



The development and validation of an Army team resilience measure

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ABSTRACT

Given the demanding nature of its mission, the collective units of the Army, not just individual Soldiers, need to be able to withstand and adapt to a wide range of challenges. Therefore, it is important to be able to effectively assess resilience at the team-level and to understand the factors that can enable or diminish it. This article describes the development of a construct valid and psychometrically-sound measure of team resilience – the Team Resilience Scale (TRS). A theoretical framework of team resilience and related constructs is introduced. We then summarize the procedures for developing the TRS and related constructs, providing evidence of the content validity of the TRS. Finally, we assess the psychometric soundness and construct validity of the TRS in two Army field studies. Our analyses support the convergent validity of items and indicate that the measure can be used to examine three first-order dimensions of resilience (i.e., physical, affective, and cognitive) or as a single overall resilience composite. Results show the TRS was positively related to team performance in both samples and it co-varied with stressors and team actions. Practical recommendations for use of the measure and suggestions for future research are offered.

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What is the public significance of this article?—Army teams must be resilient to withstand and adapt to a range of challenges. This research develops and validates a Team Resilience Scale (TRS) that can be used to better understand team effectiveness and can serve as a practical diagnostic tool for assessing teams' capacity to handle and bounce back from challenges and stresses.

Introduction


“In this environment, there can be no complacency—we must make difficult choices and prioritize what is most important to field a lethal, resilient, and rapidly adapting Joint Force.” – 2018 National Defense Strategy Summary. (p. 1)

Teams are essential building blocks of organizations across industries around the world (Global Human Capital Trends, 2016). But any organization that relies heavily on teams can only succeed if their teams have the capacity to withstand and work through inevitable challenges. Challenges and stressors come in many forms, all of which can threaten team processes and performance. Teams, and not just individuals, must be able to withstand and adapt to these challenges; they must be resilient.

A team is “a distinguishable set of two or more people who interact, dynamically, interdependently, and adaptively toward a common and valued goal/objective/mission” (Salas et al., 1992, p. 4). Team effectiveness is essential for organizational success, and this is particularly true in the United States Army where groups of Soldiers are assigned together into “small units” such as platoons, squads, and teams, which we will refer to collectively as teams. This amounts to tens of thousands of teams representing both the operational and institutional Army. They perform a myriad of functions, with most training and deployment activities performed by teams.

Team scholars recognize that team resilience is a key component to team effectiveness (Tannenbaum & Salas, 2021). Teams that are resilient are thought to be able to withstand and recover from challenges, pressure, and stressors. Teams that are less resilient, or brittle, are less successful at bouncing back from and overcoming setbacks (Alliger et al., 2015; Meneghel et al., 2016; Stoverink et al., 2020). Team resilience is important for teams in safety-critical environments (e.g., deployed military teams, crisis response) as well as those that perform in settings without physical safety risks (e.g., sales teams, executive teams; Raetze et al., 2021).

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Given the demanding nature of its mission, Army leaders have long had an interest in understanding, assessing, and influencing team resilience (Cato et al., 2018). They know that the Army teams of today and tomorrow encounter a wide range of stressors including isolation, ambiguity, boredom, and danger (Bartone, 2006; Bartone et al., 1998), as well as challenging deployment rates, locations, assignments, and workloads (Adler et al., 2003, March; Keats, 2010; MacGregor et al., 2012; Tucker et al., 2009). Given this, it is not surprising that surveys often find military careers to be among the most stressful (e.g., CareerCast.com, 2019). These stressors are related to symptoms of depression, anxiety, PTSD (e.g., Hoge et al., 2004) and suicide (e.g., Suitt, 2021), and have a negative impact on the retention of military personnel. According to Harms et al. (2013), “upwards of 42% of active-duty Soldiers report an intent to leave the U.S. Army after their current obligation ends” (p. 104).

The military has developed resilience programs to help service members and families deal with stressors. And while they acknowledge the importance of unit level factors (e.g., positive command climate, teamwork, unit cohesion), most programs have focused on individual resilience (Meredith et al., 2011). Similarly, research on resilience has primarily been conducted at the individual level (e.g., Cornum et al., 2011; Raetze et al., 2021), examining how stressors tax individual Soldier’s resilience. For example, Schaubroeck et al. (2011) studied Army Soldiers who served in combat units in Iraq and posited that a higher-order psychological trait, Psychological Capital, could somewhat insulate individuals from negative reactions (i.e., anxiety, somatic complaints, and depression) to traumatic circumstances. Schaubroeck et al. (2011) found general support for this, but also found that the number and severity of unit-level traumatic events moderated such individual level relationships. In other words, unit resilience was not simply an aggregation of individual Soldiers’ resilience but rather a team-level phenomenon (Alliger et al., 2015). A team comprised of highly resilient individuals may still suffer communication breakdowns, inconsistent situation awareness, coordination breakdowns, and low morale in part because of degraded *team resilience*. As detailed by Stoverink et al. (2020), the structural differences between individuals and teams (e.g., degree of task interdependence, decision making processes) create a need to examine resilience at the individual and team levels separately.

Team scholars have begun to theorize about team resilience (e.g., Alliger et al., 2015; Stoverink et al., 2020) but research focusing on team resilience is in its infancy in comparison to work examining individual resilience (Cacioppo et al., 2011; Gucciardi et al., 2018;

Raetze et al., 2021). There is relatively little research that examines team resilience theory and related factors. This is due, at least in part, to the absence of a valid measure of team resilience, leading researchers to call for the development of a such a measure (Stoverink et al., 2020).

Given the ubiquity of teams in the Army and the importance of team resilience, the Army could benefit from having a theoretically grounded, practical, military-relevant, validated measure of team resilience for research purposes and as a diagnostic in the field. A useful measure of team resilience would be content valid, demonstrate internal consistency, aggregate to the team level, show appropriate convergent/discriminant validity, be perceived as relevant by military subject matter experts (SMEs), and co-vary as expected with related variables.

To build and test such a measure, we first clarify what is meant by team resilience and differentiate it from related constructs – establishing a nomological network. We then draft and content validate a team resilience measure, the Team Resilience Scale (TRS), and test it in two Army field studies.

Conceptualization of team resilience and related constructs: The nomological network

Team resilience

Historically, a lack of conceptual clarity about team resilience led to a proliferation of different definitions and construct confusion (Hartwig et al., 2020). There is the need to distinguish it from related, but different, constructs. As noted by Stoverink et al. (2020), a compelling theory for understanding team resilience is Conservation of Resources (COR; Halbesleben et al., 2014; Hobfoll, 1989; Hobfoll et al., 2018). According to COR theory, entities are motivated to protect their current resources (conservation) and to acquire new resources (acquisition). COR theory generally defines resources as objects, states, conditions, and other factors that people value (Halbesleben et al., 2014). Team resilience can be conceived of metaphorically as a reservoir of resources that defines a team’s capacity to handle stressors. Some team resilience reservoirs may be larger than others, some may drain more quickly than others, and some may replenish faster than others, but no team has an unlimited capacity. The volume of the reservoir represents the amount of resources that a team can direct toward handling stressors to maintain performance. According to COR theory, the possession and lack of resources are fundamental to resilience and vulnerability (Hobfoll et al., 2018). Those with greater resources are less vulnerable to stressors and loss of resources and more likely to gain even more resources. COR theory also proposes that resource losses as well as

resource gains can spiral, with losses thought to be more powerful than gains. A loss of resources heightens stress, which depletes even more resources. In the face of each challenge this can spiral further as there are fewer and fewer resources to offset the loss.

