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Initial psychometric evaluation and cross-cultural generalization of the Resilience Evaluation Scale (RES) in college students

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Abstract

The Resilience Evaluation Scale (RES) is a newly developed measure of resilience written in both English and Dutch languages. To date, there have not been comprehensive psychometric evaluations of the RES' performance, including validity for use in non-Western cultural populations and languages. In our attempt to address this void, we conducted a psychometric evaluation of the RES utilizing a Western, sample of U.S. college students and non-Western sample of Chinese college students. Our psychometric evaluation of the RES in a Western, English-speaking sample of U.S. college students indicated mixed results on the construct validity of the RES for measuring resilience. We also found that the factor structure of the RES lacked configural invariance across U.S. college student and Chinese college student samples. Results suggested that additional research is needed to assess whether the RES appropriately measures internal factors of resilience or requires modification. We also highlight the need for continued development of cross-culturally valid measures, and possibly different conceptualizations, of resilience across cultural and linguistic groups.

1 Introduction

Resilience refers to the ability to mentally cope with adversity and bounce back [33, 53] and has been shown to protect individuals from negative effects of stressors and help them to maintain functioning [9, 53, 54]. Psychological resilience has drawn increasing attention in education and psychology to explain some individual's coping strategies following stressors—from trauma to academic defeat [6, 32, 58]. It is especially an important factor to explain student learning achievement in higher education. Resilient students can maintain high motivational achievement and performance even encountering stressful events and conditions that place them at risk of poor performance [20]. In other words, students with resilience will adapt themselves functionally and succeed despite the presence of adverse conditions. Psychological resilience consists of adverse experience, coping, and positive adaptation [16, 18, 33, 42, 60], influenced by both external factors such as family and environment [9] and internal factors such as self-concept, self-efficacy, self-control, and cultural and social sensitivity [29, 45, 61].

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Since 1990, researchers have developed many assessments of resilience that vary widely in their definition of resilience, factor structure, and other characteristics. The most widely used measures are the Connor-Davidson Resilience Scale (CD-RISC) [18] and Resilience Scale for Adults (RSA) [24], which assess both internal and external factors of resilience. Other measures are brief and purport to measure a singular domain of resilience, such as the Brief Resilience Coping Scale (BRCS) [55].

The Resilience Evaluation Scale (RES) [64] is a brief questionnaire that assesses two internal psychological resilience factors: self-confidence ("trust in oneself") and self-efficacy ("positive beliefs about adaptive coping with stressful situations;" ([64], p. 2). Based on definitions from Benight and Bandura [8] and Lazarus and Folkman's [39] Process Model of Coping (PMC), the RES aims to measure an individual's cognitive appraisal of their internal capacity to respond effectively to stressors. Self-efficacy and self-confidence have demonstrated significant and positive relationships to resilience [8, 10, 32, 56, 57]. Notably, this is an intentionally narrow definition of resilience, which does not include associated or external factors [32], and it is unknown if it adequately captures resilience.

Resilience, as defined by self-efficacy and self-confidence on the RES, is also applicable to stressors in an academic setting. This construct of resilience is positively and strongly associated with students' intrinsic motivation for academic success [38, 50] compared to extrinsic motivation [23, 28] and one's perceptions of their current autonomy, or ability to independently rely on oneself [65]. Consistent with the Process Model of Coping (PMC) that emphasizes tolerating and controlling internal and external demands, resilience is positively but less strongly associated with metacognitive self-regulatory strategies and learning strategies such as organization, which involves actively sorting and conceptualizing incoming information [1, 21, 50, 59]. These variables and their relationship to resilience may be particularly salient as students face academic challenges during the COVID-19 pandemic [2, 3, 22, 48, 66].

