Technical Report 1412

A Systematic Review of Instruments Measuring Team Resilience

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September 2022

United States Army Research Institute for the Behavioral and Social Sciences

U.S. Army Research Institute
for the Behavioral and Social Sciences

Department of the Army
Deputy Chief of Staff, G1

Authorized and approved:

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Research accomplished under contract
for the Department of the Army by

Consortium of Universities of Washington

Technical review by

William Kammerer, U.S. Army Research Institute
James Deller, U.S. Army Research Institute

DISPOSITION

This Technical Report has been submitted to the
Defense Information Technical Center (DTIC).

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(01-10-2020)* September 2022	**2. REPORT TYPE:** Final	**3. DATES COVERED** *(From - To)* September 2017 – August 2022

4. TITLE AND SUBTITLE

A Systematic Review of Instruments Measuring Team Resilience

5a. CONTRACT NUMBER
W911NF-16-2-0092

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER
622785

6. AUTHOR(S)
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Shala N. Blue, Bridget E. Boyle, Cassie A. Berry & Colanda R. Cato, (U.S. Army Research Institute)

5d. PROJECT NUMBER
790

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Consortium of Universities of Washington
1100 H Street NW, Suite 500
Washington DC 20005-5493

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U. S. Army Research Institute
for the Behavioral & Social Sciences
6000 6TH Street (Bldg. 1464 / Mail Stop 5610)
Fort Belvoir, VA 22060-5610

10. SPONSOR/MONITOR'S ACRONYM(S)
ARI

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
Technical Report 1412

12. DISTRIBUTION/AVAILABILITY STATEMENT: Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES: ARI Research POC: Dr. Cassie A. Berry, Emerging Research Unit

Performing Organization is Consortium of Universities of Washington, specifically Temple University.

14. ABSTRACT

A systematic review of the resilience literature was performed to identify and evaluate the methodological qualities of team resilience measures. Five measures were identified that met screening and inclusion criteria. These measures assessed a broad spectrum of constructs and sampled employees across different occupations, industries, and countries. These measures assessed state-resilience directly with self-report items, using the referent shift approach, at the team level of analysis. While most measures reported some evidence of reliability (e.g., internal consistency, interrater agreement), there was limited evidence of validity (e.g., construct, content, criterion). Based on the limited evidence of reliability and validity, the scientific quality of these measures was determined to be weak. Continued development and improvement in the measurement of team resilience is recommended. Implications of these findings are discussed for theory, research, and practice.

15. SUBJECT TERMS
Team Resilience, Measures, Psychometrics, Reliability, Validity

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT:**	**18. NUMBER OF PAGES:**	**19a. NAME OF RESPONSIBLE PERSON**
					Dr. Alok Bhupatkar
a. REPORT Unclassified	**b. ABSTRACT** Unclassified	**c. THIS PAGE** Unclassified	Unlimited Unclassified	34	**19b. TELEPHONE NUMBER** 703-712-3038

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ACKNOWLEDGEMENT

We are grateful to Katelyn McCoy and Nathaniel Ratcliff for their insights and contributions to this work.

A SYSTEMATIC REVIEW OF INSTRUMENTS MEASURING TEAM RESILIENCE

EXECUTIVE SUMMARY

Research Requirement:

Scientists conceptualize resilience as comprising a constellation of traits and abilities associated with a person's capacity to respond to threatening and/or challenging conditions (Estrada et al., 2016), to loss or trauma (Bonanno et al., 2011), and adversity (Fletcher & Sarkar, 2013; Jacelon, 1997; Tusaie & Dyer, 2004). Resilience allows individuals to adapt, bounce back, and grow when experiencing such situations (Davis et al., 2009; Estrada et al., 2016; Luthar et al., 2000).

A lot has been learned about the nature and impact of resilience at the individual level of analysis – i.e. *psychological resilience* (Estrada et al., 2016; Fletcher & Sarkar, 2013; Jacelon, 1997; Meredith et al., 2011; Tusaie & Dyer, 2004). However, there is a paucity of research examining whether resilience can be extended beyond the individual to the collective – i.e., *team resilience* (Severt & Estrada, 2015). Indeed, conceptual and theoretical frameworks of the antecedents, moderators, and outcomes of team resilience have only recently emerged (e.g., Alliger et al., 2015; Bowers et al., 2017). Not surprisingly, the development of team resilience measures is still in its infancy and the scientific quality of team resilience measures remains unknown.

This report begins to address this gap in research by critically reviewing tests and measures purporting to assess team resilience. Specifically, results of a systematic review of instruments that measure team resilience and related constructs are described in this report.

Approach:

A systematic review of the resilience literature was performed to locate available research and studies describing the development or validation of team-level measures of resilience and related constructs. A total of 1,179 source documents were initially identified. Upon review, non-empirical reports, trade publications, news articles, overviews, duplicates and items published in languages other than English were eliminated. Additionally, items that did not address the construct of resilience at the team level or that did not report complete information on the psychometric properties of the measure were also eliminated. Only five measures met screening and inclusion criteria from the initial pool of 1,179 source documents.

Findings:

Five instruments purporting to measure team resilience were identified. These measures assessed a broad spectrum of constructs, and sampled employees across different occupations, industries, and countries. They also assessed state-resilience directly with self-report items that used the referent shift approach (Chan, 1998) at the team level of analysis. Whereas most measures reported some evidence of reliability (e.g., internal consistency, interrater agreement), there was limited evidence of validity (e.g., construct, content, criterion). Given the limited evidence of reliability and validity, the scientific quality of these measures was determined to be weak.

Utilization and Dissemination of Findings:

This report sought to identify, compare, and critically assess the measurement properties of existing measures of team resilience. Although 1,179 source documents were identified, only five of these documents included sufficient information on these measures to meet screening and inclusion criteria. Accordingly, the review was limited because of the general lack of psychometric information reported within the literature. Clearly, there is a critical need to improve reporting of structural and psychometric properties of team resilience measures. Therefore, it is important for the scientific community to continue working on the development and refinement of team resilience measures.

A SYSTEMATIC REVIEW OF INSTRUMENTS MEASURING TEAM RESILIENCE

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On August 1, 1914, Sir Ernest Shackleton and a 27-member crew of the *Endurance* set out to cross the Antarctic continent. Six months into their journey, they encountered heavy packed ice and became trapped on the Weddell Sea. They drifted in ice for over 10 months until the ship was crushed and finally sank. They set up camp on the ice, and later on land on Elephant Island, managing to survive until their rescue on August 30, 1916. Over a period of two years, the crew endured long days, in extremely cold and wet conditions. They ate penguin and seal blubber—sometimes raw—in order to survive. They went without bathing and wore their clothes until they were practically rags. They sheltered in huts made out of materials from overturned rowboats. The crew survived, remained in good spirits throughout the ordeal, with many going on to serve in World War I (Shackleton, 1919).

How individuals and groups respond to challenging or threatening events is of particular interest to scientists and practitioners seeking to develop, maintain, and enhance the resilience of both individuals and groups (Estrada et al., 2016). Shackleton and the 27-member crew of the *Endurance* responded to a catastrophic event by adapting to unfolding conditions; recovering from challenging and disruptive situations; and experiencing growth as evident in their ability to survive extreme conditions in Antarctica over a period of two years. The situational demands, the time span involved, and responses of the crew of the *Endurance* highlight the importance of resilience in overcoming challenging and threatening situations.

