

Development and Validation of an Instrument that Assesses Individual Differences in Threat and Challenge Appraisal

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Rec Date: July 19, 2018; Acc Date: July 31, 2018; Pub Date: August 06, 2018

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Abstract

Objective: This paper documents the development and validation of the Appraisal of Challenge or Threat Scale, a measure of individual differences in the tendency to appraise situations as threats or challenges. In addition to avoiding construct confounding inherent in existing measures, the scale assesses appraisal in a manner consistent with the original experimental studies delineating threat and challenge responses to stress.

Method: Three studies using survey methods examined the psychometric properties of the scale and its relation to measures of the stress response, coping, and stress-related outcomes.

Results: Exploratory and confirmatory factor analysis provided consistent evidence for the scales structure. Correlations provided evidence of validity.

Conclusion: The results provide evidence for the factor structure, reliability, and construct validity of the measure of individual differences in the appraisal of stressful events as threats or challenges.

Keywords: Appraisal; Threat; Challenge; Stress; Coping; ACTS Scale; Scale development

Introduction

Cognitive-relational stress theory defines appraisal as the process of classifying situations and events based on their significance for well-being [1-3]. In Lazarus and Folkman's [2] original conception, primary appraisal reflected evaluations of a situation as irrelevant, benign-positive, or stressful whereas secondary appraisal reflected an evaluation of options and resources for coping. "Stressful" primary appraisals included harm/loss, threat, or challenge with harm/loss reflecting events that had already transpired. Threat and challenge, in contrast, were anticipatory reflecting situations lacking a determined outcome. Threat appraisal reflected situations having the perceived potential for harm or loss and produced emotions such as fear, anxiety, and worry. Challenge appraisal reflected situations having the potential for gain, growth, or mastery and produced feelings of eagerness, excitement, and exhilaration [4-8]. Several decades of work on the anticipatory stress appraisals has enhanced the distinction between threat and challenge [5-8]. Such research has further delineated the nature of the appraisal processes in each, identified factors leading to the likelihood of making each type of appraisal, and by identifying the affective, behavioral, and physiological consequences of such appraisals. Regarding delineation of the appraisal process, Tomaka et al. [4] and others [7,8] have suggested that threat and challenge reflect coordinate consideration of both the situation (i.e., primary appraisal) and one's abilities or resources for coping (i.e., secondary appraisal). As

such, threat and challenge reflect different appraisal patterns across primary and secondary appraisal dimensions.

In this view, what makes a situation challenging is the overall perception that although an individual may face significant situational demands, he or she also possesses the resources, skills, or abilities required to deal with such demands. By contrast, what makes a situation threatening is the perception that current demands exceed one's resources or abilities to cope with them [6,9,10]. This formulation of appraisal as reflecting a relationship between perceived demands and coping abilities is highly consistent with Lazarus and Folkman's [1] original definition of stress as "a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" (p.19).

To date, numerous studies spanning several decades have supported this conception of threat and challenge appraisals and their respective affective, behavioral, and physiological outcomes. These include initial validation studies [6,11], studies examining personality correlates of threat and challenge [12-17], studies of the implications of threat and challenge for task performance [18-20] and sports performance [21,22], and studies citing implications for health outcomes [23-26].

Individual differences in cognitive appraisals of threat or challenge

Although appraisal is inherently a situational construct, many have recognized that appraisals may also reflect dispositional tendencies [12-16]. Moreover, the notion of stable individual differences in stress

appraisal and responding is essential if such responses are to impact health outcomes, particularly those that develop over extended periods of time including coronary heart disease and hypertension [27,28].

Perhaps reflecting these concerns, researchers have developed several measures of cognitive appraisal. Such instruments include semantic differential assessment of potentially stressful appraisals [29]; Peacock and Wong's Stress Appraisal Measures (SAM) [30] for adults and Stress Appraisal Measure for Adolescents (SAMA) [31]; the Appraisal of Life Events Scale (ALE) [32]; the Stress Appraisal Inventory for Life Situations (SAILS) [33]; and the Cognitive Appraisal Scale (CAS) [34].

Despite the potential utility of such measures, they have share significant limitations. For example, many confound appraisal per se with other aspects of the stress process including aspects of the emotional reaction, overall perceived stressfulness, coping, and personality. Sometimes this confounding is inherent in the assessment technique scale (e.g., Fish's semantic differentials assessment) and other times it is by the inclusion of items or subscales reflecting constructs other than cognitive appraisal (e.g., Skinner and Brewer's CAS). As such, these instruments do not measure individual differences in appraisal processes or tendencies per se, but rather assess multiple correlates of threat and challenge experiences including affective and behavioral reactions, stress consequences, coping activities, and stress-related personality dimensions [35,36]. Such confounding is important because, by confounding appraisal (i.e., the initial cognitive processing of a potentially stressful situation) with later stages of the stress response sequence (e.g., affective reactions, behavioral response), such measures will necessarily predict other stress processes such as coping and emotional well-being because of construct confounding, and not because of any true relationship between appraisal processes and adaptational outcomes.

