The Research Resilience Scale: Development and Initial Validation

by Dian Ratna Sawitri

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Abstract

We developed and provided initial validation for a 15-item scale for use with academics. In Phase 1, we utilized a review of the literature, focus groups, and expert feedback to generate 36 items. In Phase 2, we conducted item and exploratory factor analyses to reduce the number of items and assess the factor structure ($N = 212$; 51.4% female; mean age 48.93 years, $SD = 9.45$). In Phase 3, we conducted confirmatory factor analyses to verify the initial structure (hold-out sample: $N = 210$; 56.7% female; mean age 49.20 years, $SD = 9.98$). In Phase 4, we provided construct validity.

Résumé

L'échelle de résilience en recherche: Développement et validation initiale. Nous avons développé et fourni une validation initiale pour une échelle de 15 items à utiliser avec les universitaires. Dans la phase 1, nous avons utilisé une revue de la littérature, des groupes de discussion et des commentaires d'expert·e·s pour générer 36 items. Dans la phase 2, nous avons effectué des analyses d'items et des analyses factorielles exploratoires pour réduire le nombre d'items et évaluer la structure facto-

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rielle (N=212; 51,4% de femmes; âge moyen 48,93 ans, ET=9,45). Dans la phase 3, nous avons effectué des analyses factorielles confirmatoires pour vérifier la structure initiale (échantillon non retenu: N=210; 56,7% de femmes; âge moyen 49,20 ans, écart-type=9,98). Dans la phase 4, nous avons fourni la validité de construction.

Zusammenfassung

Die Skala zur Resilienz von Forschenden: Entwicklung und erste Validierung
Wir haben eine 15-teilige Skala zur Verwendung mit Akademikern entwickelt und eine erste Validierung durchgeführt. In Phase 1 nutzten wir eine Überprüfung der Literatur, Fokusgruppen und Expertenfeedback, um 36 Items zu entwickeln. In Phase 2 führten wir Item- und explorative Faktorenanalysen durch, um die Anzahl der Items zu reduzieren und die Faktorenstruktur zu bewerten (N=212; 51,4% weiblich; Durchschnittsalter 48,93 Jahre, SD=9,45). In Phase 3 führten wir konfirmatorische Faktorenanalysen durch, um die ursprüngliche Struktur zu verifizieren (Hold-out-Stichprobe: N=210; 56,7% weiblich; Durchschnittsalter 49,20 Jahre, SD=9,98). In Phase 4 haben wir die Konstruktvalidität überprüft.

Resumen

Escala de resiliencia para la investigación: Desarrollo y validación inicial Desarrollamos y proporcionamos la validación inicial de una escala de 15 ítems para su uso con académicos. En la fase 1, utilizamos una revisión de la literatura, grupos de discusión y comentarios de expertos para generar 36 ítems. En la fase 2, realizamos análisis factoriales exploratorios y de ítems para reducir el número de ítems y evaluar la estructura factorial (N=212; 51,4% mujeres; edad media 48,93 años, DE=9,45). En la Fase 3, realizamos análisis factoriales confirmatorios para verificar la estructura inicial (muestra no seleccionada: N=210; 56,7% mujeres; edad media 49,20 años, DE=9,98). En la fase 4, se comprobó la validez de constructo.

Introduction

In a changing context of higher education, nearly all universities around the world have been placing an increasing emphasis on university research excellence and highlighting promotion of research competence and productivity to raise university rankings at national and/or international levels (Dai et al., 2021). Consequently, academics working in higher education institutions often participate in research activities as part of their role and are increasingly under pressure to secure grant funding and publish scientific papers (Chan et al., 2021). Academic researchers are often considered "successful" depending on the funding they obtain, the number of publications they generate, and the reputation of the journals they publish in (Day, 2011). For many, the processes of research – applying for research grants and publishing – bring experiences of negative feedback, rejection, and criticism on a regular basis, and these ongoing experiences of rejection can lead to feelings of discouragement, disappointment, and pessimism regarding their research, and stress regarding their career development and job security (Carson et al., 2013).

