76$. In addition, it showed that the latent mean for the factor cognitive reappraisal was larger by 0.70 standard deviation units in the Chinese compared to the German sample. This difference was also statistically significant: $z = 9.65$, $p < .001$, Cohen’s $d = .60$. Thus, the Chinese children and adolescents reported using both emotion regulation strategies to a greater extent than the German children and adolescents.

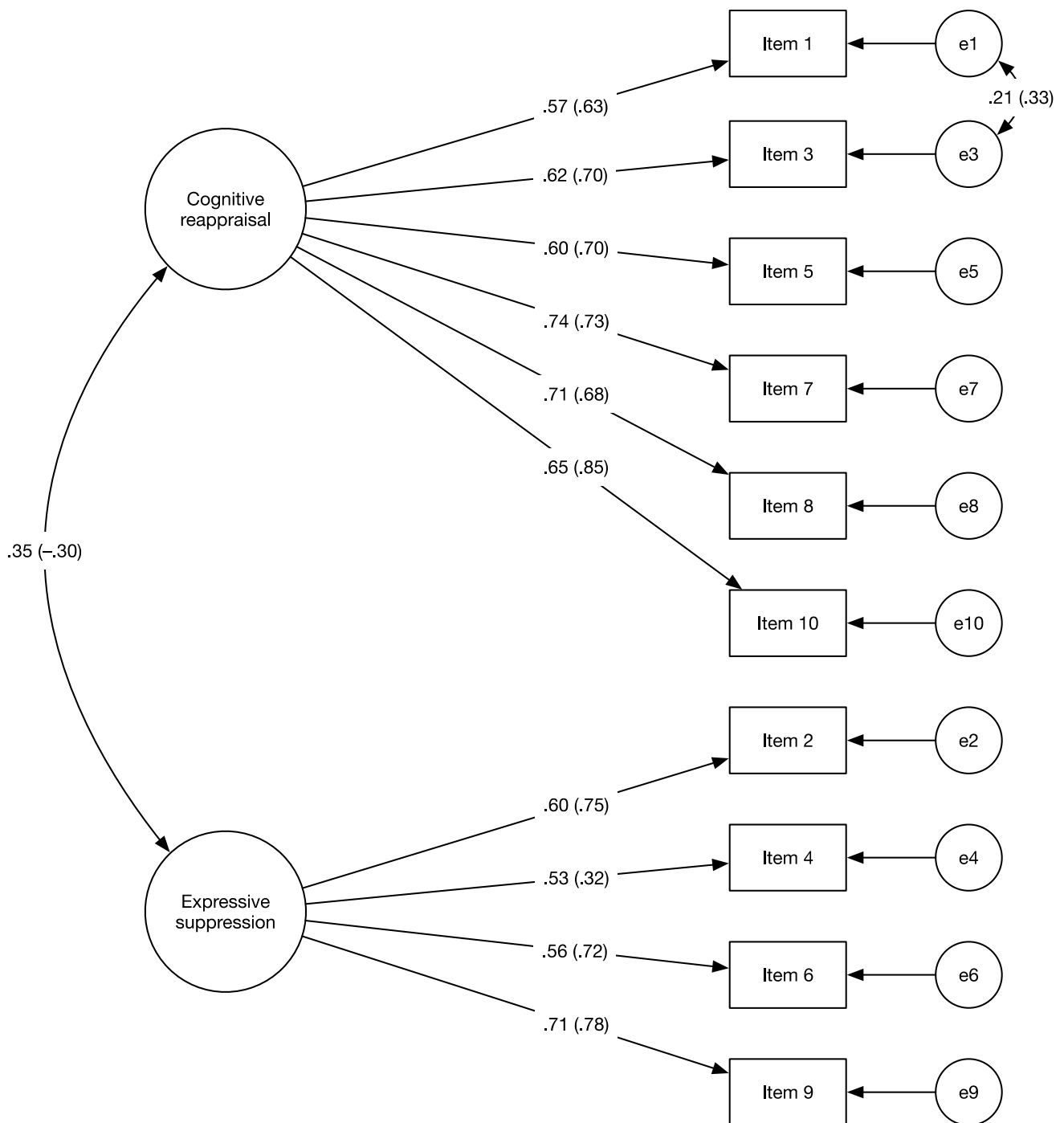


Fig. 1 The Final confirmatory factor analysis model of the emotion regulation questionnaire for children and adolescents in the Chinese and German samples. *Note.* e=error variance. The standardized