Resilience is conceptualized to include a constellation of traits, abilities, and competencies associated with a person's capacity to respond to threatening and/or challenging conditions (Estrada et al., 2016), to loss or trauma (Bonanno et al., 2011), and adversity (Fletcher & Sarkar, 2013; Jacelon, 1997; Tusaie & Dyer, 2004). Resilience allows individuals to adapt, bounce back, and grow when experiencing such situations (Davis et al., 2009; Estrada et al., 2016; Luthar et al., 2000). Research has documented linkages between resilience and cognitive abilities (e.g., Garmezy, 1985, 1987, 1991; Simonton, 2000; Werner, 1989), personality characteristics (e.g., Block & Block 1980; Cicchetti & Rogosch, 1997; Tedeshci & Calhoun, 1996), emotional and behavioral responses to stress (e.g., Affleck & Tennen, 1996; Garmezy, 1985, 1987, 1991), as well as psychological adjustment (e.g., Affleck & Tennen, 1996; Connor & Davidson, 2003).

Several instruments have been developed to assess resilience (for reviews see Ahern et al., 2006; Connor, 2006; Estrada & Severt, 2014; Wald et al., 2006; Wagnild, 2009; Windle et al., 2011). However, to date, no universally accepted definition of the construct exists (Meredith et al., 2011) and the psychometric evidence of existing instruments is lacking (Estrada & Severt, 2014; Meredith et al., 2011; Wald et al., 2006; Windle et al., 2011). Much has been learned about the nature and impact of resilience at the individual level of analysis – i.e. *psychological resilience* (Estrada et al., 2016; Fletcher & Sarkar, 2013; Jacelon, 1997; Meredith et al., 2011; Tusaie & Dyer, 2004). However, there is a paucity of research examining whether resilience can be extended beyond the individual to the collective – i.e., *team resilience* (Severt & Estrada, 2015). Indeed, conceptual and theoretical frameworks of the antecedents, moderators, and outcomes of team resilience have only recently emerged (e.g., Alliger et al., 2015; Bowers et al.,

2017). Not surprisingly, the development of team resilience measures is still in its infancy and the scientific quality of team resilience measures remains unknown. Having reliable and valid measures of team resilience is of critical importance to organizations that employ teams to work in austere conditions and require resilience to achieve success (e.g., police, fire, and EMS personnel responding to emergencies involving life-death circumstances; disaster response teams responding to a natural disaster; military units deployed to hostile foreign environments). This paper begins to address this gap in research by critically reviewing tests and measures purporting to assess team resilience. Specifically, the results of a systematic review of instruments that measure team resilience and related constructs is reported. Before describing the main findings of this work, a brief review of the literature on the theoretical conceptualization of resilience and its correlates is provided to contextualize the study.

Conceptualizing Resilience

Contemporary theories of resilience typically conceptualize this construct at the individual level of analysis — i.e., *psychological resilience*. Psychological resilience has been regarded as a multi-dimensional set of traits, processes, and outcomes associated with an individual's response to threatening and/or challenging conditions (Estrada et al., 2016). For example, Wald and colleagues (2006) reviewed conceptual and theoretical definitions of psychological resilience and noted three dimensions of resilience that were commonly cited in the literature, including *adaptivity*, *growth*, and *positive outcomes*. More recently, Meredith and colleagues (2011) identified over 100 definitions of resilience and noted that both *adaptivity* and *growth* were the most salient dimensions of resilience found in the literature. Other definitions of resilience have gone beyond these overarching dimensions and have characterized resilience as either a trait, a process, or an outcome. The sections below briefly summarize relevant conceptualizations of resilience as a trait, process, and outcome at both the individual and collective level of analysis.

Resilience as a Trait

As a trait, *resiliency*[1] includes a constellation of stable dispositional characteristics that allow individuals to respond to threatening or challenging conditions, as well as to loss, trauma, and adversity (Bonanno et al., 2011; Estrada et al., 2016; Jacelon, 1997; Luthar et al., 2000). Trait resiliency encompasses a multiplicity of risk and protective factors that function to mitigate negative effects associated with an adverse event (Fletcher & Sarkar, 2013; Wald et al., 2006). Risk and protective factors span across multiple levels including the individual, family, community, and unit levels (Britt et al., 2016; Meredith et al., 2011; Rutter, 1990; Wald et al., 2006).

At the individual level, risk and protective factors include a wide range of *affective, cognitive*, and *behavioral variables*. *Affective variables* include measures of control, openness to experience, and psychological well-being (Diener, 2000; Garmezy, 1985, 1987, 1991; Luthar, 1991). *Cognitive variables* include measures of intellectual functioning and cognitive appraisals

[1] Whereas resilience is used to refer to either a process or state, *resiliency* is used to refer to relatively stable characteristics or psychological traits associated with responses to a threatening or challenging event (Luthar et al., 2000).

involving threat, safety, and adversity (Bonanno, 2004; Curtis & Cicchetti, 2003; Garmezy, 1985, 1987, 1991). *Behavioral variables* include measures of communication and problem solving skills, coping and help seeking behaviors, and behavioral control (Bonanno, 2004; Garmezy, 1985, 1987, 1991; Werner, 1989).

At the collective level, risk and protective factors encompass *family, community* and *unit* level factors. At the *family level*, risk and protective factors include variables like close, nurturing, and supportive parent-child and family relations, and open and inclusive communication among family members (Bell, 2001; Black & Lobo, 2008; MacDermid et al., 2008; Walsh, 2003). At the *community level*, risk and protective factors include variables such as a sense of connectedness, belongingness, and cohesion with the community, as well as external support and community agency (Bonanno, 2004; Conner & Davidson, 2003; Garmezy, 1985, 1987, 1991; Rutter, 1990). At the *unit level*, risk and protective factors include variables like, teamwork, cohesion, leadership, and organizational climate (Brailey et al., 2007; Harland et al., 2005; Paton, 2006).

Trait conceptualizations of resiliency highlight various risk and protective factors that function to modify, ameliorate, or alter responses to an adverse event (Block & Block, 1980; Rutter, 1990). Moreover, trait conceptualizations of resiliency posit that risk and protective factors extend beyond the individual to collectives of different sizes and composition. Thus, trait conceptualizations of resilience suggest that it is possible for a group of individuals (e.g., team or family, unit or community) to exhibit resilience.

Resilience as a Process

Resilience is also theorized as a dynamic process that enables a person to combine his or her enduring characteristics, abilities, and competencies in order to respond to an adverse event (Agaibi & Wilson, 2005; Estrada et al., 2016; Fletcher & Sarkar, 2013; Jacelon, 1997; Luthar et al., 2000; Tusaie & Deyer, 2004). For example, Richardson (2002) describes resilience as "the process of coping with stressors, adversity, change, or opportunity" (p. 308). Richardson (2002) posits that biopsychospiritual homeostasis of individuals may be influenced by various life events. Disruption in the homeostasis results in efforts to reintegrate in one of four ways, including *resilient reintegration, reintegration back to homeostasis, reintegration with loss,* and *dysfunctional reintegration* (Richardson, 2002). *Resilient reintegration* results in growth, self-understanding, and increased resilience. *Reintegration back to homeostasis* results in pre-event levels of homeostasis. *Reintegration with loss* results in losses in homeostasis levels prior to the event. *Dysfunctional reintegration* results in losses to homeostasis that impairs functioning.

Similarly, Polk (1997) describes resilience as a process resulting from dispositional, relational, situational, and philosophical factors. The dynamic interplay among these factors result in a synergistic process that underlies resilience. Likewise, Agaibi and Wilson (2005) describe resilience as an integrative process between the person and the environment that involves personality, affect modulation, ego defenses, coping style and mobilization, and the utilization of protective factors. Van Vliet (2008) posits that resilience involves a process of rebuilding the self that includes connecting, refocusing, accepting, understanding, and resisting.