Although COR theory has primarily been used to explain individual behavior, team scholars have extended it to teams through its integration with Westman's (2001) crossover model (Hobfoll et al., 2018; Stoverink et al., 2020). Crossover refers to inter-individual transmission of psychological states, negative or positive, and acts as one of the ways resources are exchanged. According to Hobfoll et al. (2018), "this mechanism of resource exchange at the team or organizational level may be fundamental to creating and sustaining engaged and resilient teams and organizations, and organizations would be wise to develop interventions to increase resource exchanges" (p. 111).

As COR theory focuses on an entity's capacity, it aligns well with a definition of team resilience introduced by Alliger et al. (2015): "the capacity of a team to withstand and overcome stressors in a manner that enables sustained performance; it helps teams handle and bounce back from challenges that can endanger their cohesiveness and performance" (p. 177). Resilience helps a team respond to challenges that can endanger their cohesiveness and performance. The concept of resilience as a team-level (resource) capacity to respond and bounce back is the most prevalent conceptualization in the research literature (Altman-Dautoff, 2001; Brykman & King, 2021; Hartwig et al., 2020; Sutcliffe & Vogus, 2003; West et al., 2009).

Another key component of team resilience found in many definitions refers to the team's *collective confidence* or efficacy style belief. For example, Carmeli et al., (2013) defined resilience in terms of "a team's belief that it can absorb and cope with strain, as well as a team's capacity to cope, recover and adjust positively to difficulties" (p. 149). Others have advanced similar definitions of resilience that include competency beliefs (e.g., Meneghel et al., 2016; Morgan et al., 2013). We believe that team resilience incorporates both the capacity and collective confidence dimensions of resilience, and consistent with Bowers et al. (2017) we consider team resilience as an emergent state. Marks et al. (2001) defined emergent states as "constructs that characterize properties of the team that are typically dynamic in nature and vary as a function of team context, inputs, processes, and outcomes. Importantly, emergent states describe cognitive, motivational, and affective states of teams, as opposed to the nature of their member interaction" (p. 357). Team resilience is a collective function of members' current capacities of, and confidence in,

their cognitive, affective, and physical states. As an emergent state, team resilience fluctuates dynamically over time. Drawing from COR and the aforementioned team literature, we define team resilience as *team members' collective confidence and capacity (cognitive, affective, and physical) to withstand and overcome stressors in a manner that enables sustained performance*.

Team resilience is also a latent construct. Latent constructs give rise to behaviors – or indicators – but latent constructs are not themselves directly observable. In other words, *team resilience levels give rise to behavioral manifestations when the team is under stress*. Underlying latent team resilience, while unobservable, can be estimated by members of the team.

Related constructs

The construct of team resilience has often been conflated with factors that build or drain resilience and outcomes that stem from it (cf., Sharma & Sharma, 2016). Resilience levels may enable a team to adapt to challenging circumstances and maintain performance under pressure. However, adaptation and performance changes are not themselves resilience – they are manifestations or outcomes of resilience. Similarly, stressors may drain resilience or evoke the need to take actions to sustain resilience, but stressors are not resilience. Although underlying resilience as we define it may enable manifestations in the form of adaptability under stress, and adaptability may serve to build future resilience capacities – they are separate and distinct constructs. However, there is value in measuring those related constructs, as that allows us to examine whether our measure of team resilience covaries with them in predictable ways.

Figure 1 depicts our team resilience framework or nomological network of relations, surrounding team resilience. Team resilience is a multi-dimensional latent construct comprised of members' confidence and current capacity levels (i.e., cognitive, affective, and physical) which give rise to behavioral resilience manifestations when teams are stressed. Also depicted and described below are several related constructs we measure in this study: stressors, and three team actions and preparations that a team can engage in – minimizing actions, mending efforts, and resilience manifestations.

Stressors are challenges that can drain a team's resilience, and in Army contexts can include for example, time pressures, staffing or skill shortages, physical demands, lack of sleep, and hazardous conditions. As stressors can drain a team's resilience, we anticipate that they will be negatively related to team resilience.

Resilience manifestations are behaviors and actions that a team evokes while under stress in order to maintain health and performance. Manifestations may

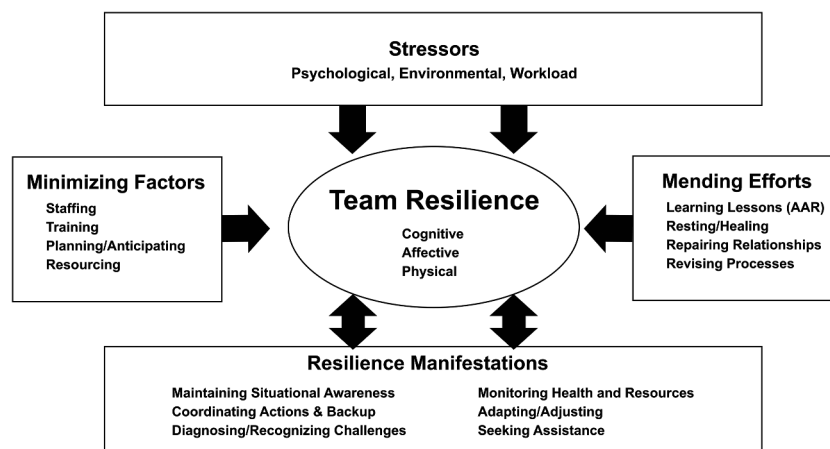


Figure 1. The Team Resilience Framework.

include maintaining situational awareness, monitoring members' health and team resources, providing backup, and adapting. We would expect teams with greater underlying resilience to engage in more of these behaviors. Two other constructs represent enablers or antecedents of team resilience. *Minimizing factors* can help build and protect resilience levels and *mending efforts* can help promote recovery or refilling of the resilience reservoir. Both of these enablers are supported by COR theory, which focuses on two related phenomena: 1) primacy of resource loss – the notion that there is a greater premium on avoiding losses than there is on promoting gain; and 2) resource investment – individuals will invest resources in order to protect against and recover from losses, and to stockpile resources (Halbesleben et al., 2014; Hobfoll, 1989).

Examples of minimizing factors include adequate staffing, training, and resources; contingency planning; and strong working relationships. Examples of mending efforts include identifying lessons learned, addressing sleep deficits, repairing relationships, providing positive feedback, and revising procedures. We would expect that teams with stronger minimizing factors and mending efforts would report higher levels of team resilience. Finally, while not depicted in Figure 1, teams with greater resilience should be better able to navigate through challenges and in turn, *perform* more effectively.

Materials and methods

Development of measures

Following a review of the literature we conducted group interviews with 18 team members and 2 commanders from two Army recruiting teams. Conducted as exploratory interviews, which are intended to be broad and

precede more formal research efforts, the primary purpose of the interviews was to ground our measures in the context of Army team needs and realities and guide our subsequent research activities. The interviews uncovered information about the recruiting team mission and mission flow, team interdependency, stressors, indicators of resilience manifestations, and actions recruiting teams often take to minimize and mend the impact of stressors. A summary of interview methods and findings and the interview protocol are provided in supplements 1 and 2, respectively.

Based on the literature review and our interviews, we drafted an initial set of items to measure team resilience and the other related constructs. We then conducted an iterative review with seven Army SME's (e.g., Sergeant Major, Chief Warrant Officer, First Lieutenant, Captain, Major) to ensure item clarity and relevance. The SMEs included active and reserve Soldiers and scholars who were knowledgeable about Army team demands and needs. Most of the Army reviewers had deployed to Afghanistan or Iraq and three were experienced Observers/Controller Trainers. The revised measure was then reviewed by two members of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) as well as an Army National Guard Soldier. Based on their feedback, items were finalized for testing and validation purposes.