parameter estimates are given in each case. All covariates and factor loadings were significant ($p < .001$). Parameter estimates for the German sample are shown in parentheses

The relationships between emotion regulation strategies and youth behavior

The results of the configural path coefficient invariance SEM (i.e., all path coefficients were freely estimated), using the final partial scalar invariance model extended by the dependent variables,

showed acceptable fit indices ($\chi^2_{SB} = 376.735$, $df = 150$, $p < .001$, CFI = .935, RMSEA = .054, 90% CI for RMSEA [.047, .061], SRMR = .046). In the next step (i.e., path coefficient invariance SEM), all path coefficients were constrained across groups. This model (see Table 4) fitted the data acceptably well ($\chi^2_{SB} = 407.482$, $df = 158$, $p < .001$, CFI = .929, RMSEA = .055,

Table 3 Measurement Invariance of the ERQ-CA between the Chinese Sample ($n=765$) and the German Sample ($n=431$)

Model	χ^2_{SB}	df	RMSEA [90% CI]	CFI	SRMR	$\Delta\chi^2_{SB}/\Delta df$	$\Delta RMSEA$	ΔCFI	$\Delta SRMR$
MI: Configural	147.661***	66	.052 [.040, .063]	.970	.036	–	–	–	–
MI: Metric	208.381***	74	.062 [.052, .072]	.952	.056	68.94***/8	.010	–.018	.020
MI: Partial metric	164.155***	73	.051 [.041, .062]	.967	.041	14.114*/7	–.001	–.003	.005
MI: Scalar	340.104***	81	.080 [.072, .089]	.910	.060	193.3***/8	.029	–.057	.019
Final MI: Partial scalar	195.905***	78	.056 [.046, .066]	.958	.046	154.74***/3	–.024	.048	–.014

ERQ-CA Emotion Regulation Questionnaire for Children and Adolescents, χ^2_{SB} Satorra-Bentler scaled chi-square test statistic, df degree of freedom, $RMSEA$ root-mean-square error of approximation, CI confidence interval, CFI comparative fit index, $SRMR$ standardized root-mean-square residual, MI measurement invariance

* $p < .05$; *** $p < .001$

90% CI for RMSEA [.048, .061], SRMR = .051). According to the criteria suggested by Chen (2007), this model was not substantially less well than the configural path coefficient invariance SEM ($\Delta\chi^2_{SB}=44.269$, $\Delta df=9$, $p < .001$, $\Delta CFI = -.006$, $\Delta RMSEA = .001$, $\Delta SRMR = .005$). Hence, there were no significant differences in the relationships between emotion regulation strategies and youth behavior between the two cultural groups.

Discussion

It is evident that culture impacts the way individuals express and regulate their emotions. However, less is known about cultural differences in the habitual use of emotion regulations strategies in children and adolescents. To measure the two most often used strategies—cognitive reappraisal and expressive suppression—the ERQ has been widely used and recently translated into several language versions for children and adolescents. However, no attempts have been made to test its measurement invariance between Chinese and German children and

adolescents representing collectivistic and individualistic cultural backgrounds. This study aimed to fill these research gaps by testing the measurement invariance of the ERQ-CA between these two cultural groups, comparing the cultural differences in the habitual use of cognitive reappraisal and expressive suppression, and examining the relationships of these strategies with behavior problems and prosocial behavior. In line with our hypotheses, we found partial scalar measurement invariance of the ERQ-CA. Furthermore, Chinese children and adolescents reported higher levels of both emotion regulation strategies than German children and adolescents. Overall, the patterns between emotion regulation and youth behavior were similar for both samples. Cognitive reappraisal can be seen as an adaptive strategy, whereas expressive suppression can be seen as a maladaptive strategy in both cultural groups.