Previous studies have identified the important role of resilience when coping with research-related setbacks. For example, a qualitative study with academics from a range of public universities in China showed that emotional resilience played a significant part in the balancing of tensions resulting from managing the conflicting roles of teacher, researcher, administrator, and someone who needs to engage with their community (Yang et al., 2021). Studies also have identified factors that protect against research discouragement, providing insight into the underlying domains that constitute research resilience. Chan et al. (2021), for example, in a qualitative study, identified three broad areas that contributed to the resilience of academics when engaging in research. These were the academic values and beliefs (e.g., commitment to research as an important activity; maintaining focus on the reasons for working as an academic), valuing the experience (e.g., viewing knock-backs as learning experiences; developing several research interests, and learning which ones to focus on), and seeing the bigger picture (e.g., remembering that research is inherently competitive and stressful; not taking rejection personally, it is common and part of the process).

Additionally, Chan et al. (2021) highlighted collaboration with colleagues, managing emotions, and cognitive reframing as strategies for survival for academics. Colleagues offer sympathy and support, act as sounding boards and sources of information for next steps, give confidence that the academic's research path has merit, and provide context and normalise rejection by sharing their own set-backs. Managing emotions allows the academic to re-engage with the research process. Discussing and/or venting outcomes with colleagues and friends, detaching from the emotions generated by stepping back from them (e.g., by putting next steps aside, engaging in exercise, switching focus), are examples of how this might be achieved. Finally, reframing refers to changing cognitions regarding the negative feedback around research. This might include setting more realistic expectations (e.g., grant success often takes multiple attempts to be successful) and replacing harmful self-messages (e.g., "I am useless") with more helpful ones (e.g., "I can learn from this").37

Resilience has been defined variously as the ability to develop, mature, and increase competence in difficult situations (Gordon, 1995), a dynamic process in individuals that allows them to demonstrate positive adaptation despite experiencing difficult or traumatic situations (Luthar & Cicchetti, 2000), and the ability that develops in individuals to be able to "bounce back" from personal difficulties or obstacles, and even to grow and strengthen as a consequence of successful adaptation (Luthans et al., 2006).

Resilience can be either proactive or reactive, so that resilience can be said to be resistance and at the same time a response to psychological tension associated with negative experiences (Tugade & Fredickson, 2004). Resilience requires a constant effort by individuals to be able to move forward in a positive way and to cope with psychosocial risk factors as they emerge (Southwick et al., 2014). In this way, resilience is a dynamic process involving ongoing change and adaptation, but is it also somewhat context specific, as individuals can be very resilient in one area, but not in another (Luthar et al., 2000; for review, see Vella & Pai, 2019). Therefore, progressive action after managing problems in reporting

administrative research reports and capacity to "bounce back" with a positive attitude after facing challenge in research are needed.

Resilience in the career area, or career resilience, is defined as "effective vocational functioning under disabling circumstances" (Rochat et al., 2017, p. 5), and includes the capacity to adjust and adapt to the changes required for career construction (Lengelle et al., 2017). Mishra and McDonald (2017) defined career resilience as a developmental process of persisting, adapting, and/or flourishing in one's career despite challenges, changing events, and disruptions over time. More specifically, and by extension, research resilience can be considered to be "the ability to adapt and continue" with the research endeavour in the face of setbacks (Rahman et al., 2021; p. 3). Thus, developing a research resilience measure needs a clear understanding of the research resilience sub-domains, contextual realities, and individual characteristics (e.g., the capacity to change and adapt and manage emotions) in order construct a measure that differentiates among academics as to their resilience in the academic context.

Windle et al. (2011) reviewed 15 measures of general resilience and found no "gold standard" (p. 1) among them. London (1993) proposed that career motivation consisted of three characteristics, career resilience, identity, and insight'', and that these three components could be evaluated using an assessment centre approach (Bray, 1982). Noe et al. (1990) developed a 26-item measure of motivation to assess London's (1993) three factors, with subscales for career resilience (13 items), career insight (8 items), and career identity (5 items). A sample item from the resilience subscale is "I believe other people when they tell me that I have done a good job." Carson and Bedeian (1994) devised a 12-item Career Commitment Measure with three subscales of career resilience, identity, and planning (4 items each subscale). A sample item from this resilience subscale is, "Given the problems in this line of work/career field, I sometimes wonder if the personal burden is worth it." Last, Fourie and Van Vuuren (1998) constructed a 60-item Career Resilience Questionnaire (CRQ) for use with adult workers, with subscales of belief in oneself, disregard for traditional sources of career success, self-reliance, and receptivity to change. A sample item is, "[I am] capable of taking independent action and work without assistance from colleagues." Higher scorers demonstrated that they were more flexible, adaptable, and competent when facing difficult situations. However, De Bruin and Clew (2000) tested the constrict validity of the CRQ and failed to replicate Fourie and Van Vuuren's (1998) factor structure.