At the team level of analysis, Alliger and colleagues (2015) describe resilience as a multidimensional construct that operates at both the individual and team level of analysis. They posit that team resilience involves "the capacity of a team to withstand and overcome stressors in a manner that enables sustained performance and helps a team to handle and bounce back from challenges that can endanger their cohesiveness and performance" (p. 177). Resilient teams are able to engage in behaviors that function to minimize, manage, and mend as a way to deal with pressures, stressors, and difficult circumstances. Similarly, Bowers and colleagues (2017) posit that team resilience emerges from the interplay of input-mediator-outcome variables that operate at the individual, team, and organizational level. Specifically, the authors specify that team emergent states (e.g., shared mental models, collective efficacy, cohesion) synergistically combine in response to significant adversity and result in positive outcomes at the individual, team, and organizational level of analysis. At the unit level of analysis, Cato and colleagues (2018) describe resilience as a process that requires units to use skills, abilities, and resources to prepare, respond, and recover from challenging events or stressors.

Taken together, the above literature suggests that resilience as a process involves a dynamic interplay among person-level factors (e.g., traits, dispositional characteristics, cognitive, and behavioral responses), situational and environmental conditions (e.g., team, organizational, and contextual factors), and an adverse event. Furthermore, this process can unfold over time in distinct phases or stages and result in discernable patterns of interaction among sets of variables that can be useful to characterize both individual- and group-level responses to threatening or challenging conditions. Accordingly, this perspective suggests that team resilience may emerge from the synergistic combination of team member traits, dispositional characteristics, cognitive and behavioral responses, as well as interplay among situational characteristics, environmental conditions, and an adverse event.

Resilience as an Outcome

As an outcome, *resilience* is theorized to be reflected in the pattern of responses a person exhibits in relation to a loss or to a *potentially traumatic event* (PTE; Bonanno et al., 2011). Responses to PTEs are not uniformly negative and may be characterized into one of four prototypical outcome trajectories that include *resilience*, *recovered*, *delayed,* and *chronic*. A *resilience trajectory* is marked by the presence of "transient symptoms and minimal impairment, [coupled with a relatively stable pattern] of healthy physical and psychological functioning [that is experienced] soon after the PTE" (Bonanno et al., 2011, p. 1.4). A *recovery trajectory* is marked by a pattern of "elevated symptoms [with] some functional impairment [that is experienced] after the PTE [and is] followed by a gradual return to normal levels of functioning" (Bonanno et al., 2011, p. 1.5). A *chronic trajectory* is marked by a "sharp elevation in [both] symptoms and functional impairment [that continue] years after the experience of the PTE" (Bonanno et al., 2011, p. 1.5). A *delayed trajectory* is marked by the presence of "moderate to elevated symptoms [of distress that are experienced] soon after the PTE [and] gradually worsen over time" (Bonanno et al., 2011, p. 1.5). Accordingly, this perspective suggests that resilience as an outcome may be observed in the *pattern of responses* that individuals, and by extension teams, exhibit following the exposure to a loss or the experience of PTE(s). Moreover, the pattern of responses may not be static, but vary in reliable and discernable ways. As such, this

perspective suggests that resilience for individuals, and by extension teams, is dynamic, emerging from the interaction of persons within particular situations, and evolve over time.

Correlates of Resilience

A large body of research has identified numerous correlates of resilience. Research shows that psychological resilience is associated with increasing levels of self-determination, self-discipline, and an internal locus of control (Garmezy, 1985, 1987, 1991; Luthar, 1991); increasing humor, optimism, happiness, and subjective well-being (Connor & Davidson, 2003; Garmezy, 1985, 1987, 1991; Masten & Reed, 2002); increasing capacity for emotional expression, positive thinking, and adaptive coping (Bonanno, 2004; Tugade & Frederickson, 2004); higher levels of creativity, critical thinking, and intellectual functioning (Curtis & Cicchetti, 2003; Garmezy, 1985, 1987, 1991; Simonton, 2000); and higher levels of agreeableness, extraversion, and openness to experience (Affleck & Tennen, 1996; Dumont & Provost, 1999; Kobasa, 1979; Tedeschi & Calhoun, 1996, 2004). Psychological resilience has also been shown to correlate with flexibility, patience, and adaptability to change (Block & Block, 1980; Bonanno, 2004; Dumont & Provost, 1999), as well as with good communication and problem-solving skills (Garmezy, 1985, 1987, 1991; Werner, 1989).

Other research has examined the correlates of resilience at the family, community, and organizational levels of analysis (Britt et al., 2016; Meredith et al., 2011; Rutter, 1990; Wald et al., 2006). For example, Meredith and colleagues (2011) identified six family-level correlates of resilience that included emotional ties, communication, support, closeness, nurturing, and adaptability; four community-level correlates of resilience that included belongingness, cohesion, connectedness, and collective efficacy; and three organizational-level correlates of resilience that included strong and positive organizational climate, teamwork, and unit cohesion. Similarly, Britt and colleagues (2016) identified individual, unit, family, and community resources associated with the ability or likelihood that an individual would positively adapt to adversity. Unit-level resources included cohesion, support, and flexibility; family-level resources included support, close relationships, and low conflict; and community-level resources included belongingness and connection (Britt et al., 2016). Though this work has delineated family, community, and organizational variables that may influence resilience at multiple levels of analysis, the empirical evidence is not particularly strong. In fact, Meredith and colleagues (2011) concluded that individual-level correlates of resilience have been more frequently and robustly studied than family-, community-, or organizational-level correlates. Nevertheless, the research to date clearly points to various factors that are associated with resilience at multiple levels of analysis (Bowers et al., 2017; Britt et al., 2016; Meredith et al., 2011; Wald et al., 2006).

Summary and Purpose of the Present Study

To summarize, resilience has been conceptualized as a multidimensional construct that includes three core elements of *adaptivity*, *recovery,* and *growth*. Other research has also conceptualized resilience in terms of traits, processes, and outcomes that can emerge at multiple levels of analysis including the individual, family, community, and unit levels (Britt et al., 2016; Meredith et al., 2011; Wald et al., 2006). Moreover, research also suggests that the interplay

between persons and situations over time can produce prototypical trajectories that can be associated with the experience of a threatening or challenging condition (e.g., PTEs; loss of a loved one, adversity; Bonanno et al., 2011). Other research has shown that resilience is correlated with a number of positive outcomes at multiple levels of analysis (Britt et al., 2016; Meredith et al., 2011; Rutter, 1990; Wald et al., 2006).

Given the many implications that resilience may have on individuals, families, communities, and organizations, it is important to examine the scientific quality of existing measures of this construct at multiple levels of analysis. While several systematic reviews of measures of (psychological) resilience have documented the psychometric properties of various instruments (Ahern et al., 2006; Estrada & Severt, 2014; Wald et al., 2006; Wagnild, 2009; Windle et al., 2011), there is a paucity of research examining the measurement characteristics of resilience at multiple levels of analysis. This paper begins to address the gap in the literature by reporting the results of a systematic review of team resilience measures. This review aims to identify, compare, and critically assess the measurement properties of existing measures of team resilience drawing on methodological approaches described by Estrada and Severt (2014). Specifically, the methodological characteristics of measures are described (e.g., definition, dimensions, samples or population used, level and scale of measurement used, and response formats), structural and psychometric properties of measures are described and evaluated (e.g., factorial structure, reliability, and validity), and the scientific quality of measures is assessed (i.e., global assessment of the scientific quality of empirical evidence for each measure; Estrada & Severt, 2014).