Main findings

In the original work of Gross and John (2003), the latent constructs of cognitive reappraisal and expressive suppression

Table 4 The results of the path coefficient invariance structural equation model

Regressions		B (SE)	β	
			China	Germany
Behavior problems				
China: $R^2 = .126$	Cognitive reappraisal	–2.673*** (.266)	–.340***	–.376***
Germany: $R^2 = .276$	Expressive suppression	1.739*** (.220)	.246***	.267***
	Age	–0.163 (.123)	–.029	–.040
	Gender ^a	0.809** (.293)	.071***	.078***
Prosocial behavior				
China: $R^2 = .136$	Cognitive reappraisal	0.876*** (.074)	.337***	.384***
Germany: $R^2 = .179$	Expressive suppression	–0.015 (.068)	–.006	–.007
	Age	–0.004 (.043)	–.002	–.003
	Gender ^a	0.588*** (.097)	.157***	.175***

B = unstandardized path coefficient (constrained across groups); SE = standardized error; β = standardized path coefficient; R^2 = explained variance

^a0 = male; 1 = female

** $p < .01$; *** $p < .001$

measured by the ERQ were found to be orthogonal in American adult students. This factor structure was replicated in studies with Italian undergraduate students (Balzarotti et al., 2010) and Spanish adults (Cabello et al., 2013). In the present study, however, the correlated two-factor CFA model with a residual correlation between Items 1 and 3 showed the soundest model fit. This result is in line with several previous findings on the factor structure of the ERQ-CA from studies with children and adolescents (e.g., Gómez-Ortiz et al., 2016; Gullone & Taffe, 2012; Liu et al., 2017). Also, the residual correlation between Items 1 and 3 has been demonstrated in prior studies with adolescents (Gullone & Taffe, 2012; Ng et al., 2019; Teixeira et al., 2015). The similar wording of these items may explain this result.

It should be noted that the relationship between the two latent factors—cognitive reappraisal and expressive suppression—was different in the cultural groups: This factor correlation was moderately positive in the Chinese sample but moderately negative in the German sample (see Fig. 1). Accordingly, greater use of cognitive reappraisal was related to greater use of expressive suppression in the Chinese children and adolescents but to less use of expressive suppression in the German children and adolescents. In accordance with the assumption of Matsumoto et al. (2008b), Chinese children and adolescents may use the two strategies in combination in different emotion-generative stages to generate context-appropriate emotional reactions. In contrast, German children and adolescents prefer one of the two emotion regulation strategies, which negates the use of the other strategy. In addition, according to Matsumoto et al. (2008b), the positive correlation between the two emotion regulation strategies may imply a greater overall need for emotion regulation, whereas the negative correlation may imply a lower overall need for emotion regulation.

In the present study, partial scalar measurement invariance of the ERQ-CA was found for the two groups of Chinese and German children and adolescents. This means that mean differences in the latent construct capture partial mean differences in the shared variance of the items. As pointed out by Putnick and Bornstein (2016), full measurement invariance is often not supported in empirical studies, and as a consequence it has been common practice to accept some violations of measurement invariance by releasing constraints on some parameters such as factor loadings or item intercepts. In this study, we freed the factor loading of Item 4 and the intercepts of Items 2, 5, and 8. Item 4 is the only item that refers to the suppression of a positive emotion. This may additionally explain the slightly lower internal consistencies of this subscale. Previous studies (e.g., Huwaë & Schaafsma, 2018) have revealed differences in suppression of positive emotions between participants from Western and Eastern societies. The intercept variance of the other three items can be caused by cultural differences in

the tendency to answer in a socially desirable way. Through this study, it is hardly possible to investigate the underlying mechanism. Future cross-cultural studies are necessary for a deeper understanding. Nevertheless, we found evidence that the ERQ-CA enables meaningful mean comparisons of cognitive reappraisal and expressive suppression habits between children and adolescents from China and Germany.