To the best of the authors' knowledge, no research resilience scale suitable for use with academics has been published in the peer-reviewed literature. We addressed this gap by designing a brief, multidimensional, and psychometrically sound instrument that could be applicable to universities and other research institutions regardless of specific discipline. Having a scale to measure research resilience would assist researchers to explore ways to assist academics to improve their research productivity while at the same time protect themselves from the negative outcomes of the strain associated with research activities, such as burnout, career stagnation, and job loss/leaving.

Present study

We followed classic scale development procedures (cf. DeVellis, 2016) to devise and initially validate a scale to assess research resilience in academics. Measurement is the assignment of scores to individuals, so that the scores reflect characteristics of the individuals (Hinkin, 1995). First, focus group discussions with academics confirmed the domains identified in a literature review that should be incorporated in the scale. We then used feedback from five experts to review and rate the items, to add content validity support. Last, we conducted item and exploratory factor analyses on one data sample to reduce the initial list of items to 15 and determine the underlying structure, and then ran confirmatory factor analyses on a second sample to confirm the factor structure. Reliability and initial validity of the final measure also were assessed. Convergent validity was examined by associating the newly-developed scale with measures of general resilience, intrinsic research motivation, and career satisfaction. Predictive validity was not assessed as we have a cross-sectional design.

We involved Indonesian academics to develop the Research Resilience Scale. All participants were academics with research components in their profile. In Indonesia, to reach each level, there is a key research requirement (as well as other requirements related to teaching and community service). To achieve lecturer level, the basic requirement of at least one published article in a national journal (as the first author) is required, to achieve assistant professor level, at least one article in an accredited national journal (as the first author) is required, to achieve associate professor level, at least one article in an accredited national or international journal (as the first author) is required, and to achieve the professor level, at least one article in a highly reputable international journal (as the first author) is needed. Thus, at every step, there are research requirements. The higher the level, the more research output required as well as the quality of the key scientific articles.

Phase 1: item development

The aim of this phase was to generate a broad pool of items, approximately twice the number as desired for a final scale of fewer than 20 items (i.e., sufficient to ensure construct coverage and be suitable for research; Hinkin, 1998). Generating more items than needed allows for poorer functioning items identified in the evaluation to be discarded (Hinkin, 1998; Kline, 2013). Following Vogt et al.'s (2004) recommendations, we reviewed the relevant literature (e.g., Chan et al., 2021; Heffernan, 2021; Heron et al., 2021), refined the definition of the main construct, and conducted three online focus groups with individuals from the target population ($N = 24$, 68% female; aged 31–57 years; 25% professors; 33.33% associate professors; 25% assistant professors; 16.67 lecturers) to enhance item content validity and to validate the underlying domains of the construct. Focus group participants which were asked to share their own research experiences, what made them frustrated about research, their feelings when they faced challenges, their strategies to cope with research problem, and their thoughts about research after managing difficulties. All focus group discussions were recorded for later analysis and reference.

From the literature review and focus groups, we identified three domains of resilience, First, the capacity to bounce back and take progressive action after managing the administrative aspects of research. Administrative aspects of research were mentioned by 95% of the focus group participants as a big issue for them to tackle and this leaves them with only 40% of their capacity to become productive. Second, capacity to cope and bounce back by collaborating and learning from others. It is important for Indonesian academic to see what other academics do, to have a strong reason not to surrender while facing difficulties when conducting research. Finally, capacity to bounce back with a positive attitude after facing the challenge of research. Difficult situation often makes academics not anymore enthusiastic with their research activity, and this situation determines whether one's will show research persistence. After these stages, we developed 14 items for each domain.