Method

A systematic review of the resilience literature was performed to locate available research and studies describing the development or validation of team-level measures of resilience and related constructs. The sections below describe the general search strategy and measure identification process employed, define measurement characteristics examined for each of the studies included in the review, and outline procedures used for data extraction and evaluation.

Search Strategy and Measure Identification Process

Search Strategy

A systematic review of the resilience literature was performed in EBSCOhost,[2] GoogleScholar, and the Defense Technical Information Center (DTIC)[3] in April, 2019. The

[2] EBSCOhost Research Databases included: PsycINFO; Academic Search Complete; Business Source Premier; Education Research Complete; Leadership & Management Source; PsycARTICLES; Psychology and Behavioral Sciences Collection; SocINDEX with Full Text; Sociological Collection; PsycEXTRA EBSCOhost Research Databases.

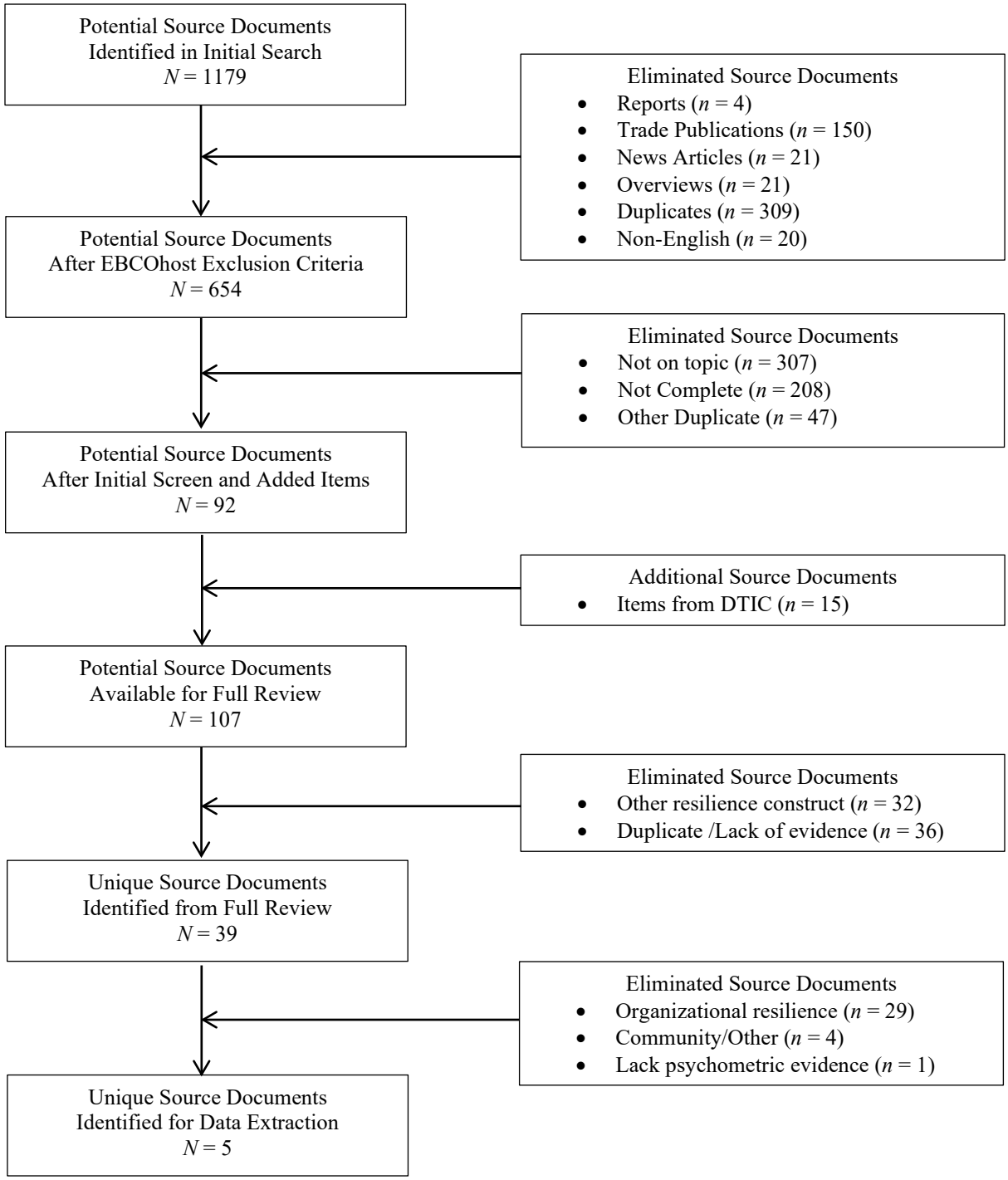
[3] The Defense Technical Information Center (DTIC®) is a Department of Defense (DoD) Field Activity whose mission is "to aggregate and fuse science and technology data…[to inform the] develop[ment of] the next generation of technologies [in] support [of] Warfighters and national security" (https://discover.dtic.mil/)

search strategy sought to uncover any source document (e.g., peer-reviewed journal articles and reports) that described the development or validation of measures of resilience, or analogous concepts at multiple levels of analysis (e.g., group/team/squad/crew resilience; workforce/organizational/company resilience; unit/total force fitness). The following terms were used to perform the search in EBCOhost and GoogleScholar: "*unit* resilien*"* OR *"Team* Resilien*"* OR *"Group* Resilien*"* OR *"squad* Resilien*"* OR *"crew* Resilien*"* OR *"total force fitness"* OR *"Fit* Unit*"* OR *"workplace* resilien*"* OR *"Workforce* Resilien*"* OR *"organization* resilien*"* OR *"compan* resilien*"* OR *"Unit Fitness"* OR *"neighborhood* Resilien*"* OR *"communit* resilien**."

The initial search yielded a total of 1,179 source documents (see Figure 1). Non-empirical reports, trade publications, news articles, overviews, duplicates, or items published in languages other than English were eliminated, reducing the number of source documents to 654. Next, two authors independently screened each of the 654 source documents to ensure each item was on topic, complete, and did not duplicate information from any of the other sources identified. As part of this process, review articles were also screened to further identify any empirical reports of measures of team resilience. This process reduced the number of source documents to 92. A parallel search in DTIC added 15 source documents to the pool of available source documents. Thus, a total of 107 source documents were deemed eligible for review (see Figure 1).

Figure 1

Search Strategy Process and Yield.



Measure Identification Process

Each of the 107 source documents identified were reviewed to ensure that each document conceptualized and measured the construct of resilience at the team-level of analysis. A source document was included if (a) it addressed the construct of resilience at the team level, and (b) reported information on the psychometric properties of the measure. Application of these criteria reduced the total of number source documents to 39. Further examination of the 39 unique source documents revealed that only five documents included adequate information on the measurement of resilience at the team level of analysis (see Figure 1). Table 1 lists each of the source documents included in the review.