Measures

Team Resilience Scale (TRS)

The TRS examines a team's resource levels, covering three domains: 1) *Affective* includes team psychological states relating to feelings, attitudes, and emotions (e.g., mutual trust, motivation); 2) *Cognitive* consists of team states that concern members' thoughts or beliefs

regarding a specific factor (e.g., shared situational awareness, mental readiness); and 3) *Physical* states refer to members' somatic conditions (e.g., rest, physical fitness). We developed four items for each of the three domains, for a total of 12 items. Each item uses a 10-point scale, which asks members to indicate the team's current resource level for each of the resources (10 = Low – Totally spent, nothing in reserve; 50 = Medium – Somewhat depleted, but something in reserve; 100 = High – Fully ready with plenty in reserve). Respondents also completed a parallel measure that asked them to think about future challenges their team might face and assess how confident they are that they will have enough of each resource to handle them effectively. The results revealed no meaningful differences between the current and future scales and the scales were highly correlated (Study 1: $r = .90, p < .001$; Study 2: $r = .94, p < .001$) so we only report results based on the current scale.

Nomological network measures

To be able to test the relationship of the TRS with other key variables, we developed measures of other constructs in the nomological network. A final set of all measures is available in supplement 3. Note that the TRS uses a 10-point scale, and the remaining scales use 5-point scales. In all instances, higher values imply greater amounts of the variables.

Team actions and preparations

Based on Alliger et al. (2015), we drafted three sets of items that ask about team actions and preparations – minimizing, mending, and manifestations.

The minimizing factors

Refer to actions “taken before the arrival of a problem or at its earliest onset . . . [and] . . . involves anticipating and planning for challenges, avoiding some and reducing the impact of unavoidable ones (Alliger et al., 2015, p. 178).” Our scale contains six items that describe common actions that can be taken to prepare for or minimize the occurrence or impact of stressors, including for example, being adequately staffed and trained. Respondents rated the extent the team experienced each action.

Mending efforts

Involve “recovering from stress, learning from experience, and adapting as necessary. These are actions taken after a stressful event” (Alliger et al., 2015, p. 180). As

reflected in our framework, these include, for example: identifying lessons learned, resting/healing, providing positive feedback, revising procedures, and repairing relationships. Respondents rated how often their team exhibited each of ten behaviors when needed.

We conceptualized team resilience as a latent construct that cannot be directly observed but can be inferred on the basis of responses to indicators (i.e., items). Latent constructs may also give rise to certain behaviors. Accordingly, we developed a resilience manifestations scale that represents observable actions that more resilient teams are expected to exhibit under duress.

Resilience manifestations scale

This scale asks how often the team exhibited 11 different behaviors when needed including for example, maintaining situational awareness, maintaining emotional control, and adapting.

Stressors

Prior work has theorized how stressors/disruptions influence resilience (e.g., Maynard et al., 2015). We adopted Dietz et al.'s (2017) definition of “Teamwork stressors are stimuli, or conditions, that influence the team's capability to interact interdependently or capacity to achieve their goals” (p. 296). Based on the literature (e.g., Dietz et al., 2017; Griffith & Vaitkus, 1999) and SME input, we developed 15 items that assess the extent to which the team experienced three types of stressors: 1) psychological (e.g., uncertainty or doubt, emotional stressors, interpersonal conflicts or disagreements); 2) external (e.g., hazardous conditions, time pressures, loud noises, physical demands); and 3) workload (e.g., heavy workload, insufficient resources, staffing or skill shortages). These items were written to cover stressors that can be relevant to different types of Army teams (see supplement 4 for details).

Team performance

Team resilience is expected to be positively related to team performance, so we also assessed team performance in both studies. Team performance in the first study was measured with four items that asked team members, “during the last month, to what extent has your team accomplished its primary goals, performed important tasks to standards, performed efficiently, and performed well overall.” In the second study, we

measured performance using an archival recruiting yield, relative to each monthly station goal, allowing for comparable metrics across stations.

Content validation of Team Resilience Scale (TRS)

To ensure the TRS is relevant to and representative of the targeted team resilience construct, we assessed this measure's content validity following the general recommendations set out by McKenzie et al. (1999) and Rubio et al. (2003). We employed a methodology outlined by Anderson and Gerbing (1991) for assessing substantive (i.e., content) validity of items and collected subject matter experts' (SMEs) categorizations of the items. Specifically, 36 colleagues from 12 institutions (89% academic, 11% applied) who were well-versed in the team literature and applications provided input. The sample was 72% women and ranged in age from 22 to 49 (mean = 30.83, SD = 6.65). Their education levels ranged from bachelor's degrees, to master's degrees (25%), to doctorates (36%). Seventy-five percent of the sample reported their primary discipline as psychology, and 25% as management.

Content validation results

Respondents were presented a randomized list of the 12 team resilience items and asked to classify each as Affective, Cognitive, or Physical. On average, items were classified as belonging to their intended dimension 80% of the time. Eleven of the 12 items were accurately categorized significantly more often than chance, with the exception being *Alertness*, which was intended as an indicator of Cognitive (11%) but was actually classified more often as Physical (23%). We also calculated *coefficients of substantive-validity* (C_{SV} ; Anderson & Gerbing, 1991). This provides a more stringent test than does a comparison against a random baseline. Detailed C_{SV} results can be found in supplement 5. The content validation results suggest that the 12 items can be tested as part of planned field validation efforts. Although the content analysis intimated that one item may be problematic, Mathieu et al. (2019) found that some items that may be considered weak in terms of content validity can turn out to be acceptable when subjected to empirical scrutiny. Hence, all items were included in the subsequent field studies.

Field validation studies: Methods and results

The two field studies are intended to test the validity of the TRS, assess its' psychometric qualities, and test its relationships with other constructs in the

nomological space. Study 1 sampled Soldiers from a variety of Army teams. While Study 1 yielded useful psychometric information, it was based on data collected concurrently from the same source (i.e., team members) which can be subject to method variance. Therefore, we conducted Study 2 whereby we gathered data from team members, leaders, and outcomes at multiple points in time. In study 2, Army recruiters completed the TRS, and their station commanders completed all the other measures. The same measures were used in both studies except for performance, which was a more context-specific metric in Study 2.

Study 1: Army soldier teams at installations

Contacts at four Army installations identified available squads with intact teams of at least four Soldiers to attend data collection sessions. Researchers administered paper scannable surveys to the participating Soldiers during one-hour sessions at each installation during 2019. Participants ($N = 705$) were asked to report their team membership, but all individual responses remained confidential. We dropped 26 of the surveys: (a) two for excessive missing data (>50% nonresponses); and (b) 24 that lacked sufficient identification to identify their team, or who represented a single respondent per team. This resulted in 679 useable member surveys from 449 teams, of which approximately 45% were from Engineering, 21% from Armor, 21% from Military Police, and 13% were from Cavalry, Infantry, and Field Artillery units. Participants were mostly ranked Private First Class, Specialist, and Sergeant and most had been members of their team 1–12 months.

Study 2: Army recruiting teams

Bartone and Bowles (2020) underscore the fact that "Recruiting for the military is a highly stressful job, and one that leads many recruiters to burn out and quit the job early" (p. 390). Yet, Army recruiters work as a team at their respective stations making team resilience an important construct. Accordingly, we administered online surveys to 1,629 recruiters and 291 recruiting station commanders at over 250 recruiting stations. Each station represents a recruiting team, which served as the unit of analysis in this study. This sample was selected because they are representative of other Army teams with members who work interdependently to overcome challenges and achieve their mission.

Recruiters completed the TRS and Station Commanders completed all other measures. We employed a longitudinal design where data were collected from multiple sources over three month-long periods. This afforded us the opportunity to model relationships in a predictive design. Moreover, the repeated observations per teams afforded us greater statistical power than a strictly between-team design. The final sample included 210 instances over time for which there were team performance data, commander responses, and at least one recruiter survey available. Supplement 6 provides further information about the design.