All of the 42 positively worded items (i.e., positively worded to reduce response bias; Salazar, 2015) were written in English to reflect the three identified domains. All items were then shown to five independent reviewers with expertise in research and scale development to evaluate whether the items reflected a particular domain of the construct and to comment on item clarity, phrasing, and readability. Based on feedback from these experts, some item wording was adjusted, and six items were deleted as they were considered overlapping, leaving 36 items.

We then used a standard forward and backward translation procedure (Beaton et al., 2000) to convert the 36 items into the Indonesian language. The first author (Indonesian national who also is fluent in English) translated the items into Bahasa Indonesian, and the items were then back-translated blindly into English by two independent bilingual colleagues without seeing the original English version. The back-translated version was compared with the original English version by the first and fourth authors for precision of meaning, and then modified when needed. Last, the final set of items was piloted with three Indonesian academics to assess the readability of the instructions, items, and response format; at this stage, no further items were revised or deleted.

Phase 2: item analysis and exploratory factor analysis

The objective of this phase was to identify items to be retained in the scale using item analysis and exploratory factor analysis (EFA). We followed Gorsuch's (1983) recommendation to have a ratio of five participants for each variable included in the EFA.

Method

Participants

Participants were 422 Indonesian academics (54% female), whose mean age was 49.06 years ($SD = 9.70$). Most (68.7%) had doctorate-level training and 31.3% held a masters' degree. Approximately half (51.6%) were assistant professors, 30.1%

associate professors, and 18.2% full professors. The mean tenure was 21.4 years ($SD = 10.32$), with the vast majority (87.7%) working in government funded universities, with the remainder (12.3%) employed by private institutions. Reported disciplines were psychology (13%), engineering (12.1%), medicine (12.6%), science and mathematics (4.3%), public health (5.0%), pharmacy (3.1%), social and political sciences (5.9%), economics and business (10.7%), fisheries and marine sciences (6.9%), veterinary and agriculture (5.7%), cultural sciences (8.1%), law (4.0%), dentistry (0.7%), and literature and philosophy (0.2%); 7.7% did not report their discipline. Most participants (92.2%) were married.

We divided the data set of 422 academics into two subsamples using the SPSS random split technique. One of these subsamples (Sample A: $N = 212$; 51.4% female; mean age 48.93 years, $SD = 9.45$) was used for the item analysis and EFA (Phase 2), and the second one, the hold-out sample (Sample B: $N = 210$; 56.7% female; mean age 49.20 years, $SD = 9.98$), was used for a confirmatory factor analysis (CFA) to determine how well the original structure could be generalised to a second group (Phase 3). This step guards against sample-specific bias and threats to reliability and validity when scale development is based on one sample only (Byrne, 2016). van Prooijen and van der Kloot (2001) underlined the importance of using the same samples for EFA and CFA analyses. How well the original model can be generalised can be examines by using a cross-validation sample. If a model can be generalised, then the same set of questions should be able to examine the same constructs in other samples. Chi-square and t-test analyses demonstrated no differences between the two samples on any of the demographic variables (age, $p = 0.78$; gender, $p = 0.28$; educational level, $p = 0.06$; work status, $p = 0.97$; functional position, $p = 0.63$; marital status, $p = 0.57$), suggesting that the random split was free from bias based on these variables.

Materials

The 36 resilience scale items generated in Phase 1 were administered along with three scales that were used to assess initial validity. These were the Brief Resilience Scale (Smith et al., 2008), the Intrinsic Research Motivation Subscale (Deemer et al., 2010), and the Career Satisfaction Scale (Greenhaus et al., 1990; Hofmans et al., 2008). As the Brief Resilience Scale assesses the level of general resilience, we expected this scale to be associated positively with the Research Resilience Scale because of content overlap. Resilience also has been found to be related positively to both intrinsic motivation (e.g., León-Guereño et al., 2020; Siu et al., 2014) and career satisfaction (Srivastava & Madan, 2020); thus, we expected that research resilience to be associated with these two constructs, supporting construct validity, as they form part of the resilience nomological net.