Since the concepts of resilience originated in Western countries, the resilience construct and specific RES scores may not generalize to individuals in other cultural and linguistic populations who may perceive resilience or its components dissimilarly [64] or be subject to different social and environmental pressures [12]. Prior research has demonstrated structural variance of commonly used resilience measures like the CD-RISC differed across different populations and cultures [35, 36, 68] and the influence of geography and cultural norms on the perception of individual's resilience beliefs [4, 12, 61]. Other resilience measures have also been translated for use and validation in Eastern cultures, including the Chinese version of the Resilience Scale-14 [15] and the Child and Adolescent Wellness Scale (CAWS) in the U.S. and Japan, Korea, Taiwan, and Thailand [5]. To add to the research on the construct and measurement of resilience in Eastern cultures, such as in China, Japan, and Korea, we aimed to also evaluate the recently developed RES in a Chinese-speaking college student sample.

Noteworthy, resilience is conceptualized differently across cultures, which influences both the expression and measurement of this construct. In Chinese culture, resilience is valued as a virtue by ascribing positive meaning to adversity and its ability to strengthen one's mind and adaptability, which shapes individuals' conceptualization, interpretation, and instantiation of resilience differently from Western culture [40, 67]. Moreover, in Chinese culture, resilience is not solely an individual pursuit but is often interwoven with collective values and the social context [49, 62]. This collective aspect emphasizes social harmony and interdependence, leading to an integrated experience and expression of resilience-related behaviors [14]. However, in Western culture, resilience is often associated with individual autonomy and personal coping strategies such as internal and personal competencies, which reflects a more individualistic ethos [67].

The present study focuses on RES on the ground that, firstly, aforementioned, resilience is a multifaceted construct pivotal to adaptive functioning in the face of adversity. It is with significant implications for both psychological well-being and educational outcomes [42, 43]. The Resilience Evaluation Scale (RES) represents a critical innovation in resilience assessment, providing a nuanced examination of internal factors such as self-confidence and self-efficacy [7, 18]. These elements are particularly important in the academic domain in predicting students' ability to endure and thrive despite educational stress [70]. Secondly, our emphasis on the RES stems from a clear gap in the literature: the lack of a comprehensive psychometric evaluation of resilience measures within Eastern cultural contexts, especially during the unparalleled stressors caused by the COVID-19 pandemic [13, 37]. This research seeks to offer critical insights into the universality and specificity of resilience across diverse cultural landscapes by exploring the applicability of RES to a Chinese-speaking student cohort. Thirdly, the pandemic's global impact underscores the necessity to validate resilience assessments such as the RES, which may inform the development of support mechanisms for students across varied educational settings [65]. Given the potential for cultural variation in the interpretation and structural integrity of resilience scales [61], the RES focused assessment of cognitive appraisals of stress responses could serve as a more globally applicable instrument. Additionally, the selection of the RES is deliberate, aiming to explore its potential for broader cultural applicability, an area where broader measures have shown limitations [34].

To date, there are no studies that provide a comprehensive psychometric and cross-cultural evaluation of the RES, nonetheless during the COVID-19 global pandemic, which is a critically important time to assess the measurement of resilience from a cross-cultural perspective [11, 41, 47]. Therefore, the aim of Study One was to provide an initial psychometric evaluation of the RES [63] by assessing the validity and reliability of the RES in a sample of U.S. college students. We hypothesized that the RES would demonstrate good internal consistency and a two-factor structure, reflecting self-efficacy and self-confidence subscales. We hypothesized that the RES scores would be differentially related as expected to measure of similar constructs (self-efficacy), related constructs (intrinsic motivation, autonomy) and discriminant constructs (metacognitive self-regulation, organization, extrinsic motivation).

In addition, it is unknown whether the RES would perform comparably with different cultural populations other than English and Dutch. Therefore, the aim of Study Two was to examine measurement invariance of the RES across two populations: the U.S. college student sample, and an Eastern, Chinese-speaking college student sample. Since Study Two was exploratory, we did not make specific hypotheses about the nature or type of variance or invariance. However, based on the extensive literature demonstrating structural differences in other resilience measures across cultures, we noted that this might also occur for the RES.