Aggregation to team level and psychometric properties

Because our focus is on team resilience, the survey instructions and item referents consistently refer to “your current team.” To justify the aggregation of data to that level, we calculated agreement indices (r_{wg} ; James et al., 1984) and intra-class correlations (ICC1, ICC2). ICC1 represents the proportion of total variance attributable to team membership, while ICC2 represents the reliability of the group average rating (Chen et al., 2004; Mathieu & Chen, 2011). Study 1 provided data from ≥ 2 members ($N = 353$) for 129 teams, whereas Study 2 provided ≥ 2 responses from over 140 teams over time, yielding 583 individual responses for 385 teams. The other measures were completed by a single respondent (station commanders) in Study 2.

Team Resilience Scale (TRS)

Table 1 reports the agreement indices and ICCs for all applicable scales. All the resilience subscales exhibited sufficient member agreement (i.e., medians $\geq .70$) to warrant aggregating data to the team level. Except for the physical resilience subscale in Study 1, all ICCs were significant at moderate levels. In addition, the TRS and all three subscales evidenced high internal consistencies. Accordingly, these findings support the aggregation of scores to the team level of analysis for all subsequent analyses.

Descriptive statistics and intercorrelations among variables

Table 1 contains intercorrelations, descriptive statistics, scale internal consistencies, r_{wg} s, and ICCs for all variables. The lower left triangle shows the correlations from Study 1 and the upper right triangle shows the correlations for Study 2. Descriptive statistics appear in the bottom rows for Study 1, and in the right-hand columns for Study 2. As shown, for Study 1, the nomological network measures demonstrated agreement indices in acceptable ranges, except for a low median r_{wg} for a stressor sub-dimension, workload stressors. The low to modest ICCs suggests that there was relatively little between-team variance to model, which may attenuate correlations among team-level constructs. All scale internal consistencies, using members’ average response per item as the indicators at the team level of analysis, were .80 or above.

Table 1. Correlation matrix and descriptive statistics for both studies.

Scale	1	2	3	4	5	6	7	8	9	10	11	12	<i>M</i>	<i>SD</i>	r_{wg}	ICC1	ICC2	α
1. Physical Res	–	.81	.75	.91	.05	.24	.25	–.15	.18	.24	.14	.04	6.57	2.10	.86	.22**	.39	.93
2. Affective Res	.67	–	.87	.96	.00	.15	.18	–.09	.17	.21	.15	.03	6.60	2.40	.78	.20*	.39	.94
3. Cognitive Res	.63	.77	–	.93	–.03	.10	.15	–.09	.16	.14	.13	.03	7.18	2.08	.84	.12*	.36	.95
4. Overall Res	.84	.92	.90	–	.01	.17	.21	–.12	.18	.21	.15	.04	6.78	2.05	.92	.18*	.23	.97
5. Psych Stress	–.47	–.46	–.39	–.49	–	.76	.67	–.30	–.02	.00	.06	–.10	2.53	0.87				.90
6. Env Stress	–.32	–.26	–.20	–.29	.59	–	.78	–.24	.12	.18	–.01	–.07	2.20	0.91				.80
7. Work Stress	–.29	–.27	–.23	–.29	.59	.71	–	–.32	.15	.14	.12	.12	2.27	0.96				.79
8. Minimizing	.48	.61	.56	.62	–.37	–.26	–.38	–	.35	.36	.24	.15	3.76	0.59				.84
9. Mending	.42	.58	.51	.57	–.29	–.17	–.23	.58	–	.61	.19	.09	3.78	0.68				.91
10. Manifest	.41	.57	.55	.58	–.29	–.13	–.19	.53	.76	–	.17	.03	3.95	0.56				.90
11. Performance	.43	.56	.55	.58	–.39	–.18	–.20	.49	.54	.52	–	.05	101.80	49.02				
12. Time												–	1.89	0.81				
Mean	6.12	5.89	6.54	6.19	2.79	2.87	3.17	3.06	3.32	3.42	3.73							
SD	1.73	2.20	1.98	1.76	0.76	0.86	0.87	0.73	0.75	0.72	0.80							
r_{wg}	.82	.77	.84	.92	.83	.74	.55	.88	.90	.92	.87							
ICC1	.05	.20**	.13*	.12*	.04	.13*	.11*	.12*	.01	.10*	.00							
ICC2	.13	.41	.29	.27	.11	.29	.24	.27	.04	.23	.00							
α	.83	.91	.92	.94	.80	.85	.79	.84	.91	.90	.91							

Note. Correlations for study 1 (lower left triangle) are based on 449 teams with one or more respondents. All correlations $p < .001$. Agreement indices and ICCs based on 353 members in 129 teams with ≥ 2 respondents. Study 2 correlations (upper right triangle) between resilience, performance, and time are based on an N of 390; correlations $\geq .12$ are significant. Other correlations based on an N of 103 with correlations $\geq .21$ significant. Study 2 agreement indices and ICCs are based on 583 responses from 385 teams per time. Descriptive statistics appear in the bottom rows for Study 1, and in the right-hand column for Study 2. * $p < .05$. ** $p < .01$ for ICCs. Blank cells indicate data not applicable.

Factor structure of the Team Resilience Scale (TRS)

We conducted confirmatory factor analyses (CFA) using the 12 items of the three lower-order team resilience dimensions (i.e., physical, affective, and cognitive) to determine their relative convergent and discriminant validity. The items were first fit to a three-factor latent model and compared to the results of a single-factor latent model. Standardized root mean square residual (SRMR) and the comparative fit index (CFI) are reported to gauge model fit. We also report model chi-square values which, while highly sensitive to sample size in terms of significance levels, are suitable for comparing the relative fit of nested models. Following Mathieu and Taylor (2006), models with CFI values < .90 and SRMR values > .10 are *deficient*, those with CFI \geq .90 to < .95 and SRMR > .08 to \leq .10 are *acceptable*, and those with CFI \geq .95 and SRMR \leq .08 are *excellent*.

Table 2 presents the results of the confirmatory factor analyses, again conducted separately for the two samples. In study 1 (N = 449), a three-factor CFA model evidenced a deficient fit in terms of the CFI, yet an acceptable fit in terms of the SRMR index in sample 1 [$\chi^2(51) = 666.83, p < .001$; CFI = .87, SRMR = .08]. In study 2 (N = 385), the three-factor CFA model evidenced an acceptable fit in terms of both the CFI and SRMR [Sample 2: $\chi^2(51) = 799.74, p < .001$; CFI = .90, SRMR = .08]. In both studies, all items loaded significantly and substantially (>.60) on their respective latent variables. The single factor model exhibited poor fit in both Sample 1 [$\chi^2(54) = 1249.96, p < .001$; CFI = .75, SRMR = .08] and Sample 2 [$\chi^2(54) = 1146.16, p < .001$; CFI = .81, SRMR = .06], that were significantly worse than their respective 3-factor models [Sample 1: $\Delta\chi^2(3) = 583.13, p < .001$; Sample 2: $\Delta\chi^2(3) = 589.71, p < .001$], respectively.

These results suggest that the three factors do exhibit discriminant validity, but the overall model fit could be improved. The three sub-factors were highly correlated in both samples (see Table 1) which suggests that they may relate significantly to a higher-order single factor. We fit such a model (which has identical degrees of freedom as the 3-factor model, and therefore identical overall fit indices), and each first-order construct evidenced a significant loading on the single second-order construct [Sample 1: physical: $\Gamma = .75, p < .001$; affective: $\Gamma = .97$; cognitive: $\Gamma = .83$; Sample 2: physical: $\Gamma = .86, p < .001$; affective: $\Gamma = 1.00$; cognitive: $\Gamma = .91$]. In sum, these findings support the use of the TRS as either a 3-dimensional construct or a single overall composite depending on the purpose of the data collection (cf., Luciano et al., 2018). That is, the 12 item TRS can be used as an index of overall team resilience and/or the subscales may be employed as more targeted measures of the three sub-dimensions as desired.