The second limitation of existing measures is that none assesses threat and challenge appraisals in a manner consistent with the psychophysiological studies establishing the construct validity of these constructs. As noted above, considerable research has elucidated threat and challenge as distinct stress processes with unique emotional, behavioral, and health-related outcomes. Such outcomes have included unique physiological patterns with implications for disease [6,7,11,16]; emotional reaction [37], psychological well-being [38], and behavioral performance in sporting situations [22] and in medical emergencies [23]. Despite the utility of the threat and challenge distinction, researchers do not yet have a validated self-report instrument that accurately reflects this body of work on the distinction of threat and challenge appraisals and reactions.

Accordingly, we describe the development and validation of an instrument that assesses individual differences in the tendency to appraise events as threatening or as challenging and that which does so without confounding cognitive appraisal processes with other aspects of stress and coping responses. The first study was exploratory and established the content domains for the Appraisal of Challenge or Threat Scale (ACTS); the second and third studies provided confirmatory evidence of the scale's factor structure. All studies provided evidence for the construct validity of the scale.

Research Methodology

Participants

Studies 1 and 2 included 166 and 244 college students, respectively. Participants in both were students enrolled in a large University in the southwestern region of the United States. Study 3 included 740 municipal firefighters from a large metropolitan fire department. The university IRB reviewed and approved all studies; students participated voluntarily in exchange for course credit whereas firefighters participated voluntarily as part of their normal training cycle activities. The student samples, from study 1 and study 2, had mean ages (SD) of 23.82 (6.07) and 23.91 (5.88), respectively, were predominantly female (73% and 67%, respectively), and Hispanic (78% and 79%, respectively). The firefighter sample had a mean age of 38.24 (8.06), was predominantly male (98%), and Hispanic (75%).

Measures

Appraisal of Challenge and Threat Scale (ACTS). The Appraisal of Challenge or Threat Scale was based on laboratory research examining threat or challenge appraisals and responses in potentially stressful active coping tasks (i.e., motivated performance situations; Tomaka et al., [6,7,11]. Items ask respondents to appraise a variety of potentially stressful situations that they might face in daily life. The rationale behind the scale was to present respondents with a series of potentially threatening or challenging situations and then to have them appraise that situation in terms of the level of perceived demand and subjective ability to cope. Thus, ACTS "items" reflect common, potentially stressful events that most individuals can at least imagine encountering in daily life and which required or allowed some form of coping response.

Preliminary lists of such events were compiled by approximately 15 research assistants reflecting on their own and others' experiences. To avoid confounding appraisal with other aspects of the stress and coping response, we eliminated all events initially proposed that described affective and behavioral reactions, coping, and/or stress-related personality dimensions (e.g., low self-esteem, social anxiety, fear of negative evaluation, and poor overall self-confidence). After the elimination of duplicates, 38 distinct events remained. Sample items included, "You find that someone has said something negative about you," "You encounter unexpected medical expenses," "A supervisor asks you to give a speech," and "You have an argument with a partner or spouse".

The initial version of the scale presented the 38 items (i.e., events) individually, accompanied by primary and secondary appraisal questions, for primary appraisal, "How demanding is this event to you", and for secondary appraisal, "How able are you to take action to deal with it?" Each had a 5-point scale ranging from "not at all" to "very much." The difference between primary and secondary appraisal reflects the degree to which demands exceed resources, or degree of threat (with demands exceeding resources) or challenge (demands countered by resources). Thus, total scores were calculated by first taking the difference between the two appraisal subscales for each event, then taking the mean of the resulting differences to derive overall appraisal tendency scores. Positive scores indicate a tendency to appraise events as threatening, perceiving demand to exceed coping abilities; negative scores indicate a tendency to appraise events as challenging, perceiving demands to be within coping abilities; scores at or near zero reflect no clear tendency. In addition to overall appraisal

scores, we also anticipated that the items would cluster into several domains. A priori, we anticipated five domains including self-concerns (health, esteem, identity), financial concerns, work/school hassles, relationships with family and others, and transportation.

Perceived Stress Scale (PSS). The PSS is a 14-item instrument that assesses overall stress levels by measuring the degree to which ongoing situations in life are appraised as stressful [9]. Typical items ask about frequency of experience of stressful emotions and feelings that one was able to keep up with demands. Items include, “how often have you felt nervous and “stressed”, “how often have you felt that things were going your way”, and “how often have you found that you could not cope with all the things that you had to do.” Each item was rated on a frequency scale from 1=never to 5=very often.

Brief Coping. The Brief Coping is a 28-item instrument that assesses individual coping efforts across multiple forms of coping including active coping, planning, positive reframing, acceptance, humor, religion, emotional support, instrumental support, self-distraction, denial venting, substance use, behavioral disengagement, and self-blame [39]. All items asked how the individual has been dealing with stress within the past three months (e.g., “I’ve been taking action to try to make the situation better”) on scales ranging from 1=I haven’t been doing this at all to 4=I’ve been doing this a lot.