2 Study one

2.1 Materials and methods

2.1.1 Participants and procedures

Participants were recruited from a large South-eastern U.S. public university in the Spring of 2020. Participants ($N = 161$) were eligible to participate for course extra credit if they were at least 18 years old, fluent in English, and enrolled as full-time student during the COVID-19 global pandemic. Participants completed an anonymous 8–10-min Qualtrics survey after reading the informed consent, consistent with American Psychological Association (APA) ethical guidelines and approved by the University Institutional Review Board (IRB).

We carefully screened the data and excluded participants from the analyses if they did not complete any surveys ($n = 12$; 7.45%). The final usable sample consisted of 147 U.S. students, of whom 24 (16.2%) self-identified as men, 120 (81.1%) as women, 1 (0.7%) as agender, and 2 (1.4%) as nonbinary, genderqueer, or gender fluid. Among those who completed the survey, most participants were fourth-years ($n = 36$; 24.5%), followed by third-years ($n = 32$; 21.8%), first-years ($n = 31$; 21.1%), graduate students ($n = 25$; 17%), second-years ($n = 13$; 8.8%), and fifth- or sixth-year undergraduate students ($n = 10$; 6.8%). In terms of ethnicity, 83.7% ($n = 123$) of participants identified themselves as White, 11.6% ($n = 17$) as Asian or Pacific Islander, 4.1% ($n = 6$) as African American, and 0.7% ($n = 1$) as an "Other" racial group. A minority of participants reported being first generation college students ($n = 20$; 13.6%).

2.1.2 Measures

The online survey administered through Qualtrics consisted of a demographic questionnaire and the Resilience Evaluation Scale (RES) [63], the Motivated Strategies for Learning Questionnaire (MSLQ) [51], and the Basic Psychological Need Satisfaction in General (BPNS) [19].

Resilience Evaluation Scale (RES). The RES [63] consists of 9 items measuring self-confidence and self-efficacy following adversity. Respondents indicated the degree to which they agreed with questions related to their self-perception on a 5-point Likert-type scale ranging from 0 = *Completely disagree* to 4 = *Completely agree*. The RES was demonstrated good convergent validity and internal consistency in initial development studies in English and Dutch [63]. In the current study, Cronbach's alpha was 0.83 for the Self-Confidence subscale and 0.76 for the Self-Efficacy subscale.

Motivated Strategies for Learning Questionnaire (MSLQ). The MSLQ [51] is an 81-item questionnaire designed to assess student learning strategies and academic motivation. Participants indicate whether an item characterizes their behaviors and thinking on a 7-point Likert-type scale from 1 = *Not at all true of me* to 7 = *Very true of me*. We used the subscales: Intrinsic Motivation ($\alpha = 0.81$), Extrinsic Motivation ($\alpha = 0.72$), Self-Efficacy ($\alpha = 0.91$), Organization ($\alpha = 0.79$) and Metacognitive Self-Regulation ($\alpha = 0.78$) for the present analyses. The MSLQ has demonstrated internal consistency and construct validity in several studies [27, 44, 52].

Basic Psychological Need Satisfaction Scale (BPNS). The BPNS [19, 26] is a 21-item questionnaire that assesses basic psychological need satisfaction levels in domains of Autonomy, Competence, and Relatedness. Respondents indicate how true each statement is for them on a 7-point Likert-type scale from 1 = *Almost never/ never true* to 7 = *Almost always/always true*. In the current sample, we only used the Autonomy scale (α = 0.72), for which higher scores indicate one's perception of volition to act purposefully toward interests and lower scores indicate perceptions of being less self-directed and/ or pushed in unwanted directions [19]. The BPNS has demonstrated evidence of reliability and validity as a measure of basic psychological need satisfaction [19, 25].