Research resilience

The 36 items generated in Phase 1 that reflected the three domains of capacity to bounce back and take progressive action after managing administrative activities,

by collaborating and learning from others, and maintaining a positive attitude in the face of research challenges. Example items were, "I get my motivation back quickly after experiencing hurdles preparing administrative research reports" (administration), "I collaborate with competent researchers to help me bounce back from problems writing good-quality research proposals" (collaborating and learning from others), and "It doesn't take me long to get my research enthusiasm back after facing difficulties collecting and analysing research data" (remaining positive). Participants were asked to respond to each item using a Likert-type format, with options that ranged from 1 (*strongly disagree*) to 6 (*strongly agree*). Higher scores indicate higher levels of research resilience.

General resilience

We used the 6-item Brief Resilience Scale (Smith et al., 2008), which measures the individual's capacity to bounce back after facing challenges generally (e.g., "I tend to bounce back quickly after hard times; 6-point scale of 1 = *strongly disagree* to 6 = *strongly agree*). Higher scores reflect higher levels of global resilience. Internal consistency has been good in previous studies ($\alpha \geq 0.80$), and, for validity, the scale was found to be correlated positively with physical and mental wellbeing and negatively with somatization, depression, and anxiety (Furstova et al., 2021).

Intrinsic research motivation

This was assessed using the 9-item Intrinsic Research Motivation Subscale from the 21-item Research Motivation Scale (Deemer et al., 2010). The scale taps levels of intrinsic motivation for conducting research activities (e.g., "Conducting research provides me with feelings of satisfaction", and "I enjoy doing research for its own sake"; 6-point scale of 1 = *strongly disagree* to 6 = *strongly agree*). Higher scores reflect more intrinsic motivation. Previous research has reported high internal reliability ($\alpha = 0.90$) and provided support for validity by finding positive associations with research self-efficacy and outcome expectations (Sawitri & Creed, 2021).

Career satisfaction

The 5-item Career Satisfaction Scale (Greenhaus et al., 1990; Hofmans et al., 2008) was used to measure participants' satisfaction with the progress being made towards meeting career-related goals (e.g., development, overall career goals). Participants responded to items such as, "I am satisfied with the success I have achieved in my career," on a 6-point scale (1 = *strongly disagree* to 6 = *strongly agree*; higher scores equate to greater satisfaction). Internal consistency of 0.90 has been reported and validity supported by finding positive associations with measure of career adaptability (McKenna et al., 2016).

Procedure

The study was conducted with approval from the authors' university ethics committee. Participants were contacted via emails and messages sent key persons at the participating universities. From this email and message, academics could be taken to a website that contained study details and the online survey (i.e., demographic questions and study scales). Participation was voluntary and anonymous. For participating, the academics could opt to enter a prize draw for a voucher valued at 250,000 Rupiah (approx. A\$20).

Results

Item analysis (Sample A)

To identify poorer functioning items, we examined item skew and kurtosis, inter-item correlations (items $r \geq 0.80$ marked for deletion), and item-total correlations ($r < 0.30$), and then assessed if participants responded differently to any items according to age, gender, work status, and functional position (Kline, 2013). No items were identified as problematic; therefore, none was removed at this stage.

Exploratory factor analysis (Sample A)

The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy (0.94) and Bartlett's test of sphericity ($p < 0.001$) indicated that the 36 items in Sample A were suitable for factor analysis. We used common factor analysis (i.e., principal-axis factoring), as the common variance is of interest in determining the underlying factor structure of a scale (Hair et al., 2010). As the three anticipated factors were expected to be correlated domains of an overall academic resilience construct, we utilised a direct oblimin rotation (Hair et al., 2010). Decision rules to determine the number of factors to be retained were eigenvalues > 1, Velicer's MAP test, parallel analysis (O'Connor, 2000), a minimum of three items per factor (Costello & Osborne, 2005), and interpretability of factors (Hinkin, 1998).