Nomological network results

We anticipated that team resilience, as assessed with the TRS, would be negatively related to stressors and positively related to minimizing factors, mending efforts, and manifestation behaviors, as well as with team performance. To examine these substantive relationships, we regressed resilience on all the variables except manifestations and team performance. Because manifestations are by-products of resilience, they were not included as antecedents of resilience in these analyses. However, the bi-variate correlations (see Table 1) between manifestations and overall resilience showed the expected positive relationship in Study 1 ($r = .58, p < .001$) and Study 2 ($r = .21, p < .05$). As team resilience

Table 2. Confirmatory factor analysis of team resilience items.

Items	Resilience Factor Structures					
	Study 1			Study 2		
	Physical	Affective	Cognitive	Physical	Affective	Cognitive
Rest	.86			.90		
Energy	.90			.95		
Physical fitness	.62			.78		
Endurance	.64			.88		
Mutual trust		.77			.85	
Morale		.89			.93	
Motivation		.90			.91	
Composure		.83			.90	
Task or mission related knowledge			.83			.87
Shared situational awareness			.91			.91
Alertness			.91			.95
Mental readiness			.83			.90

Note. Study 1 based on 449 teams with one or more respondents per team. Study 2 based on 385 teams per time with one or more respondents per team. Table values are standardized loadings, all $p < .001$.

is expected to be an antecedent of team performance, we also regressed team performance on team resilience and the other nomological network variables.

Regression analyses of substantive relations

Study 1. In study 1, psychological stressors exhibited significant unique negative relationships with team resilience, while minimizing factors and mending actions evidenced positive significant unique relationships with team resilience. Contrary to our expectations, workload stress exhibited a small, yet unique positive relationship with team resilience. This pattern of relationships was largely consistent with our nomological network expectations and accounted for 53% of the team resilience variance (see left-hand columns in Table 3).

Regressing team performance on team resilience and the other variables in Study 1, minimizing factors evidenced a unique positive relationship, and psychological stressors had a significant negative relationship with team performance. Team resilience was positively related to team performance ($R^2 = .43$). In sum, these findings reveal team resilience as a partial mediator of the relationships between the correlates and team performance, and are consistent with our expectations and support the construct validity of our team resilience measure.

Study 2. For purposes of evaluating the psychometric properties of our measures, all of the data were treated as independent observations of the constructs in question. However, given the repeated measure(s) design in Study 2, error terms are not independent and may bias significance tests of substantive relationships. Consequently, the Study 2 data were analyzed using repeated measures multiple regression (RMMR) techniques which employ the proper error terms. Using RMMR correlations we regressed recruiters' reported team resilience on the variables provided by the station

commanders, controlling for time (i.e., phase of each pairing). As presented in the right-hand columns in Table 3, only psychological stressors exhibited unique negative effects on resilience ($R^2 = .14$). Next, controlling for time we regressed team performance onto team resilience and the other variables. The relationship with resilience was positive and significant as expected, as was a negative significant relationship with environmental stressors and a positive significant relationship with minimizing factors. Yet, contrary to expectations, there were also significant positive relationships with psychological and workload stressors. All totaled, 17% of team performance was accounted for by the combined predictor set. These findings are generally consistent with our expectations and support the construct validity of the team resilience measure.

Discussion

While there have been theoretical advancements in the team resilience domain (e.g., Alliger et al., 2015; Stoverink et al., 2020), there has not been a commensurate increase in empirical research. Meta-analyses have been conducted on other team emergent states such as cohesion (Chicchio & Essiembre, 2009), psychological safety (Frazier et al., 2017), and trust (De Jong et al., 2016) but not on team resilience. That is likely because there are more commonly accepted measures and greater conceptual clarity for those other constructs. As noted in a recent systematic review by Chapman et al. (2020), "... meta-analyses require much greater clarity about a concept than currently exists with respect to team resilience" (p. 61).

Our research was an attempt to establish a conceptually distinct, acceptable, validated measure of team resilience to help advance research and support practical, diagnostic needs in the Army and other settings. A useful, validated measure of team resilience would be perceived as relevant by military SMEs, be content valid, demonstrate internal consistency, aggregate to the team level, show appropriate convergent/discriminant validity, and co-vary as expected with related variables. In this effort, we developed and assessed the usefulness of a 12-item measure, the Team Resilience Scale (TRS), against those criteria.

The TRS was perceived as relevant by SMEs, demonstrated content validity as assessed by team experts and had appropriate psychometric properties. As recommended in prior team resilience theory we treated team resilience as an emergent state (Bowers et al., 2017) and consistent with COR theory we measured it as a capacity (Hobfoll et al., 2018). Prior researchers have pointed to prior construct confusion (Hartwig et al., 2020) and a need to strengthen the nomological network of team

Table 3. Multiple regression analyses predicting overall team resilience and performance.

Predictors	Criteria			
	Study 1 ^a		Study 2	
	Resilience	Performance	Resilience ^b	Performance ^c
Time	NA	NA	.01	-.02
Psychological Stress	-.33***	-.20***	-.39*	.30*
Environmental Stress	-.04	.03	.22	-.33*
Workload Stress	.13*	.09	.20	.31*
Minimizing Factors	.37***	.10	-.18	.27*
Mending Actions	.28***	.28*	.15	.02
Team Resilience		.30***		.19*
R ²	.53***	.43***	.14*	.17*

Notes. ^a N = 449 teams; ^b N = 103 team pairings over time; ^c N = 210 pairings over time. Table values are standardized beta weights. Empty cells represent not applicable data. * $p < .05$; ** $p < .01$, *** $p < .001$.

resilience (Raetze et al., 2021) so we carefully distinguished team resilience from related yet different variables, such as stressors or behaviors that can minimize the impact of stressors. The two field studies confirmed that the TRS is distinct from and displays logical relationships with related constructs, including a positive relationship with team performance in both field studies.

In sum, these findings support the use of the TRS as either a 3-dimensional construct or a single overall composite depending on the purpose of the data collection (Luciano et al., 2018). For most research purposes, a single composite measure is the most parsimonious solution, and the results fully support using the measure in that manner. The results also suggest that it is acceptable to use the three sub-scales separately. This may be valuable when seeking to identify the specific source(s) of weak resilience so as to target interventions accordingly. Recognize however, that consistent with the resource caravan aspect of COR theory (Hobfoll et al., 2018), resources tend to co-vary, so the sub-scales are likely to be correlated as they were in both our research samples. Nonetheless, in field settings, where the primary intent is to diagnose and remediate a lack of resilience, it may be beneficial to examine physical, cognitive, and affective resilience separately.

The TRS could be used to diagnose team resilience during team training or in the field. We tested two versions of the scale, one that asked about current resilience and one that asked about future resilience. While we only reported findings for the current version, the future version (available in supplement 7) demonstrated similar results, which suggests that either version can be used to fit diagnostic needs. For example, to conduct a diagnostic pulse check of a team “in action” during a deployment, it would make sense to assess current resilience. However, when a team is completing pre-deployment training, the future version could be administered to learn about their perceived readiness and confidence for when they are deployed.

There is little time to complete surveys when teams are actively deployed, so the TRS was limited to only 12 items. We also developed and tested a 2-item resilience measure (available in supplement 7) for instances when a one-minute pulse check is all that is feasible. That measure asks, “to what extent can your team: a) withstand future challenges, b) bounce back quickly from setbacks.” The 2-item measure was significantly correlated with the 12-item resilience scale in both studies (study 1: $r = .58, p < .001$, study 2: $r = .76, p < .001$).