Table 1

Measures of Team Resilience

Author	Measure Name	Sample Item
Carmeli et al. (2013)	Top Management Teams Resilience	• When encountering a new and difficult task, we are certain that we can do it successfully • We do not make the necessary changes and adaptations to respond effectively to changes in the industry
Meneghel et al., (2016)	No formal title	• In difficult situations, my team adapts to changes in a positive way, and become stronger when overcome them
Sharma & Sharma, (2016)	Team Resilience Scale	• Mistakes are openly discussed in the team in order to learn from them • Team mates maintain close social relationship with each other • My team is larger than it needs to be • I have confidence that my team members can perform tasks that are assigned to them
Van der Beek & Schraagen, (2015)	Team Resilience Questionnaire	• There are enough people and resources in my team to respond promptly to unexpected situations and events • We regularly reserve time to improve the working methods in our team • The members of my team are sometimes dismissive of people because they are different • My team regularly revises our working methods after a near-accident • If an irregularity/unexpected situation arises during a repair job my team searches actively for information to get a clearer understanding of it
West et al., (2009)	Adapted Psychological Capabilities Questionnaire	• Our team usually manages difficulties one way or another when working

Measurement Characteristics

Each source document was independently reviewed to extract descriptive and psychometric characteristics, and to evaluate the scientific quality of each measure. Approaches described by Estrada and Severt (2014) were followed to define, extract, and evaluate characteristics for each of the measures included in this review. Descriptive characteristics included: (1) definition of the construct; (2) underlying dimensions; (3) sample or population used; (4) level of measurement; (5) scale of measurement; (6) response format; (7) type of measure; (8) format of measure; and (9) sample items. Psychometric characteristics included evidence regarding the measures': (10) reliability (e.g., internal consistency, interrater agreement) and (11) validity (e.g., content, construct, criterion).

Data Extraction and Evaluation

A code sheet was created to document descriptive and psychometric characteristics for each of the measures we reviewed. The code sheet also included a rating matrix used to assess the overall quality of the scientific evidence based on criteria from previous methodological reviews of measures (see Table 2; Cohen et al., 2008; Estrada & Severt, 2014; Meredith et al., 2011; Mokkink et al., 2010; Terwee et al., 2011; Windle et al., 2011). Three authors independently extracted information on the characteristics of each measure (see Table 2). The authors then met to compare extracted data for each of the measures and identify any missing or conflicting information. Through iterative discussion, issues related to missing or incomplete information were reconciled through consensus. No discrepancies were observed in the extraction of data and group discussion were used to address missing or incomplete information. After extracting the data, three authors independently evaluated each measure using the rating matrix of scientific quality (see Table 2). A rating of "none" was assigned to documents that did not include any empirical evidence of scientific quality. A rating of "weak" was assigned to documents reporting partial psychometric evidence or referencing psychometric evidence with limited details. A rating of "moderate" was assigned to documents reporting multiple forms of reliability and validity. A rating of "strong" was assigned to documents reporting multiple and robust forms of reliability and validity.

Table 2

Rating Matrix of Scientific Quality

Rating	Definition[a]	Examples of Reliability and Validity Evidence[b]	
None	The measure has not been subject to scientific study. Document did not include any empirical evidence of scientific quality.	No evidence of reliability was reported (e.g., internal consistency, test-retest or parallel forms; interrater or inter-score agreement).	No evidence of validity was reported (e.g., content, criterion, construct).
Weak	The measure has been studied, but there is minimal or inconclusive evidence. Documents reporting partial psychometric evidence or referencing psychometric evidence with limited details were assigned this rating.	Limited evidence of reliability was reported. For example, some evidence of internal consistency or agreement (e.g., Cronbach's alpha(s) < 0.60; ICC[2]) or test-retest reliability (Pearson r / Spearman rho ≥ 0.2); some evidence of interrater or inter-score agreement (ICC (1)/$AD_{M[J]}$/r_{wg}/weighted Kappa = 0 to .40].	Limited evidence of validity was reported. For example, some evidence of content validity [unclear target population information, aim, or involvement of experts in item selection]; criterion validity [correlation with criterion measure < 0.40]; or construct validity [factor analytical evidence by way of EFA/CFA explaining < 40% of the variance; convergent/divergent-test of hypotheses in expected direction with correlations < .40] was reported.
Moderate	The measure has been studied, and there is clear and consistent psychometric evidence reported across multiple studies that may include correlational or cross sectional data. Documents reporting multiple forms of reliability and validity were assigned this rating.	Multiple forms of reliability were reported. For example, evidence of internal consistency (e.g., Cronbach's alpha(s) ≥ .70; ICC[2]) or test-retest reliability (Pearson r / Spearman rho ≥ .5 to .80); along with evidence of interrater or inter-score agreement (ICC (1)/$AD_{M[J]}$/r_{wg}/weighted Kappa = .40 to .74) was reported in moderate forms.	Moderate forms of validity were reported. For example, content included clear descriptions of one or some of the items for below (for a strong rating, but not all items relevant to target population); for criterion validity, correlations with criterion measure >.40 to .70 were reported; for construct validity factor analytic evidence by way of EFA/CFA explained 40-50% of the variance; convergent/divergent-test of hypotheses were in expected direction with correlations > .41-50.
Strong	The measure has been studied, and there is clear, consistent, and robust psychometric evidence across multiple studies that may employ longitudinal designs. Documents reporting multiple and robust forms of reliability and validity were assigned this rating.	Multiple and strong forms of reliability were reported. For example, evidence of internal consistency (e.g., Cronbach's alpha(s) ≥ .70 to .95; ICC[2]) or test-retest reliability (Pearson r / Spearman rho ≥ .80); along with evidence of interrater or inter-score agreement (ICC (1)/$AD_{M[J]}$/r_{wg}/weighted Kappa = .40 to .74) was reported that were strong in form.	Multiple and strong forms of validity were reported. For example, content included a clear description of measurement aim, target population and investigators or experts involved in item selection (all items relevant to target population); for criterion validity, correlation with criterion measure > 0.70 in at least two studies; for construct validity factor analytical evidence by way of EFA/CFA explained > 50% of the variance; convergent/divergent-test of hypotheses were in expected direction with correlations >.50.

Note. (a) Definition was adapted from Cohen et al. 2008; Estrada & Severt, 2014; Meredith et al., 2011. (b) Examples of reliability and validity criteria evidence were adapted from Cicchetti, 1994; Terwee et al., 2011; Windle et al. 2011.

Results

Five instruments purporting to measure team resilience were identified. These instruments were drawn from a pool of 1,179 source documents identified from our systematic review of measures (see Figure 1). Below we describe descriptive and psychometric characteristics for each of these measures and provide an assessment of the scientific quality of each measure.

Descriptive Characteristics

As seen in Table 3, most of the instruments reviewed were published within the past decade (i.e., 2009-2016). The instrument used different definitions to operationalize team resilience. Definitions encompassed a range of resilience related capacities—a team's belief and capacity to cope, recover, and adjust; the capacity to bounce back; the capacity to respond, monitor, anticipate, and learn; as well as broader psychosocial processes protecting groups from negative stressors (see Table 3). The instruments evaluated a broad spectrum of constructs associated with team resilience including adaptability (e.g., ability to respond, monitor, and anticipate), recovery (e.g., ability to bounce back), or growth (e.g., ability to learn, develop, or grow; Estrada et al., 2016). Items within these instruments assessed general forms of team resilience (e.g., responding, monitoring, anticipating, and learning) as well as specific elements of team resilience (e.g., self and collective efficacy, mastery, social capital, and group structure). Studies of these instruments included samples of employees across a wide spectrum of occupations (e.g., employees, managers, senior executives) and industries (e.g., construction, gas and chemical, information technology, service)—only one study relied exclusively on student samples (West et al., 2009). Moreover, studies of these instruments sampled data from a wide range of countries including India, Israel, Spain, the Netherlands, and the United States. These instruments assessed state-resilience with self-report items using the referent shift approach (Chan, 1998) with most of them purporting to assess resilience directly at the team level of analysis. Most instruments included multi-item statements that were individually rated on a 5-7-point interval scale using anchored response formats (e.g., never-to-always; not at all-to-a large extent). A sample item for a general measure includes "In difficult situations, my team adapts to changes in a positive way, and becomes stronger when overcoming them" (Meneghel et al., 2016), and a sample from a specific measure includes "My team is good at improvising when we are solving an unexpected situation or event" (Van der Beek & Schraagen, 2015). The length of these instruments ranged from six items to over 40 items (see Table 3).