2.2 Data analysis

We conducted latent variable modeling using Mplus 7 [46]. For all other analyses, we used IBM SPSS version 25. First, we evaluated the internal consistency of the Resilience Evaluation Scale (RES). To do this, we computed and interpreted inter-item correlations, item-total correlations, Cronbach's alpha coefficients, and McDonald's omega coefficients. To explore the factor structure of the RES, we conducted an Exploratory Factor Analysis (EFA) with robust maximum likelihood and goemin (oblique) rotation.

We assessed convergent and discriminant validity for the RES, Motivation, first using observed correlations between the RES total score and external subscale scores from the MSLQ and the BPNS. Next, we used the latent approach of confirmatory factor analysis (CFA) to calculate the latent interfactor correlations of resilience (RES) and external latent factors derived from the subscales of the MSLQ and the BPNS. We calculated the Wald test statistic to quantify the decrement in model fit that occurred when pairs of latent covariances were constrained to equality with one another. We then calculated Cohen's q effect sizes of the difference in magnitude between each pair of correlations and interpreted these according to Cohen [17]: $q < 0.10$ none; 0.10-0.30 small, 0.30-0.50 medium, > 0.5 large effect.

2.3 Results

2.3.1 Reliability

Both Cronbach's alpha and McDonald's omega were high for Resilience total score (α = 0.81; ω = 0.81), the Self-Confidence subscale (α = 0.83; ω = 0.86), and the Self-Efficacy subscale (α = 0.76; ω = 0.76). For the Self-Efficacy subscale, inter-item correlations ranged from 0.11-0.60, with a mean of 0.38, and corrected item-total correlations ranged from 0.36-0.62. For the Self-Confidence subscale, inter-item correlations ranged from 0.54-0.69 with a mean of 0.63, and corrected item-total correlations ranged from 0.65-0.76. Self-Confidence and the Self-Efficacy subscale scores were moderately correlated ($r = 0.44$), and correlations between items on both subscales were low to moderate (range rs = 0.11-0.69), indicating the two subscales likely measure unique but related constructs of resilience. See Table 1 for item-level descriptive statistics and Supplemental Materials for full scale and subscale descriptive statistics. Taken together, these results provide evidence of the internal consistency of RES scores in the U.S. college student sample.

Table 1 Item-level descriptive statistics for the Resilience Evaluation Scale (RES)

Item	U.S. Students						Chinese Students					
	M	*SD*	Min	Max	Skewness	Kurtosis	*M*	*SD*	Min	Max	Skewness	Kurtosis
I have confidence in myself	3.51	0.80	1	4	−1.35	0.50	2.41	0.87	0	4	−0.46	−0.37
I can easily adjust in a difficult situation	3.67	0.63	2	4	−1.75	1.76	2.41	0.85	0	4	−0.51	−0.16
I am able to persevere	3.86	0.39	2	4	−2.75	7.32	2.46	0.84	0	4	−0.61	0.04
After setbacks, I can easily pick up where I left off	3.58	0.62	2	4	−1.18	0.34	2.41	0.87	0	4	−0.50	−0.02
I am resilient	3.76	0.53	2	4	−2.17	3.83	2.60	0.78	0	4	−0.77	1.20
I can cope well with unexpected problems	3.52	0.76	1	4	−1.57	1.85	2.48	0.83	0	4	−0.61	0.15
I appreciate myself	3.48	0.81	1	4	−1.50	1.46	2.45	0.83	0	4	−0.45	0.10
I can handle a lot at the same time	3.46	0.74	1	4	−1.07	0.02	2.34	0.89	0	4	−0.38	−0.54
I believe in myself	3.56	0.78	1	4	−1.91	3.09	2.71	0.77	0	4	−0.54	0.73