The first EFA generated three factors with eigenvalues > 1, accounted for 62.95% of the variance, and was consistent with Velicer's MAP test and parallel analysis. The three factors were interpretable theoretically and consistent with what we expected; thus, a 3-factor solution was accepted. Subsequently, eleven items were removed: two items cross-loaded and nine did not load highly enough (i.e., ≥ 0.4) or were deleted to give equal number of items to each factor (Hinkin, 1998). The final 15 items accounted for 74.69% of the variance. Factor 1 (50.88% of variance; 5 items), labelled "dealing with administrative aspects", captured the capacity to bounce back and take progressive action after managing research administration ($\alpha = 0.92$, $M = 22.73$, $SD = 4.35$). Factor 2 (13.48%; 5 items), labelled "collaborating and learning from others", measured capacity to cope and bounce back by drawing

on others ($\alpha = 0.89$, $M = 24.04$, $SD = 4.07$). Last, Factor 3 (9.33%; 5 items), labelled "remaining positive in face of challenges", reflected a capacity to bounce back from research challenges with a positive attitude ($\alpha = 0.92$, $M = 23.35$, $SD = 4.37$). The associations among the three factors (0.44, 0.65, and 0.50; all $p < 0.001$) indicated that the subscales were somewhat independent, but with overlap among them. Full scale alpha was 0.93, and alphas for the three factors were 0.88, 0.88, and 0.88, respectively. See Table 1 for factor loadings and eigenvalues.

Phase 3: Confirmatory factor analyses (Sample B)

The objective of this phase was to confirm the factor structure of the Research Resilience Scale using Sample B. By means of a CFA (AMOS Version 4.0; Arbuckle & Wothke, 1995), we tested the 3-factor structure identified in Phase 2 (i.e., administrative matters, learn from others, and positivity), and then compared this model with 1-factor and 2nd-order factor (Reise et al., 2013; van Prooijen & van der Kloot, 2001). Model fit was examined using χ^2, the normed χ^2 (χ^2/df), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). A significant χ^2, χ^2/df < 3.0, CFI and TLI values ≥ 0.95, and RMSEA ≤ 0.08 indicate a satisfactory fit when cases are < 250 and observed variables range between 12 and 30 (Hair et al., 2010). Differences among the models were assessed using the Akaike Information Criterion (AIC), which is recommended for non-embedded models, where the lower value indicates a better fit (Hair et al., 2010).

The 3-factor model demonstrated good fit statistics (see Table 2). All factor loadings were significant ($p < 0.001$) and ranged from 0.78 to 0.97 (administrative matters), 0.59 to 0.89 (learn from others), and 0.61 to 0.87 (positivity). Correlations among the latent variables ranged from 0.28 to 0.74.

Phase 4: construct validity (Sample B)

The aim of this phase was to evaluate initial construct validity of the scale by testing associations between the newly devised Research Resilience Scale with scores from measures of resilience, intrinsic research motivation, and career satisfaction. We expected research resilience to be associated positively with resilience, intrinsic research motivation, career satisfaction, and also with Scopus H-Index. These analyses were conducted on Sample B ($N = 210$). All correlations were significant and in the expected directions, as reported in Table 3. These results indicated that the Research Resilience Scale, both total and subscale scores, were related to the three other constructs and an indicator of objective research-related success (i.e., Scopus H-Index) as expected, providing support for construct validity.

We also conducted four hierarchical regression analysis to determine if the Research Resilience Scale predicted intrinsic research motivation and career satisfaction over and above general resilience. General resilience accounted for 12.3% ($p < 0.001$) of the variance in intrinsic motivation and 1% ($p > 0.05$) in career satisfaction. The Research Resilience Scale total explained an additional 29%

Table 1 Items and factor loadings for Research Resilience Scale (Sample A; N = 212)