Table 3

Descriptive Characteristics of Measures of Team Resilience or Analogous Construct

Author(s)	Definitions, Dimensions, and Respondents	Measure Type, Format, and Scale	Reliability, Validity, and Scientific Quality
1. Carmeli et al. (2013)	• Definition: Team's belief that it can absorb and cope with strain; and capacity to cope, recover and adjust positively to difficulties. • Dimensions: Efficacious Beliefs (3 items); Adaptive Capacity (3 items) • Respondents: 228 senior executives from 74 Top Management Teams in Israel	• Direct self-report state-measure of group • 5-point interval scale ranging from "Not at all" to "A Large Extent"	• Reliability: α = .82/.88; r_{wg} = .87/.83; *ICC*(1) = .54/.52; *ICC*(2) = .86/.80; for efficacious beliefs and adaptive capacity respectively. • Validity: Resilience (efficacy) correlated positively with top management team financial performance (.37), connectivity (.42). strategic decision comprehensiveness (.51). Resilience (adaptive capacity) correlated positively with top management team financial performance (.40), connectivity (.50). strategic decision comprehensiveness (.62). • Scientific Quality: Weak (3)
2. Meneghel et al. (2016)	• Definition: Capacity to bounce back from failure, setbacks, conflicts, or any other threat to well-being. • Dimensions: Global Resilience (7-items) • Respondents: 1,076 employees from 216 teams in 40 companies (construction, service and industry) in Spain	• Direct self-report state-measure of group • 7-point interval scale ranging from "Never" to "Always"	• Reliability: α = .85 Individual; α = .87 Team; *ICC*(1) = .10 -.14. $AD_{M(J)}$ = .72 - .97. • Validity: Team resilience correlated positively with team-level enthusiasm (.59), optimism (.59), satisfaction (.56), comfort (.58), relaxation (.41), in-role performance (.17); extra-role performance (.19); and negatively with team size (-.15). • Scientific Quality: Weak (3)
3. Sharma & Sharma (2016)	• Definition: Dynamic psychosocial process which protects a group from potential negative effects of stressors they collectively encounter. • Dimensions: Group Structure (15 Items); Mastery (18 Items); Social Capital (9 Items); Collective Efficacy (8 items) • Respondents: 152 IT executives from 12 IT companies in India	• Direct self-report state-measure of group • 5-point interval scale ranging from SD/SA	• Reliability: α = .72 - .87 • Validity: N/A • Scientific Quality: Weak (1)
4. Van der Beek & Schraagen (2015)	• Definition: Ability to respond, monitor, anticipate, and learn. • Dimensions: Responding (9 items); Monitoring (11 items); Anticipating (5 items); Learning (4 items) • Respondents: 91 employees from a gas fitter or chemical companies in The Netherlands	• Direct self-reported state-measure of group • 5-point interval scale ranging from SD/SA	• Reliability: α = .49 - .87 • Validity: N/A • Scientific Quality: Weak (1)
5. West et al. (2009)	• Definition: Capacity to bounce back from failure, conflicts or any other thereat to well-being that a team may experience • Dimensions: Global Resilience (6 items) • Respondents: 308 students in management from 101 project teams in the United States	• Direct self-report state-measure of group • 6-point interval scale ranging from SD/SA	• Reliability: α = .76; r_{wg} = .58/.79 • Validity: Resilience correlated positively with team-level efficacy (.70/.76), optimism (.69/.76), cohesion (.43/.40), cooperation (.37/.49), coordination (.54/.55), satisfaction (.53/.52); and negatively with team-level conflict (-.21/-.42) • Scientific Quality: Weak (3)

Note. N/A indicates data were not available. r_{wg} is a measure of collective agreement used to justify aggregation and interpretation of a group level construct, with minimum levels set at .70 (James et al., 1984). ICC(1) is an intraclass correlation coefficient used to measure the relative consistency of response among raters of the same group, with ICC(1) values greater than .05 considered adequate to justify aggregation (Bliese, 2000). $AD_{M(J)}$ is a measure of within-group agreement developed to evaluate evidence of team agreement, with values equal to or less than 1.0 considered adequate to establish team agreement (Burke et al., 1999). For the rating of scientific quality "none" refers to instances where documents did not include any empirical evidence of scientific quality; "weak" refers to instance where documents reported partial psychometric evidence or referenced psychometric evidence with limited details; "moderate" refers to instances where documents reported clear and consistent evidence of reliability and validity across multiple studies employing correlational or cross-sectional designs; and "strong" refers to instances where documents reported clear, consistent and robust evidence of reliability and validity across multiple studies including longitudinal designs.

Psychometric Characteristics

Next, the psychometric properties of these instruments were examined for evidence of reliability and validity. Reliability evidence included estimates of internal consistency (e.g., Cronbach alpha coefficient; Cronbach, 1951), as well as estimates of interrater agreement, such as the r_{wg} index (James et al., 1984), the Intraclass correlation (ICC[1]; Bliese, 2000), and the Average Deviation Index ($AD_{M[J]}$; Burke et al., 1999). The Cronbach alpha coefficient is used to determine whether a set of items measuring a given variable are sufficiently correlated with each other in order to be aggregated into a single composite score to represent that variable (Cronbach, 1951). Cronbach alpha coefficients can range from 0 to 1.0, with values ranging from .70 to .80 considered to provide adequate evidence of item consistency reliability for research purposes (Nunnally & Bernstein, 1994). The r_{wg} index is used to determine whether sufficient agreement among individuals' responses on a given variable exists (i.e., within-group agreement) to represent a team's collective standing on that variable (e.g., aggregating individual ratings within a team to represent a team-level score), with levels above .70 considered to provide sufficient justification for aggregation and interpretation of scores to the team level of analysis (James et al., 1984). The ICC(1) is an intraclass correlation coefficient used to determine whether responses among a group of raters are consistent (i.e., interrater agreement), with values > .05 considered adequate to justify aggregation and inference to the team level of analysis (Bliese, 2000). The $AD_{M(J)}$ index is used to determine whether similarity among individual responses in a group provide evidence of within group agreement (Burke et al., 1999). Unlike, the r_{wg} and the ICC(1), the $AD_{M(J)}$ expresses agreement in terms of deviation of individual responses from the group mean and does not require the definition of a theoretical distribution. $AD_{M(J)}$ values ≤ 1.0 are considered adequate to justify aggregation and inference to the team level of analysis (Burke et al., 1999).

As shown in Table 3, estimates of reliability (as measured by Cronbach alpha) ranged from .49 to .88, with a majority of measures having acceptable levels of reliability for research purposes (i.e., $\alpha = .70$ to .80; Nunnally & Bernstein, 1994). While estimates of internal consistency, like Cronbach's alpha, provide evidence of item reliability, they do not indicate whether individual-level responses to these items can be aggregated and interpreted to infer the existence of the variable at the team-level of analysis. Estimates of agreement like those noted above (e.g., r_{wg}, ICC[1], $AD_{M[J]}$,) can be used to justify aggregation and to determine whether the aggregate score can be used to infer the existence of that variable at a higher level of analysis—i.e., aggregating individual responses to infer existence of a specified variable at the team level (Bliese, 2000; Burke et al., 1999; James et al., 1984). Examination of the evidence in support of within-group or interrater agreement was limited. Few of these studies provided evidence to justify aggregation and interpretation of individual-level responses to the team level of analysis (see Table 3). In fact, only three of the five instruments documented any evidence of within-group or interrater agreement (Carmeli et al., 2013; Meneghel et al., 2016; West et al., 2009). For the three studies that included estimates of agreement, the data revealed patterns that were consistent with recommended standards to justify aggregation, with reported ICC(1) values exceeding .05 (Bliese, 2000), $AD_{M[J]} \leq 1.0$ (Burke et al., 1999) and $r_{wg.} \geq .70$ (James et al., 1984). Thus, for these three measures, evidence of within-group agreement indicated that individual scores could be aggregated to infer the existence of a team-level construct—i.e., team resilience.