For U.S. Students, *N* = 147. For Chinese Students, *N* = 332

2.3.2 Structural validity

Results of the EFA indicated that the hypothesized two-factor solution was optimal (Table 2), consistent with the original test development study. The two-factor model explained a total of 54.79% of the variance in responses: Self-Efficacy (6 items; 34.39%) and Self-Confidence (3 items; 20.30%). The final model had good fit according to some fit statistics, but not all ($\chi^2 = 33.883$, $p = 0.019$; RMSEA $= 0.073$ [90% C.I. $= 0.029$-0.112]; CFI $= 0.961$; TLI $= 0.925$; SRMR $= 0.036$). As expected, Self-Efficacy and Self-Confidence latent factors were moderately associated ($r = 0.47$, $p < 0.001$). All variables had significant and salient loadings on their primary factors with magnitudes ranging from 0.41 to 0.97. Item 1, which loaded primarily onto Self-Confidence (magnitude 0.584), was the only item with a significant and salient cross-loading (Self-Efficacy, magnitude 0.303), which may indicate poor performance as a pure indicator of Self-Confidence or need for content revision.

2.3.3 Convergent and discriminant validity

Contrary to expectations of a strong correlational relationship, RES total scores had a small, positive association with students' perceptions of their self-efficacy related to learning and academic performance on the MSLQ ($r = 0.295$, $p < 0.001$). RES total scores were moderately strongly associated with students' perceptions of their autonomy on the BPNS ($r = 0.482$, $p < 0.001$). As expected, RES total scores were positively related to total intrinsic motivations for academic success ($r = 0.291$, $p < 0.001$) and not significantly related to total extrinsic motivations ($r = -0.003$, $p = 0.973$).

Wald tests of the significant difference in latent factor intercorrelations revealed mixed findings with regards to the differential relationships of Resilience with other related factors (see Table 3). As expected, the Resilience latent factor was more strongly related to Academic Self-Efficacy factor than the Self-Regulation factor ($W = 4.270$, $p = 0.038$, $q = 0.159$) or Organizational Study Skills factor ($W = 6.503$, $p = 0.011$, $q = 0.327$). Consistent with hypotheses, the Resilience factor was more strongly related to the Intrinsic Motivation factor than the Extrinsic Motivation factor ($W = 6.109$, $p = 0.014$; $q = 0.383$). However, the Resilience factor did not demonstrate a significantly stronger association with the Academic Self-Efficacy factor than with the Autonomy factor ($W = 1.27$, $p = 0.258$, $q = 0.205$) or with the Intrinsic Motivation factor ($W = 0.626$, $p = 0.429$, $q = 0.041$), which is inconsistent with convergent validity hypotheses. These findings provide mixed evidence of convergent and discriminant validity of the RES. They also pose questions about whether the RES more so assesses student independence or motivation rather than self-efficacy and self-confidence components of resilience.

Table 2 Standardized factor loadings for exploratory factor analysis (EFA) on the RES in a U.S. student sample

| | Standardized Factor Loadings | | |
| | U.S. Sample | | Chinese Sample |
Items	Self – Efficacy	Self – Confidence	Resilience
1. I have confidence in myself	0.303*†	**0.584***	**0.783***
2. I can easily adjust in a difficult situation	**0.680***	0.006	**0.733***
3. I am able to persevere	**0.772***	0.001	**0.708***
4. After setbacks, I can easily pick up where I left off	**0.747***	0.001	**0.725***
5. I am resilient	**0.885***	−0.193*	**0.777***
6. I can cope well with unexpected problems	**0.651***	0.065	**0.774***
7. I appreciate myself	−0.007	**0.970***	**0.785***
8. I can handle a lot at the same time	**0.411***	0.178	**0.622***
9. I believe in myself	0.142	**0.687***	**0.837***
Eigenvalue	3.013	1.827	5.084
% of Total Variance	34.49%	20.30%	– –
Total Variance		54.79%	56.49%

Note. The bolded values in the table represent factor loadings that are statistically significant. These loadings are prominent within their primary factors and indicate a substantial contribution to the factor they are associated with

*$p < 0.05$

† Indicates salient item cross-loading

Table 3 Wald tests of difference in factor intercorrelations with Resilience on the RES