Items	F1	F2	F3
1.1.1. I get my motivation back quickly after experiencing hurdles preparing administrative research reports	**.91**	−.04	−.02
2.2.2. I do not easily give up, even after struggling to prepare administrative research reports	**.87**	−.13	−.03
3.3.3. It is easy for me to remain positive about research after dealing with problems associated with preparing administrative research reports	**.83**	.10	.08
4.4.4. I tend to get my research interest back quickly after handling problems preparing administrative research reports	**.76**	−.02	−.14
5.5.5. I apply strategies to bounce back from the hurdles of preparing administrative research reports	**.72**	.14	.03
6.6.6. I collaborate with competent researchers to help me bounce back from problems writing good-quality research proposals	−.07	**.91**	.03
7.7.7. I work with experienced colleagues to help me bounce back after the pressure of pursuing a competitive research grant	.03	**.89**	.10
8.8.8. The way other researchers use innovative strategies teaches me how to bounce back after facing hurdles during data collection and analysis	.02	**.75**	−.07
9.9.9. I see other researchers handle problems and this gives me ideas for how to bounce back after facing a variety of research problems	.13	**.57**	−.16
10.10.10. I collaborate with competent colleagues to support me bounce back from the difficulties of producing scientific publications	.07	**.57**	−.19
11.11.11. It doesn't take me long to get my research enthusiasm back after facing difficulties collecting and analysing research data	.02	−.08	**−.89**
12.12.12. I tend to get my motivation back quickly after confronting difficulties during my research activities	.04	−.03	**−.86**
13.13.13. It doesn't take long to get my positive mood back after facing the difficulties of the scientific publication review process	−.04	.05	**−.83**
14.14.14. It doesn't take me long to get my research interest back after experiencing difficulties developing a research proposal	.03	.09	**−.77**
15.15.15. I retain my research goals easily, even after facing the difficulties of preparing a research manuscript	.02	.08	**−.76**
Eigenvalues	7.78	2.02	1.40
% variance explained	51.88	13.48	9.33

Main loadings highlighted in bold

Table 2 Model fit indices for 3-factor, 1-factor, and 2nd-order factor models (Sample B; N=210)

Model	χ^2	df	χ^2/df	CFI	TLI	RMSEA	AIC
3-Factor	180.06***	85	2.12	.96	.95	.07	250.06
1-Factor	698.28***	88	7.94	.74	.69	.18	762.28
2nd-Order	180.06***	85	2.12	.96	.95	.07	250.06

***$p<.001$

(total=41.4%; $p<0.001$) and 11.1% (11.0%; $p<0.001$), respectively. The three subscales of the Research Resilience Scale together explained an additional 37.4% (48.7%; $p<0.001$) and 11.5% (11.7%; $p<0.001$), respectively. These analyses indicated that the Research Resilience Scale (both global score and subscales) explained additional variance in intrinsic research motivation and career satisfaction over general resilience, suggesting that a resilience scale targeted specifically at research is a better predictor of research related outcomes than a general resilience scale. See Table 4.

Last, we examined the correlations between the Career Resilience Scale and the biographic variables collected. We found no association between the total score and age, gender, work level, or tenure, suggesting participants from these different groupings did not respond differently to the scale. We did find significant positive associations with education level, indicating that those with a higher education level were more likely to have greater research resilience. This could be expected as higher education qualifications suggest more interest in research and better research skills, which should lead to more experience with research.

Discussion

We developed and presented initial evidence of validity for a psychometrically sound, 15-item scale to measure research resilience in academics. We operationalized research resilience as individuals' capacity to "bounce back" from difficult experiences related to research engagement, such as when meeting administrative requirements (e.g., reporting), developing a research proposal and pursuing research funds, conducting research, and preparing scientific publications, while at the same time retaining a positive attitude, maintaining positive emotions, and taking constructive action.

The new Research Resilience Scale has three moderately inter-correlated subdomains of "bounce back and take progressive action after managing administrative reports", "bounce back and cope with research problems by collaborating and learning from others", and "bounce back with a positive attitude after facing challenges in research". Importantly, the scale can be interpreted at the full-scale and/or subscale levels. Analyses at the sub-scale level will allow finer-grain interpretations of resilience to be made.