Examination of the evidence of validity for most measures was quite limited, though consistent with theoretical expectations for team resilience and related constructs. As shown in Table 3, only three of the five studies included any type of evidence of validity (Carmeli et al., 2013; Meneghel et al., 2016; West et al., 2009). Carmeli and colleagues (2013) reported significant associations among team-level resilience (defined in terms of efficacy and adaptive capacity—i.e., adaptability) and top management team financial performance, connectivity, and strategic decision comprehensiveness. Meneghel and colleagues (2016) reported significant positive associations among team-level resilience (defined in terms of the ability to bounce back—i.e., recovery) and team-level enthusiasm, optimism, satisfaction, comfort, relaxation, and in-role performance. Meneghel and colleagues (2016) also found significant negative associations among team-level resilience and extra-role performance and team size. West and colleagues (2009) reported significant positive associations among team-level resilience (defined in terms of the ability to bounce back—i.e., recovery) and team-level efficacy, optimism, cohesion, cooperation, coordination, and satisfaction. West and colleagues (2009) also found significant negative associations among team-level resilience and team-level conflict.

Scientific Quality of Measures

Next, the scientific strength of the psychometric evidence was evaluated using the scientific quality rating matrix (see Table 3). A rating of "none" was assigned if the source document did not include any empirical evidence of scientific quality. A rating of "weak" was assigned if the source document Document reported partial psychometric evidence or referenced psychometric evidence with limited details. A rating of "moderate" was assigned if the source document reported multiple forms of reliability and validity. A rating of "strong" was assigned if the source document reported multiple and robust forms of reliability and validity. Only three of the studies included detailed evidence of reliability and validity to allow us to assess the scientific quality of these measures (Carmeli et al., 2013; Meneghel et al., 2016; West et al., 2009) and the remaining two studies reported limited evidence of reliability (Sharma & Sharma, 2016; Van der Beek & Schraagen, 2015). Collectively, the evidence reported across these studies was quite limited and in some cases insufficient, rendering the scientific quality of these measures to be generally weak (see Table 3). Though studies by Carmeli et al. (2013), Meneghel et al. (2016), and West et al. (2009) provided multiple forms of evidence of reliability and validity, the evidence was limited to that of a single study and therefore judged to be insufficient to meet the moderate or strong rating.

Discussion

Estrada and colleagues (2016) noted that the concept of resilience has become increasingly popular among scientists, practitioners, and the general public. Much has been learned about the nature and impact of resilience at the individual level of analysis (Fletcher & Sarkar, 2013; Jacelon, 1997; Meredith et al., 2011; Tusaie & Dyer, 2004). However, there is a dearth of research examining resilience beyond the individual to the collective (Severt & Estrada, 2015). Given the many implications that resilience may have on individuals, families, communities, teams, and organizations, it is important to examine the scientific quality of existing measures of this construct at multiple levels of analysis. For military organizations, like the U.S. Army, that employ teams to work in austere conditions which require resilience to achieve success, having reliable and valid measures of team resilience is critical to achieve optimal performance. Moreover, having reliable and valid measures to assess team resilience can have implications on how to monitor, improve, and enhance training designed to foster resilience among military teams. This report begins to address this gap in the research literature by critically reviewing tests and measures purporting to assess team resilience.

A systematic review of the resilience literature was performed to identify and evaluate the quality of measures of team resilience. Five measures were identified from a pool of 1,179 source documents that met screening and inclusion criteria. These measures assessed a broad spectrum of constructs, and sampled employees across different occupations, industries, and countries. They also assessed state-resilience directly with self-report items that used the referent shift approach (Chan, 1998) at the team level of analysis. Whereas most measures reported some evidence of reliability (e.g., internal consistency, interrater agreement), there was limited evidence of validity (e.g., construct, content, criterion). Given the limited evidence of reliability and validity, we determined that the scientific quality of these measures was weak. Implications of our findings are discussed in the sections below.

Conceptual and Theoretical Implications

Consistent with methodological reviews of measures of *psychological resilience* (Ahern et al., 2006; Estrada & Severt, 2014; Wald et al., 2006; Wagnild, 2009; Windle et al., 2011), most team resilience measures lacked a conceptual definition grounded in the theoretical literature (e.g., Bonanno et al., 2011; Luthar et al., 2000; Richardson, 2002). Whereas most definitions and measures addressed either adaptability (e.g., Carmeli et al., 2013; Van der Beek & Schraagen, 2015; West et al., 2009), recovery (e.g., Carmeli et al., 2013; Meneghel et al., 2016; Sharma & Sharma, 2016; West et al., 2009), or growth (e.g., Van der Beek & Schraagen, 2015), none of the definitions or measures addressed all elements of resilience delineated in theory and investigated in empirical studies (Britt et al., 2016; Estrada et al., 2016; Luthar et al., 2000; Meredith et al., 2011; Wald et al., 2006). Moreover, most measures confounded the antecedents, outcomes, and covariates of resilience, with resilience itself. For example, Carmeli and colleagues (2013) included items assessing efficacious beliefs and adaptive capacity to measure resilience. Meneghel and colleagues (2016) included items assessing social support and financial solvency, and adaptability to measure resilience. Sharma and Sharma (2016) included multi-item scales to assess mastery (e.g., learning orientation, flexibility), group structure (e.g., team composition, group norms), social capital (e.g., trust, network ties), and collective efficacy

(e.g., perceived efficacy of team members and collective team action) to measure resilience. Van der Beek and Schraagen (2015) included multi-item scales to assess a team's ability to anticipate, monitor, respond, and learn, to measure resilience. While constructs like efficacious beliefs, collective efficacy, social support, mastery, group structure, and a team's ability to anticipate, monitor, and respond may be associated with resilience, these constructs are *not* resilience per se. While this state of affairs may be a byproduct of the nascent nature of this literature, emerging conceptualizations and theories of team resilience should inform, influence, and impact the development and refinement of measures of team resilience (e.g., Alliger et al., 2015; Bowers et al., 2017).

Britt and colleagues (2016) highlighted the importance of distinguishing between the capacity for resilience (e.g., personal, familial, organizational, and community factors associated with resilience) and the demonstration of resilience (i.e., documentation that individuals encountering significant adversity have exhibited positive adaptation). In addition, Britt and colleagues (2016) highlighted the importance of measuring resilience independently from both an adverse event and from those factors associated with the capacity for resilience. Most measures reviewed, measured and evaluated, antecedents, outcomes, and covariates of resilience concurrently, and presumed these variables aligned perfectly with resilience. Unfortunately, this is an all too common occurrence in this literature (see Estrada & Severt, 2014), which leads to the development of models that are domain specific rather than universal, and measures that fail to integrate items and variables studied across populations and settings. Thus, it can be argued that "resilience is in the eye of the beholder," that is, resilience means different things to different people. Regretfully, this state of affairs is evident across the empirical literature and in the measurement of the team-resilience construct as well.