External factor	Resilience	
	Latent correlation (r_{latent})	p
A. Self-Efficacy	0.331	0.001
B. Autonomy	0.500	< 0.001
C. Intrinsic Motivation	0.367	< 0.001
D. Extrinsic Motivation	0.002	0.988
E. Self-Regulation	0.182	0.075
F. Learning Skills—Organization	0.017	0.877
Difference Test	Wald W (Cohen's q)	p
A vs B	1.278 (0.205)	0.258
A vs C	0.626 (0.041)	0.429
A vs E	4.270 (0.159)	0.039
A vs F	4.320 (0.327)	0.038
C vs D	6.109 (0.383)	0.014

For U.S. Students, $N = 147$. RES = Resilience Evaluation Scale

2.3.4 Path analysis

A path model was tested using SmartPLS 4 to investigate the relationships between basic psychological needs satisfaction (BPNS), motivated strategies for learning (MSLQ), and resilience (RES Total) in a U.S. student sample. Results indicated that BPNS significantly predicted RES Total, $\beta = 0.463$, $p < 0.001$, while MSLQ did not significantly predict RES Total, $\beta = 0.149$, $p = 0.087$. The model explained approximately 28% of the variance in RESTOT, $R^2 = 0.281$. Furthermore, another Path Analysis was conducted to explore the relationship between motivated strategies for learning (MSLQ) and resilience (RES Total) in a U.S. student sample. Results indicated that MSLQ significantly predicted RES Total, $\beta = 0.280$, $p < 0.001$. The model explained approximately 8% of the variance in RES Total, $R^2 = 0.078$.

3 Study two

3.1 Materials and methods

3.1.1 Participants and procedures

Participants ($N = 332$) were eligible to participate voluntarily if they were at least 18 years of age, fluent in Chinese, and enrolled full-time at a university in China during the COVID-19 global pandemic. Participants completed an anonymous 8–10 min Qualtrics survey after reading the informed consent, consistent with American Psychological Association (APA) ethical guidelines and approved by the University Institutional Review Board (IRB).

All participants identified as ethnically Chinese and averaged 19.72 years of age ($SD = 0.96$; range = 18–23). In terms of gender, which was characterized as binary according to Chinese cultural norms, 106 (31.9%) were men, 222 (66.9%) were women, and 4 (1.2%) did not report their gender. A majority of participants were second-year students ($n = 161$; 48.5%), followed by first-years ($n = 142$; 42.8%), third-years ($n = 20$; 6%), fourth-years ($n = 1$; 0.3%), and unreported year in school ($n = 4$; 1.2%). Some were first generation college students ($n = 77$; 23.2%).

3.1.2 Measures

The online survey administered through Qualtrics consisted of a demographic questionnaire and the Resilience Evaluation Scale (RES) [63], and select subscales of the Motivated Strategies for Learning Questionnaire (MSLQ) [51], mentioned previously as used in the U.S. sample. To ensure content validity, all items originally written in English were translated to Chinese by a certified bilingually fluent translator using a standard translation and back-translation procedure [30]. The

Chinese version was evaluated and back-translated by the first author, who is fluent in English and Chinese, then checked by the certified translator. In the Chinese sample, Cronbach's alpha was 0.92 for the RES. Cronbach's alphas were 0.93 (Self-efficacy for learning and performance) and 0.85 (Metacognitive Self-regulation) for the MSLQ subscales used in analyses.

3.2 Data analysis

Parallel to Study One, we evaluated the internal consistency of the RES in the Chinese college student sample. Then, we conducted measurement invariance testing using multigroup CFA (MGCFA) across the U.S. and Chinese college student samples and follow-up exploratory analyses.