Although our focus was on team resilience, we also developed a set of related measures, including ones that assessed stressors, minimizing factors, mending actions, and resilience manifestations. These may be useful in

future research on team resilience, or in instances where military leaders want a more complete diagnostic picture of the factors that can impact their teams’ resilience. For example, at times, leadership may be interested in team resilience manifestations or behaviors, in which case the manifestations measure may be of interest. Keep in mind however, that it only makes sense to examine resilience behaviors when a team is under pressure. Between stressful experiences, resilience of a team should be measured as a latent capacity, as reflected in our TRS.

Limitations and future research

The current research offers encouraging results, but should be interpreted in light of its limitations. The first study gathered data from different types of teams, but the data were from a single source, at a single point of time. The second study overcame those limitations by using multiple-sources and gathering data over time, but it was limited to examining a single type of Army team. Neither study examined Soldiers deployed in physically dangerous settings.

As noted by Meredith et al. (2011), “Standardized resilience measures could be applied to a variety of populations in different contexts and allow for a comparison across programs” (p. xviii). Future research should test the usefulness of the TRS in other settings, including with deployed teams that may face a different mix of stressors. Studying Army teams that work in various field environments, including those performing in isolated or dangerous environments, can provide further insights about how different types of stressors impact resilience and subsequent performance. Research conducted with teams from other military branches and other stressful nonmilitary work environments, such as healthcare, could help establish the generalizability and usefulness of our findings. Research in traditional work settings should examine how various work arrangements (e.g., remote, hybrid, co-located) impact team resilience.

Our focus was on team resilience and related factors at the team level, but future research could use the TRS to study cross-level phenomena, such as the relationship of team resilience with individual outcomes such as well-being and mental health, and with desirable organizational outcomes such as Soldier retention levels. Given the potential importance of team resilience, it would be worthwhile to gather normative data using a common measure of team resilience (and perhaps common measures of stressors and related behaviors), as a form of baseline indicator in various settings. When the military and other organizations take actions to enhance team resilience in various

settings (e.g., team resilience training or “inoculations,” the use of resilience-focused debriefs, and changes in doctrine, staffing, or deployment schedules), future researchers could study how those interventions impact team resilience “in the wild.”

Data availability statement

The data that support the findings of this study are not available, in accordance with DoD policy.

Disclosure statement

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Supplemental Materials

Supplement 1. Team Member Interview Summary

Supplement 2: Army Team Member Interview Protocol

Supplement 3. Team Resilience and Nomological Network Measures

Supplement 4: Exploratory Factor Analyses of the Nomological Network Measures

Supplement 5. Detailed Content Validation Methods and Results

Supplement 6. Study 2: Army Recruiting Teams Research Design Details

Supplement 7. Alternative Team Resilience Measures

Supplement 1. Army Team Member Interview Summary

Introduction

Following our review of the literature we conducted exploratory group interviews (i.e., focus groups) with members of Army recruiting teams. The objective of these interviews was twofold. First, we sought to ensure that our measures, based on theory, would also be grounded in Army team needs and realities. Second, as we planned and prepared for our construct validation efforts, we needed to ensure that the teams that would participate in our validation activities were ideal candidates for our research. Specifically, the teams needed to be composed of members who worked interdependently (i.e., not simply groups of individuals who do not interact) and needed to be exposed to stressors that could trigger manifestations of team resilience.

Method

Participants

During planning stages of our project, Army recruiting teams had been identified as potential participants for subsequent validation work given their stressful mission and that they worked in teams. Therefore, we conducted interview sessions with members of two Army recruiting teams. Participants from one team included 11 recruiters/team members and a team commander and participants from the second team were 7 recruiters/team members and a commander.

Procedures and Materials

Researchers interviewed recruiters together as a team and interviewed team commanders individually and separate from their teams. In total, we conducted two team interviews and two commander interviews. In contrast to qualitative research interviews that sometimes produce detailed data for subsequent for analysis, these interviews were designed to be exploratory and were conducted to gather general insights for our subsequent measure development and research activities. Discussion questions focused on the nature and structure of typical recruiting teams and the recruiting team mission, the interdependency of recruiting teams, challenges and stressors faced by recruiting teams and their commanders, and outcomes/metrics. The protocol with interview questions is provided in the final page of this supplement.

Results and Discussion

Our discussions with the teams and commanders suggest that most Army recruiting teams are at least somewhat interdependent in terms of how they work and would be suitable for our validation research. The interviews also suggest that recruiting teams execute a stressful mission with both acute and chronic stressors at the individual and team levels. For example:

- A variety of stressors are tied to external factors (e.g., economy, unhappy public), lack of tools/resources, long hours and work-life balance struggles.
- Many recruiters, who are re-assigned from their primary military occupation and area of expertise, find it stressful to start over in a new career.
- Team members feel accountable to the team to perform well (e.g., poor individual performance can feel like you have let the team down).

- Teams operating with fewer members are still expected to meet the same goal.
- It can be stressful for some who feel they are an “outsider” to the rest of the team (fault lines).

Also, participants shared that some stressors are predictable/expected (e.g., those tied to certain times of the year, events, and locations) while others are “pop up” stressors (e.g., recruits changing their minds; getting yelled at by people in public; last minute tasks assigned; team members getting sick).

Given that we were planning to use a longitudinal research design for our subsequent validation work, we were interested in learning about their mission flow and stress inflection points. We learned that recruiting teams work within monthly “phase lines” or windows. Most teams need to “make mission” each month, but no one week within the monthly cycle is perceived as universally more stressful than the rest. The first quarter of the year tends to be the busiest (creating more stress) and the workload tends to taper off toward the end of the summer. Teams also need to meet annual goals. Commanders feel a constant flow of stress throughout the year.

Of note, our discussions revealed that recruiting teams engage in an assortment of activities to handle stressors. For example, team members often talk about their stress and “vent” to one another, helping each other decompress. Some take breaks while others use humor to reduce stress. Some team members offer advice and support to other team members who need it. Also, team commanders can act as a buffer from some stressors (e.g., can “take the heat” from above). We heard that some teams may engage in more of these activities than others, but most recruiting teams engage in at least some “minimizing” and “mending” activities.

Conclusion

Our interviews with Army recruiting teams grounded our theory within the Army unit context and confirmed the suitability of Army recruiting teams for our research. Army recruiting teams encounter a variety stressors. Teams often take actions to “minimize” and “mend” the impact of those stressors, but the exact actions they take and the extent to which they take them may differ. Based on these insights, and our theoretical framework of team resilience, we set out to develop measures of team resilience (capacity and confidence), manifestations, minimizing behaviors, mending behaviors, and stressors.

Supplement 2: Army Team Member Interview Protocol

The Team

1. How many Soldiers are on a typical recruiting team? What are the typical roles and responsibilities on a recruiting team?
 - a. **[PROMPT:]** Are all team members recruiters? If not, what are the other members' roles?
 - b. **[PROMPT:]** What is the role of the team leader?
2. **[OPTIONAL]:** How long do recruiters typically serve on a team?

Interdependency

3. How often do recruiters interact/collaborate with other recruiters on the team?
4. Do recruiting team members have shared objectives/goals? If yes, please explain.
5. **[OPTIONAL]:** Do recruiters need to rely or help one another and if so, under what circumstances?
 - a. **[PROMPT:]** Do recruiters share advice, information, or ideas? If yes, when does this typically occur?
 - b. **[PROMPT:]** Do recruiting team members discuss recruiting strategies and techniques? And if so, how often are recruiting strategies and techniques discussed?

Challenges and Responses

6. What are the biggest challenges and stressors recruiting teams typically face and how are they handled?
 - a. **[PROMPT:]** To what extent, if at all, can the challenges that recruiting teams encounter be anticipated?