Content validity for the scale was supported by a review of the literature and the use of focus groups, pilot testing, and expert ratings. Construct validity was supported by

Table 3 Summary data and bivariate correlations with validity scales and research and career-related success indicator (Sample B; *N*=210)

Scale	M	SD	Range	α	2	3	4	5	6	7	8
1. Full scale	69.67	10.04	30–90	.92	.86***	.71***	.87***	.52***	.40***	.34***	.22**
2. Subscale 1 (administrative matters)	22.60	4.66	5–30	.94	–	.33***	.70***	.46***	.42***	.23**	.24**
3. Subscale 2 (learning from others)	23.66	3.93	5–30	.86		–	.44***	.22**	.54***	.29**	.000
4. Subscale 3 (positivity)	23.41	3.75	5–30	.88			–	.60***	.64***	.31***	.29**
5. General resilience	26.60	4.67	16–36	.81				–	.35***	.12**	.18**
6. Intrinsic research motivation	47.00	5.81	16–54	.95					–	.32***	.26**
7. Career satisfaction	22.53	4.58	5–30	.92						–	.08
8. Scopus H-index	2.19	3.08	0–14	–							–

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

Table 4 Hierarchical regression analyses predicting intrinsic motivation and career satisfaction (Sample B)

Predictor variables	Intrinsic Motivation						Career Satisfaction					
	Model 1			Model 2			Model 3			Model 4		
	β	SE	t	β	SE	t	β	SE	t	β	SE	t
Step 1												
General resilience	.35	.08	5.41***	.35	.08	5.41***	.12	.07	1.75 ns	.12	.07	1.75 ns
Step 2												
General resilience	.02	.08	0.26 ns	−.03	.08	− 0.52 ns	−.08	.08	− 1.06 ns	−.09	.08	− 1.14 ns
Research Resilience Scale (RRS)	.37	.04	10.12***	–	–	–	.38	.04	4.96***	–	–	–
RRS Subscale 1	–	–	–	−.08	.09	− 1.12 ns	–	–	–	.03	.09	0.36 ns
RRS Subscale 2	–	–	–	.31	.08	5.67***	–	–	–	.19	.08	2.62**
RRS Subscale 3	–	–	–	.58	.13	7.18***	–	–	–	.26	.13	2.43**

$**p<.01, ***p<.001$; ns not significant

conducting a series of EFAs and validating the outcomes with CFAs using two samples of tertiary-level academics. Associations with the Brief Resilience Scale, Intrinsic Research Motivation Scale, and Career Satisfaction Scale supported convergent construct validity and demonstrated that those with higher research resilience were more likely to demonstrate greater general resilience, intrinsic research motivation, and career satisfaction. We also confirmed that the Research Resilience Scale explained greater variance in career satisfaction and motivation than a brief measure of general resilience.

The Research Resilience Scale is a comprehensive measure of research resilience, which assesses multiple aspects of the research resilience construct. At 15 items, the scale will be practical and convenient to use when a short measure of research resilience is needed for research. Studies into research resilience of academics using this scale has the potential to add to our understanding of how academics manage setbacks faced when undertaking research. Investigators can confidently design research studies that require a measure of academic resilience to extend our current understanding of the nature of research resilience, its antecedents, consequences, and how and why it might change over time. The Research Resilience Scale has the potential to provide a boost for research in this area, which has been hindered to date by the lack of an adequate measure.

While not validated as a counselling tool, the Research Resilience Scale would also be a useful starting point for discussion with academics who are struggling with their research or having difficulty coping with research setbacks. Practitioners can work with young researchers to optimize their involvement in research-related activities, use the scale as a screening tool for newly-commencing academics, or employ it in program evaluation when delivering courses for academics.

Study limitations

In the scale development process, while drawing on academics from multiple tertiary institutions, we included participants from one country only. Therefore, generalization to other groups of academics needs to be examined by assessing the psychometric properties of the scale in different settings. Academics from more individualist countries than our sample, might, for example, place less emphasis on collaborating and learning from others and give greater priority to drawing on individual resources to remain positive. [18]

As we did not test the predictive validity of the scale, future researchers need to investigate the longitudinal associations between scores on the scale at one point in time and later outcomes and assess the measurement invariance. We showed that the scale was unrelated to several demographic variables (e.g., age, gender, functional position), suggesting no inherent bias based on these characteristics; however, future studies need to assess structural invariance on these variables to confirm the results.

Conclusion

In conclusion, this study yielded support for an instrument to measure research resilience in academics, which should provide a stimulus for research in this area. Additional studies are needed to continue generating support for validity, extend its nomological net, investigate the predictive usefulness of the scale, and test the measure in other situations to extend its generalisability.

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