3.3 Results

3.3.1 Reliability

Cronbach's alpha and McDonald's omega were high for Resilience total score ($\alpha = 0.92$; $\omega = 0.92$), the Self-Confidence subscale ($\alpha = 0.87$; $\omega = 0.86$), and the Self-Efficacy subscale ($\alpha = 0.87$; $\omega = 0.87$). For the Self-Efficacy subscale, interitem correlations ranged from 0.41 -0.63, with a mean of 0.54, and corrected item-total correlations ranged from 0.55 -0.74. For the Self-Confidence subscale, inter-item correlations ranged from 0.62-0.72 with a mean of 0.69, and corrected item-total correlations ranged from 0.72-0.79. Self-Confidence and Self-Efficacy scores were highly correlated ($r = 0.81$), and inter-item correlations across subscales were moderately high ($rs = 0.41–0.72$). See Table 1 for item-level descriptive statistics and Supplemental Materials for full scale and subscale descriptive statistics. These findings provided evidence that RES total scores are reliable in the sample of Chinese students, but the two theorized subscales of resilience are highly overlapping and may not assess distinct constructs of confidence and efficacy.

3.3.2 Cross-cultural measurement invariance

A multiple-group confirmatory factor analysis (MGCFA) revealed that factor structure and factor loadings were not equivalent across cultural groups (χ^2 [52] = 129.211, $p < 0.001$), indicating the lack of configural invariance. Results suggest that the same two-factor model of resilience as measured by the RES in the U.S. college student sample does not hold for Chinese students in our sample. Thus, observed scores on the RES may not be comparable across U.S. (Western) and Chinese (Eastern) samples, and items on the RES may represent different underlying constructs depending on culture.

Follow-up exploratory factor analysis (EFA) of the RES in the Chinese college student sample revealed that a unidimensional model was optimal (Table 2), consistent with the observed strong correlation between Self-Efficacy and Self-Confidence subscales in the Chinese college student sample. The unidimensional model had good fit according to some fit statistics, but not all ($\chi^2 = 60.257$, $p < 0.001$; RMSEA = 0.081 [90% C.I. = 0-0.105]; CFI = 0.964; TLI = 0.932; SRMR = 0.026), and significant and salient factor loadings (magnitude 0.62–0.84).

3.3.3 Convergent and discriminant validity

Given that the definition of the construct measured by the RES in the Chinese college student sample is unknown, we did not have enough information to specify predictions for subsequent convergent and discriminant validity analyses. Exploratory analyses revealed RES total scores were moderately strongly related to Academic Self-Efficacy scores ($r = 0.542$, $p < 0.001$), which was higher compared to the U.S. college student sample ($r = 0.295$).

3.3.4 Path analysis

A path model was tested using SmartPLS 4 to investigate the relationship between resilience (resilience) and a resilience measure (RES) in a Chinese student sample. Results indicated that resilience significantly predicted RES, $\beta = 0.948$, $p < 0.001$. The model explained approximately 90% of the variance in RES, $R^2 = 0.899$; the path analysis results suggest that resilience

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strongly predicts the RES measure in the Chinese student sample. Additionally, another model with U.S. sample, which takes Self-efficacy and Self-Regulation as the exogenous variables and measures their effect on RES, performs poorly ($R^2 = 0.083$) compared with the model with the Chinese sample using the same items. This discrepancy suggests that the U.S. sample aligns with a two-factor model as indicated by the loadings in Table 2, whereas the Chinese sample supports a unidimensional RES dimension, thereby indicating a lack of measurement invariance between the samples.

4 Discussion

At an era when educationalists and researchers face an increasingly international student body, this study provided an initial psychometric evaluation of the RES with U.S. and Chinese college student samples and an exploration of its cross-cultural generalizability. In the U.S. college student sample, the RES demonstrated evidence of internal consistency and structural validity, but mixed evidence of convergent and discriminant validity. The latent factor of RES Resilience had a significantly higher associations with the external factor of Academic Self-Efficacy compared to some (e.g., Organizational Study Skills, Self-Regulation), but not all (e.g., Intrinsic Motivation; Autonomy) less theoretically related factors. This corresponded with bivariate correlations, for which the RES total score had a much smaller association with the MSLQ self-efficacy scores than expected, lower than its association with the BPNS autonomy score. Given these results, there is some uncertainty about the construct validity of the RES for measuring resilience. While RES items appear content valid, hang together reliably, and adopt the expected internal structure for Western student data, it is ambiguous as to whether they appropriately measure internal factors of resilience (self-efficacy and self-confidence) or other constructs also positively predictive of success or good academic performance, such as autonomy and intrinsic motivation. Given the mixed performance of the RES in this sample, it is questionable whether this additional measure of resilience is useful beyond already existing measures such as the CD-RISC.