Regarding the cultural differences in the habitual use of cognitive reappraisal and expressive suppression, our results show that Chinese children and adolescents use both strategies to a greater extent than German children and adolescents. The result regarding expressive suppression replicates numerous studies on the use of emotion regulation strategies in individuals from Eastern/collectivistic compared to Western/individualistic cultures (Arens et al., 2013; English & John, 2013; Soto et al., 2011). This result is also consistent with the assumption that, in contrast to individualistic cultures (e.g., Germany), moderate emotion expression is encouraged in collectivistic cultures (e.g., China; Fernández et al., 2000). The result regarding cognitive reappraisal was surprising and in contrast to previous findings suggesting cultural independence (Arens et al., 2013; English & John, 2013; Soto et al., 2011). It is, however, notable that these previous studies focused on adult populations. We speculate that individuals from Eastern/collectivistic cultures may be socialized at an earlier age to regulate their emotions in general, but in particular to use cognitive strategies such as reappraisal. Furthermore, cognitive reappraisal and expressive suppression are only two of many emotion regulation strategies (e.g., Heiy & Cheavens, 2014). Therefore, it would be interesting to test whether Chinese also use other emotion regulation strategies to a greater extent compared to German children and adolescents, and how the use of different emotion regulation strategies develops over longer developmental periods.

After controlling for age and gender, the relationships between cognitive reappraisal, expressive suppression, behavior problems, and prosocial behavior were comparable across groups. That is, children and adolescents who reported higher levels of cognitive reappraisal also reported higher levels of prosocial behavior but lower levels of behavior problems. Hence, in line with previous findings (Eastabrook et al., 2014; Gullone & Taffe, 2012; Lanteigne et al., 2014; Li et al., 2021; Liu et al., 2017; Teixeira et al., 2015; Verzeletti et al., 2016; Zhao & Zhao, 2015), cognitive reappraisal can be regarded as an adaptive emotion regulation strategy. In comparison, children and adolescents who reported increased expressive suppression also reported more behavior problems. Unexpectedly, there was no significant relationship between expressive suppression and prosocial behavior in the final partial path coefficient invariance SEM. Although several researchers have found similar results using adolescent samples (e.g., Flouri &

Panourgia, 2014; Li et al., 2021), Lebowitz and Dovidio (2015) conducted two experimental studies and found that expressive suppression predicted less empathic concern and led to fewer prosocial behaviors in adults. In our study, we did not include possible mediators, such as empathic concern. It is possible that expressive suppression influences prosocial behavior indirectly. Therefore, in the context of cross-cultural research, the relationship between expressive repression and prosocial behavior, as well as possible underlying mechanisms, should be examined more closely. Nevertheless, it can be concluded that expressive suppression is a maladaptive emotion regulation strategy in both cultural groups.

Empirical and practical implications

In this study, we comprehensively tested the measurement invariance of the ERQ-CA between Chinese and German children and adolescents. The partial scalar measurement invariance of the questionnaire indicates that, on the one hand, it enables meaningful latent mean comparisons on the habitual use of cognitive reappraisal and expressive suppression between these cultural groups and permits meaningful investigation of the relationships of these emotion regulation strategies with youth behavior. On the other hand, this finding suggests that comparing cultural differences using observed composite scores (e.g., manifest mean scores) may be unreliable (Steinmetz, 2013). Therefore, ensuring measurement invariance of the ERQ-CA should be a prerequisite for examining cultural differences in the habitual use of emotion regulation strategies and its relationship with other constructs in future empirical studies.