Outcomes

7. How is recruiting team performance/success evaluated?
[PROMPT:] Are recruiting teams evaluated as a team (vs. individually)?
8. **[FOR TEAM LEADERS:]** What performance metrics are available to team leaders, if any?
[PROMPT:] What do these performance metrics measure?

Supplement 3. Team Resilience and Other Nomological Network Measures

1. Team Resilience Scale
2. Minimizing Factors
3. Mending Efforts
4. Resilience Manifestations
5. Stressors

Team Resilience Scale

INSTRUCTIONS: Please read the team resilience definition below, then use the scale to answer survey items #1 to #12.

Team Resilience Definition: A team's ability to deal with and bounce back from challenges. Resilience is based on a team's current resources and the team's confidence that they can draw upon or replenish its resources to handle future challenges.

Using the 10-100 current resource level scale, please **choose the number** that describes your team's **CURRENT RESOURCE LEVEL** for each of the team resources listed below.

Current Resource Level Scale		
10 = Low -----	50 = Medium -----	100 = High
Totally spent, nothing in reserve	Somewhat depleted, but something in reserve	Fully ready with plenty in reserve

Team Resources	Low	-----Medium-----								High
1. Rest	10	20	30	40	50	60	70	80	90	100
2. Energy	10	20	30	40	50	60	70	80	90	100
3. Physical fitness	10	20	30	40	50	60	70	80	90	100
4. Endurance	10	20	30	40	50	60	70	80	90	100

Team Resources	Low	-----Medium-----								High
5. Mutual trust	10	20	30	40	50	60	70	80	90	100
6. Morale	10	20	30	40	50	60	70	80	90	100
7. Motivation	10	20	30	40	50	60	70	80	90	100
8. Composure	10	20	30	40	50	60	70	80	90	100

Team Resources	Low	-----Medium-----								High
9. Task- or mission-related knowledge	10	20	30	40	50	60	70	80	90	100
10. Shared situational awareness	10	20	30	40	50	60	70	80	90	100
11. Alertness	10	20	30	40	50	60	70	80	90	100
12. Mental readiness	10	20	30	40	50	60	70	80	90	100

Minimizing Factors

INSTRUCTIONS: Use the scale below to rate your team.

During the last month, <u>to what extent</u> has your team...	Not at All	Very Little Extent	To Some Extent	To a Great Extent	To a Very Great Extent
1. been adequately staffed to handle future challenges?	1	2	3	4	5
2. been adequately resourced to manage future challenges?	1	2	3	4	5
3. been adequately trained to manage future challenges?	1	2	3	4	5
4. developed plans to handle different potential challenges?	1	2	3	4	5
5. developed strong working relationships with one another?	1	2	3	4	5
6. adequately assessed its preparedness for future challenges?	1	2	3	4	5

Mending Efforts

INSTRUCTIONS: Use the scale below to answer the questions about your team.

During the last month, how often did your team exhibit this behavior when it was needed?	NO NEED to demonstrate this behavior	Never or Rarely	Some of the Time	Most of the Time	Every Time
1. Identified lessons learned (for example: team debrief, After Action Review)	1	2	3	4	5
2. Worked through areas of conflict that may have developed between team members as a result of the challenges or stressors	1	2	3	4	5
3. Communicated appreciation for helpful actions taken by team members when facing the challenges or stressors	1	2	3	4	5
4. Helped individual team members who were affected by the challenging event or stressor	1	2	3	4	5
5. Repaired relationships with people outside the team that might have been strained	1	2	3	4	5
6. Thanked people outside the team for their help and support	1	2	3	4	5
7. Identified how to address future challenges (for example: who will fill in or help out if X happens, how they will address future needs)	1	2	3	4	5
8. Agreed how to follow up to ensure progress	1	2	3	4	5
9. Made changes to processes, procedures, or resources	1	2	3	4	5
10. Took actions to address deficits (for example: insufficient sleep, distrust)	1	2	3	4	5

Resilience Manifestations

INSTRUCTIONS: Use the scale below to answer the questions about your team.

During the last month, <u>how often</u> did your team exhibit this behavior when it was needed?	NO NEED to demonstrate this behavior	Never or Rarely	Some of the Time	Most of the Time	Every Time
1. Alerted one another to potential problems	1	2	3	4	5
2. Communicated about situational changes (for example: mission, resources)	1	2	3	4	5
3. Responded to challenges when they occurred	1	2	3	4	5
4. Sought assistance	1	2	3	4	5
5. Ensured all team members were comfortable speaking up	1	2	3	4	5
6. Offered backup or support when team members needed help (for example: overloaded, competing)	1	2	3	4	5
7. Maintained regular, necessary work routines while under stress	1	2	3	4	5
8. Intentionally switched to and from “normal” mode to “ emergency ” mode	1	2	3	4	5
9. Relied upon team members with the most relevant expertise	1	2	3	4	5
10. Identified "what was not working" in managing a challenging situation and made real-time changes	1	2	3	4	5
11. Monitored team members’ health	1	2	3	4	5

Stressors

INSTRUCTIONS: Please use the scale below to assess the **challenges and stressors** your team experienced at work during the **last month**.

During the last month how often did your team experience:	Never	Rarely	Occasionally	Frequently	Constantly
1. information overload?	1	2	3	4	5
2. uncertainty or doubt?	1	2	3	4	5
3. lack of sleep?	1	2	3	4	5
4. emotional stressors?	1	2	3	4	5
5. interpersonal conflicts or disagreements?	1	2	3	4	5
6. prolonged separation from family?	1	2	3	4	5
7. time pressures?	1	2	3	4	5
8. loud noises?	1	2	3	4	5
9. confined spaces?	1	2	3	4	5
10. heavy workload?	1	2	3	4	5
11. insufficient resources?	1	2	3	4	5
12. physical demands?	1	2	3	4	5
13. hazardous conditions?	1	2	3	4	5
14. staffing or skill shortages?	1	2	3	4	5
15. personnel changes?	1	2	3	4	5

Note. Exploratory Factor analyses Identified three distinguishable stress factors: 1) Psychological (items 1-6, $\alpha = .90$);

2) External (items 7-9, 12, 13, $\alpha = .80$); and, 3) Workload (items 10, 11, 14, 15, $\alpha = .79$)

Supplement 4: Exploratory Factor Analyses of the Nomological Network Measures

We ran exploratory factor analyses in both samples for each of the nomological network measures, and only the stressors category suggested more than one dimension. Inspection of the item loadings revealed that the stressors could be represented as emanating from *psychological, environmental, or workload* factors, so all substantive analyses use the three sub-dimensions of stressors.

Stressor items that loaded on each factor per an exploratory factor analysis:

Psychological Stress items: 34, 35, 36, 37, 38, 39

Environmental Stress items: 40, 41, 42, 43, 46

Workload Stress items: 44, 45, 47, 48

Supplement 5. Detailed Content Validation Methods and Results

Content Validation of the Team Resilience Scale

As the core focus of the current effort, we wanted to ensure that the Team Resilience Scale (TRS) is relevant to and representative of the targeted unit resilience construct. Therefore, we also gathered evidence of this measure's content validity. Haynes et al., (1995) define content validity as the extent to which "elements of an assessment instrument are relevant to and representative of the targeted construct for a particular assessment purpose" (p. 238). To assess the content validity of the TRS we followed the general recommendations set out by McKenzie et al., (1999) and Rubio et al., (2003).

Sample and Method

We employed a methodology outlined by Anderson and Gerbing (1991) for assessing substantive (i.e., content) validity of items and collected subject matter expert's (SMEs) categorizations of the items. Specifically, we solicited input from 36 colleagues from 12 institutions (89% academic, 11% applied) who were well-versed in the team literature and applications. The sample was 72% women and ranged in age from 22 to 49 (mean = 30.83, SD = 6.65). Their education levels ranged from bachelor's degrees, to master's degrees (25%), to doctorates (36%). Seventy-five percent of the sample reported their primary discipline as psychology, and 25% as management.