Estrada and colleagues (2016) have advanced a theoretical definition of psychological resilience that can serve to inform the conceptualization of team resilience. Based on their proposed theoretical definition, it is proposed that team resilience should be conceptualized *as a dynamic process by which [team member's] characteristics, abilities, and competencies may be combined to enable a [team] to adapt, recover, and grow in response to threatening or challenging conditions, and to loss, trauma, and adversity more generally* (Estrada et al., 2016). This conceptualization of team resilience implies that many of the individual difference variables investigated within the literature to date are best regarded as antecedent or covariates of resilience, and are thus not synonymous with *resilience* itself. This conceptualization of team resilience is consistent with emergent models and theories advanced by Alliger et al (2015) as well as Bowers et al (2017) both of whom contend that team resilience is best conceptualized as a process that emerges from the interplay of individual, team, and organizational distal and proximal variables. Given the conceptual and theoretical issues raised above, there are several methodological issues that merit careful consideration and we address these in the section below.

Methodological Implications

Research Design Considerations. With regard to research design concerns, we note several issues. All measures included in the review assessed resilience directly using self-report methodology. Using self-reports is common in the study of psychological phenomena, but it is not the only method. Relying on self-reports of psychological phenomena involving teams is

problematic because team members' reports may be more susceptible to response distortions (e.g., social desirability, flooring, and ceiling effects). Asking team members to provide self-reports of their team on multiple psychological constructs may yield ratings that either under- or over-estimate the team's standing on those variables due to a desire of team members to portray the team in a particular way (e.g., highly favorable or unfavorable). Accordingly, researchers should employ multiple approaches to measure team resilience (e.g., unobtrusive measures, behavioral measures).

Another concern involves the overreliance on cross-sectional designs. Most of the studies we reviewed employed cross-sectional designs that generated a single type of data (e.g., self-reported survey data) collected at a single time point (i.e., data collected on a single occasion). Estrada and colleagues (2016) have noted that cross-sectional designs are helpful for understanding simple relationships between resilience and resilience-related constructs. However, causal relationships between significant adversity and resilience cannot be determined without incorporating the effect of time. This is particularly important if we assume that: 1) resilience is exhibited in response to significant adversity; and, 2) resilience is demonstrated in a person or team's ability to adapt, recover, and grow from adversity. Cross-sectional designs do not account for the time lag necessary for all of these relationships to unfold. Moreover, retrospective cross-sectional designs may artificially compress adversity and resilience into shorter periods, making it difficult to study the time-dependent nature of these relationships. Accordingly, researchers should employ longitudinal designs to study team resilience (Britt et al. 2016).

Britt and colleagues (2016) have noted the importance of measuring adversity independently from resilience. Estrada and colleagues (2016) also suggested that the measurement of adversity should assess not only the presence of adversity but also its frequency, intensity, and duration. Measuring these qualities of adversity independently and comprehensively can reduce the chances of introducing measurement contamination that is common to cross-sectional designs and enhance our ability to make causal inferences regarding resilience at multiple levels of analysis.

Statistical Analyses and Reporting. With regard to the statistical evaluation of different elements of resilience (i.e., adaptability, recovery, and growth), almost none of the studies included in this review provided rigorous evidence concerning the structural properties of their team resilience measure. Structural properties refer to dimensional analyses examining the intercorrelation among items in a scale and/or the intercorrelation among subscales within a measure. To assess structural properties, researchers need to perform appropriate statistical analyses, such as factor analysis or multidimensional scaling. From this perspective, only Sharma and Sharma (2016) reported any results of factor analyses that explicitly examined the structural properties of their measure. However, given that Sharma and Sharma (2016) did not provide evidence of validity, it was not possible to discern whether any of the elements of resilience they assessed were differentially associated with the antecedents, outcomes, or covariates reported in the literature. The lack of statistical examination of the structural properties of team resilience measures is noteworthy and important to address in future studies.

In fact, extant theories of resilience (e.g., Bonanno et al., 2011; Luthar et al., 2000; Richardson 2002) suggest that the evaluation of team resilience measures should include items to assess adaptability, recovery, and growth; and should examine the intercorrelation among items using factor analytical or multidimensional scaling techniques in order to discern proper ways to score and interpret team-level results.

With regard to the reporting of statistical evidence, there was limited documentation of psychometric properties. Only three of the five measures reviewed provided evidence of reliability that served to substantiate aggregation and interpretation of team-level resilience (e.g., Carmeli et al., 2013; Meneghel et al., 2016; West et al., 2009). In other instances, reliability evidence was limited to estimates of internal consistency, yet measures were purported to assess resilience at the team level (e.g., Sharma & Sharma, 2016; Van der Beek & Schraagen, 2015). In order to infer resilience at the team level of analysis, it is necessary to estimate within-group or interrater agreement.

Validity evidence included a mix of group-level correlates of team resilience (e.g., Carmeli et al., 2013; Meneghel et al., 2016; West et al., 2009). Carmeli and colleagues (2013) found that team resilience (i.e., collective efficacy and adaptive capacity) was associated with top management team connectivity and strategic decision comprehensiveness. Meneghel and colleagues (2016) found that team resilience (i.e., recovery) was associated with collective-positive emotions (i.e., enthusiasm, optimism, satisfaction, comfort, and relaxation), and team in-role and extra-role performance. West and colleagues (2009) found that team resilience (i.e., recovery from adversity) was associated with team cooperation and cohesion.

Given the limited evidence of reliability and validity reported for the measures that were reviewed, it was difficult to discern their scientific quality. The limitations notwithstanding, we concluded that the scientific quality of existing measures of team resilience was weak. It is recommended that researchers evaluating team resilience measures should assess both internal consistency and within-group or interrater agreement. Furthermore, researchers should assess the validity of scales, including construct, content, and criterion validity for both composite and/or subscale scores of team resilience.

Research and Practical Implications

Given the theoretical/conceptual and methodological/statistical issues described above, it is difficult to recommend the use of a specific measure of team resilience. Instead, it is recommended that researchers continue working on the development and refinement of a team resilience measure. Such efforts should take into account relevant theories and empirical studies on resilience as noted above as well as more recent models that explicitly address team resilience (Alliger et al., 2015; Bowers et al., 2017). Furthermore, it is recommended that researchers perform and report results of structural and psychometric analyses that substantiate resilience at the team level of analysis. Specifically, researchers should routinely include statistical analyses designed to evaluate the structural characteristics of measures using factor analytical or multidimensional scaling techniques, examine reliability of measures at the team level of analyses employing appropriate tests of within-group and interrater agreement (e.g., r_{wg}, James et al., 1984; ICC[1] Bliese, 2000; $AD_{M[J]}$, Burke et al., 1999), include robust testing of validity

(e.g., construct, content, and criterion), and employ repeated measures or longitudinal designs. Table 2 provides a rubric outlining the types of structural and psychometric evidence worth collecting in future studies. Finally, it is recommended that studies of measures of resilience include measures of antecedents, outcomes, and covariates of resilience that are consistent with theories and empirical studies.

Conclusions

This paper sought to identify, compare, and critically assess the measurement properties of existing measures of team resilience. Although 1,179 source documents were initially identified, only five of these documents included sufficient information on measures that met our screening and inclusion criteria. Admittedly, the inclusion criteria used may have limited the search and identification of additional measures. However, the comprehensive nature of the search in multiple databases coupled with supplemental searches of past reviews provided a reasonable approach to yield what may have been available in the published peer-reviewed literature at this time. That said, it is acknowledged that despite these efforts, other measures may have been missed. This review was limited because of the general lack of psychometric information reported within the literature. Accordingly, it was not possible to rigorously assess some of the measures that survived initial screening and subsequent evaluation. Clearly, there is a critical need to improve reporting of structural and psychometric properties of team resilience measures. Therefore, it is recommended that the scientific community to continue working on the development and refinement of team resilience measures.

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