The current findings further emphasize the adaptive role of cognitive reappraisal and the maladaptive role of expressive suppression for children's and adolescents' psychosocial adjustment in both cultural groups. In Chinese and German school education, psychology-related education is not integrated into the regular curriculum, even though children and adolescents face a variety of challenging milestones (e.g., educational transition, puberty, and relationship problems) that are associated with emotion-eliciting situations and events. Knowledge about emotions, their function and their regulation, as well as practice of adaptive emotion regulation strategies (e.g., cognitive reappraisal), may foster children's and adolescents' psychosocial adjustment and consequently contribute to their positive development. Although expressive suppression is generally encouraged in the Chinese culture, our findings clearly show that it is dysfunctional and related to young people's behavior problems. We recommend that parents talk to their children about feelings and emotions and encourage them to adequately express their experienced emotions in family and social interactions.

Limitations and Future Research

Several limitations of this study should be noted when interpreting the results. Firstly, the cross-sectional design does not allow causal conclusions. Future longitudinal studies or experimental studies are encouraged. Secondly, data analysis relied on self-reports, and the quality of which may have been affected by response bias, such as socially desirable responses. For a more valid assessment of behavior problems and prosocial behavior, multiple informants would be beneficial. Thirdly, we used the widely accepted SDQ to measure behavior problems and prosocial behavior. However, the internal consistencies of the prosocial behavior subscale in the German sample were lower than $\alpha/\omega = .70$. Although our estimates were comparable to those reported in previous studies (e.g., Van Roy et al., 2008), it should be noted that this subscale may be not unidimensional. For an in-depth assessment of prosocial behavior, we recommend using multi-dimensional measures of prosocial behavior, such as the Prosocial Tendencies Measure (Carlo & Randall, 2002). Finally, only the nationality of the participants was included for the cross-cultural comparison, which was used to infer culture-related differences in the use of emotion regulation strategies. In research, the terms "nation" and "culture" are often used interchangeably, and nationality is used as a proxy for cultural values (Taras et al., 2016). However, cultural variations may even exist within nations (Taras et al., 2016). We suggest additionally estimating, for example, children's and adolescents' independent and interdependent self-construals (Singelis, 1994) to control for collectivism/individualism at the individual level. In general, more information is needed on variables that may contribute to the explanation of cultural differences.

Conclusion

There is consensus in the literature that emotion regulation is framed within a socialization context and is crucial to youth development. However, less is known about the cultural differences in the habitual use of emotion regulation strategies in children and adolescents. This study advanced our understanding of emotion regulation by testing the measurement invariance of the widely applied ERQ-CA between children and adolescents from China and Germany and investigating the relationships between emotion regulation and youth behavior. Overall, the current findings indicate that the ERQ-CA exhibits partial scalar measurement invariance between the Chinese and German children and adolescents, allowing for a latent mean comparison between these groups. Furthermore, the study illustrates that there are cultural differences in the use of cognitive reappraisal and expressive suppression.

A similar picture of the relationships between emotion regulation strategies and youth behavior emerged in both cultural groups: while cognitive reappraisal is an adaptive emotion regulation strategy across cultures, expressive suppression is a maladaptive emotion regulation strategy across cultures. It can be concluded that promoting adaptive forms of emotion regulation in children and adolescents of different cultural backgrounds is important for their psychological and social functioning.

Author contributions Ziwen Teuber designed the study, carried out data analyses, interpreted the results, and drafted and revised this manuscript; Sophia Schreiber contributed to this study by supporting the data analyses and drafting this manuscript; Jana-Elisa Rueth contributed to this study by collecting data and revising this manuscript; Arnold Lohaus contributed by collecting data and revising earlier drafts of the manuscript. All authors read and approved the final manuscript.

Funding Open Access funding enabled and organized by Projekt DEAL.

Data availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical approval The study protocol was approved by the Ethical Review Board of Bielefeld University, Germany. Participation was voluntary, and informed consent forms were collected from both the students and their parents.

Conflict of interests The authors report no conflict of interests.

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