Results

We prepared an on-line survey that presented the 12 items from the Team Resilience measure, randomized per respondent, and asked them to classify each one into one of three domains using the following definitions: 1) Affective includes team psychological states relating to feelings, attitudes, and emotions; 2) Cognitive consists of team states that concern members' thoughts or beliefs regarding a specific factor; or 3) Physical states refer to members' somatic and mental conditions at any given time. The results of their classifications are summarized in Table 1.

On average, items were classified as belonging to their intended dimension 80% of the time. Eleven of the 12 items were accurately categorized significantly more often than chance, with the exception being *Alertness*, which was intended as an indicator of Cognitive (11%) but was actually classified more often as Physical (23%).

Anderson and Gerbing (1991) described the use of a *coefficient of substantive-validity* (C_{sv}) which ranges from -1 to 1, with larger values indicating greater item substantive validity. More specifically, using the SMEs' item categorizations, items have higher C_{sv} values to the extent that they are classified consistently as belonging to their intended construct as compared against their next most commonly used category. This provides a more stringent test than does a comparison against a random baseline. As shown in the right most column of Table 1, nine of the 12 C_{sv} values were significant using this more stringent criteria. The three nonsignificant C_{sv} values included the problematic *Alertness* item, *Composure* (58% Affective as intended, but 33% Physical), and *Mental Readiness* (61% Cognitive as intended, but 36% Physical).

In summary, all four Physical items were classified significantly more often as intended (average = 92.25%) as compared to chance or the next most frequent category (average C_{sv} = .86). All four Affective items were classified significantly more often as intended (average = 77.50%) as compared to chance, and three of four significantly more often than the next most frequent category (average C_{sv} = .60). Three of the four Cognitive items were classified significantly more often as intended (average = 70.00%) as compared to chance, and two of four significantly more often than the next most frequent category (average C_{sv} = .42).

Conclusion

The results suggest that the 12 items can be tested as part of planned construct validation efforts. Although the content analysis intimated that one item may be problematic, the team measurement literature suggests a need to examine this item and scale further empirically. Mathieu et al. (2019) found that some items that were considered weak in terms of content validity (using this approach), can turn out to be acceptable when subjected to empirical scrutiny. Hence, empirical testing with a sample of responses from our target population(s) is important before making any changes.

Table 1.
Subject Matter Expert Classifications of Team Resilience Scale Items

Items	SME Classifications			%	χ^2	C_{SV}
	Physical	Affective	Cognitive			
Physical						
1. Rest	36	0	0	100	72.00***	1.00***
2. Energy	31	4	1	86	45.13***	0.75***
3. Physical fitness	36	0	0	100	72.00***	1.00***
4. Endurance	30	5	1	83	40.50***	0.69***
Affective						
1. Mutual trust	1	26	9	72	24.50***	0.47**
2. Morale	2	34	0	94	60.50***	0.89***
3. Motivation	2	31	3	86	45.13***	0.78***
4. Composure	12	21	3	58	10.13**	0.25
Cognitive						
1. Task or mission related knowledge	1	0	35	97	66.13***	0.94***
2. Shared situational awareness	3	1	32	89	50.00***	0.81***
3. Alertness	23	2	11	31	.13	-0.33
4. Mental readiness	13	1	22	61	12.50**	0.25

Note. N = 36, % = Percentage intended classification, C_{SV} = coefficient of substantive-validity

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

Supplement 6. Sample 2: Army Recruiting Teams Research Design Details

Design. We employed a longitudinal design where data were collected from multiple sources over three month-long periods. This afforded us the opportunity to model relationships in a predictive design over time. Moreover, the repeated observations per teams enabled us to generate far greater statistical power than afforded by a strictly between-team design. Table 1 outlines the overall design and the data collected. Performance information was available from archival records for over 140 teams, over time, totaling 494 monthly measures. Two or more recruiter surveys information, aggregated to the team level of analysis, were available for 148, 131, and 106 teams for phases 1-3, respectively. Station commanders survey information was available for 83, 72, and 58 teams for phases 1-3, respectively, for a total of 213. Whereas we used all of the information that was available for evaluating the psychometric properties of our measures, for testing the relationships between constructs, the above data yielded 385 instances (i.e., phases) for which we had both team performance and at least one recruiter survey available. Of those instances, 210 also had station commanders survey data available.

Table 1

Recruiter Research Design and Team-Level Yields

Data Sources and Variables	Phase			Totals
	1	2	3	
Archives				
Performance	186	166	142	494
Performance paired with >1 Recruiter Survey	148	131	106	385
Recruiter Survey				
Team Resilience	148 (239)	131 (207)	106 (137)	385 (583)
Station Commanders Survey				
Stressors	83	72	58	213
Team Actions (Minimizing, Mending, Manifestations)	83	72	58	213

Note. Values within parentheses are the number of aggregated individual surveys

Supplement 7. Alternative Team Resilience Measures

Two-Item Team Resilience Measure

We also developed two items that were designed to gather a more general or overall assessment of unit resilience. The items were developed to represent two key components to our definition of team resilience. Specifically, team members are asked to rate the extent to which the team can 1) withstand future challenges, and 2) bounce back quickly from setbacks. This measure employed a 5-point Likert-type extent scale from 1-5. The reason for developing and validating a shorter measure was to provide users with an alternative that could be used in situations where there is not enough time to administer the longer Team Resilience Measure or when information about specific resilience dimensions or resources is not desired. The two-item measure significantly correlated .58 with overall resilience in study 1 and .76 in study 2. In addition, it significantly correlated .51 with performance in study 1 and .14 in study 2

INSTRUCTIONS: Use the scale below to rate your **team**.

To what <u>extent</u> can your team...	Not at All	Very Little	To Some Extent	To a Great Extent	To a Very Great Extent
1. withstand future challenges?	1	2	3	4	5
2. bounce back quickly from setbacks?	1	2	3	4	5

Future Team Resilience Scale

INSTRUCTIONS: Please read the team resilience definition below, then use the scale to answer survey items #1 to #12.

Team Resilience Definition: A team’s ability to deal with and bounce back from challenges. Resilience is based on a team’s current resources and the team’s confidence that they can draw upon or replenish its resources to handle future challenges.

Think about the FUTURE challenges your team might face. Using the 10-100 confidence level scale below, please **choose the number** that describes your team’s **CONFIDENCE** that it will have **enough** of each resource to handle **FUTURE CHALLENGES** effectively.

Confidence Level Scale		
10 = Not confident we’ll have enough in the future	50 = Somewhat confident we’ll have enough in the future	100 = Fully confident we’ll have enough in the future

Team Resources	Not Confident-----Somewhat Confident-----Fully Confident									
1. Rest	10	20	30	40	50	60	70	80	90	100
2. Energy	10	20	30	40	50	60	70	80	90	100
3. Physical fitness	10	20	30	40	50	60	70	80	90	100
4. Endurance	10	20	30	40	50	60	70	80	90	100

Team Resources	Not Confident-----Somewhat Confident-----Fully Confident									
5. Mutual trust	10	20	30	40	50	60	70	80	90	100
6. Morale	10	20	30	40	50	60	70	80	90	100
7. Motivation	10	20	30	40	50	60	70	80	90	100
8. Composure	10	20	30	40	50	60	70	80	90	100

Team Resources	Not Confident-----Somewhat Confident-----Fully Confident									
9. Task- or mission-related knowledge	10	20	30	40	50	60	70	80	90	100
10. Shared situational awareness	10	20	30	40	50	60	70	80	90	100
11. Alertness	10	20	30	40	50	60	70	80	90	100
12. Mental readiness	10	20	30	40	50	60	70	80	90	100