In the Chinese college student sample, the RES total score and subscale scores demonstrated good internal consistency, with notably large coefficient alphas, omegas, and item-total and inter-item correlations. The large association between the Self-Confidence and Self-Efficacy subscale scores, lack of configural invariance, and optimal unidimensional factor structure revealed that the RES items are highly overlapping and represent one resilience construct rather than two factors in the Chinese sample. This is consistent with the lack of measurement invariance found using the CD-RISC [35, 36, 68] and Ungar's [62] explanations on how definitions of resilience are not culturally free. This lack of measurement invariance renders it unviable to make cross-cultural and cross-language comparisons of the RES observed scale scores. It also reinforced the need for valid cross-cultural and cross-language assessment of resilience in general [31], especially Eastern cultural groups [5]. Future research should build upon our current understanding of the cultural norms of collectivism that affect self-perceptions and resilience [15, 69].

The factor structures obtained from the U.S. and Chinese samples suggest that the Resilience Evaluation Scale (RES) may encapsulate different dimensions of resilience across these cultures. This finding aligns with the literature that posits cultural variations in the understanding and manifestation of resilience [40, 67]. For example, in Chinese culture, where collective coping mechanisms are prevalent, resilience might be reflected through a more unified construct, whereas the U.S. sample may differentiate between aspects such as self-efficacy and self-confidence due to a cultural emphasis on individualism [67]. These differences highlight the necessity of developing measures that are sensitive to cultural nuances. The present study underscored the necessity of development of cross-culturally valid measures, and possibly different conceptualizations, of resilience across cultural and linguistic groups.

5 Conclusion

In conclusion, the findings of the present research highlight the nuanced nature of resilience, which is a construct interpreted and manifested differently across cultures. The disparities observed in the factor structures of the RES between the U.S. and Chinese samples underscore the importance of considering cultural factors in the development and validation of psychological measures.

As this is the first dedicated psychometric evaluation of the RES, future psychometric evaluations should consider integrating several other measures of resilience as convergent criteria, as resilience is variably defined across the educational and psychological fields. Since the present study used convenience sampling of mostly female university students, future research should attempt to replicate and assess the generalizability of our findings to non-student populations or other demographic groups also affected by stressors. In addition, follow-up longitudinal studies concerning the test–retest

reliability of the RES would add to our understanding of its psychometric properties. Other than that, we suggest investigations into the interaction between individual and collective aspects of resilience between different cultures. This could provide a deeper understanding of how cultural values influence resilience strategies and how these strategies can be supported in multicultural educational and clinical settings. Furthermore, we suggest future studies taking the impact of global crises, such as the COVID-19 pandemic, on the conceptualization and measurement of resilience into consideration. As societies evolve in response to such events, the definition and operationalization of resilience may shift, which necessitates continuous refinement of assessment tools. Despite some limitations, our psychometric evaluation of the RES, using unique data from Western and Eastern cultural groups during the COVID-19 global pandemic, highlights strengths and weaknesses of the RES and poses questions for defining and assessing resilience that contribute to educators' and researchers' future assessment of college student success.

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

Declarations

Ethics approval and consent to participate All research procedures were approved by the Office of Human Research (IRB) of Auburn University, USA.

Consent for publication Informed consent was obtained from all individual participants after they fully understood the study.

Competing interests The authors declare no competing interests.

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