Cognitive Appraisal Scale (CAS). The CAS is an 18-item measure with separate Threat and Challenge subscales [34]. The 10-item Threat Appraisal subscale contains items from existing anxiety and other measures [34,40]. According to the authors, the threat scale assesses the “tendency to focus on possible harm to one’s self-esteem and social identity posed by the disapproval and negative evaluation of others in addition to a low self-confidence in one’s ability to cope with stressful or demanding situations” (p. 681). The 8-item Challenge Appraisal subscale includes one item from another scale [41]. According to the authors [34], “the Challenge Appraisal subscale focused on the anticipation of success and positive outcomes and confidence in one’s capacity to obtain such goals” (p. 681).

PTSD Checklist-Civilian Version (PCL-C). The PCL-C is a 17-item instrument that assesses symptoms of post-traumatic stress within the past 30 days [42]. Items reflect DSM-IV Criteria B, C, and D for PTSD (symptoms of intrusion, avoidance, and hyperarousal). Statements included in the PCL-C involve, “Repeated, disturbing memories, thoughts, or images of stressful experiences from the past?” and “Suddenly acting or feeling as if a stressful experience were happening again (as if you were reliving it)?” Responses are made on a 5-point scales ranging from 1=not at all to 5=extremely.

Satisfaction with Life Scale (SWLS). The SWLS is a short, 5-item instrument designed to measure global cognitive judgments of one’s life [43]. The scale includes items such as, “In most ways, my life is close to my ideal,” “The conditions of my life are excellent,” and “I am satisfied with my life.” Each item is accompanied by a seven-point scale ranging from 1=strongly disagree to 7=strongly agree.

Procedure

For studies 1 and 2, research assistants recruited student volunteers and administered surveys during regularly scheduled class times. Study 1 included a limited number of measures, including the initial iteration of the ACTS; Study 2 included a wider variety of measures. We also assessed basic demographics (e.g., age and gender) in all studies. Study 3 included a census of a metropolitan fire department with approximately 90% of department members completing the survey as part of a larger dissertation study.

Results

Study 1

We first calculated individual appraisal scores at the item level by subtracting the appraisal of coping ability from the appraisals of situational demand and examined each for maintenance of distributional characteristics and potential floor and ceiling effects. All items proved sufficient for inclusion in subsequent analyses. Principal components analysis in SPSS (Version 19.0) examined the initial factor structure of the 38 items. Examination of the resulting eigenvalues, scree plots, and rotated solutions using oblimin rotation suggested that a six-factor model provided the most parsimonious solution. This solution eliminated nine items from the original pool of 38 that did not load 0.32 or greater on any factor.

Table 1 shows the results of this analysis. Factor 1 contained items assessing interpersonal conflict and was labeled Conflict Situations. Factor 2 contained items assessing receipt of medical news, sudden illness, or accidents and was labeled Unexpected Events. Factor 3 contained items relating to giving speeches and making presentations and introducing oneself and was labeled Public Speaking. Factor 4 contained items relating to one’s automobile or commute and was labeled Transportation. Factor 5 contained items relating to meeting new people, being social, and potentially awkward social situations and was labeled Social Anxiety. Finally, Factor 6 contained items assessing credit and banking issues or financial pressures and was labeled Financial.

Variables	Component					
	1	2	3	4	5	6
Conflict Situations						
Friends talking behind your back	0.77	-	-	-	-	-
Someone said something negative	0.68	-	-	-	-	-
Friend or family says something bad	0.66	-	-	-	-	-
Argument with spouse/partner	0.61	-	-	-	-	-
Said something you later regretted	0.52	-	-	-	-	-

Coworker complained to boss about you	0.39	-	-	-	-	-
Unexpected Events						
Receive unwanted medical news	-	-0.8	-	-	-	-
Close relative has a heart attack	-	-0.78	-	-	-	-
Find out you have a chronic disease	-	-0.77	-	-	-	-
Involved in a car accident	-	-0.59	-	-	-	-
Unexpected medical expenses	-	-0.56	-	-	-	-
Public Speaking						
Supervisor asks you to give a speech	-	-	0.82	-	-	-
Asked to give major presentation	-	-	0.78	-	-	-
Asked to introduce yourself in public	-	-	0.77	-	-	-
Going on a job interview	-	-	0.51	-	-	-
Receive a major work/school assignment	-	-	0.47	-	-	-
Transportation						
Lost your keys	-	-	-	-0.82	-	-
Discover a flat tire	-	-	-	-0.72	-	-
Car breaks down at rush hour	-	-0.34	-	-0.67	-	-
Lock your keys in the car	-	-	-	-0.66	-	-
Car won't start before work	-	-	-	-0.53	0.35	-
Social Anxiety						
Forcing self to meet new people	-	-	-	-	0.69	-
Go to party where don't know anyone	-	-	-	-	0.68	-
Not enough money at grocery store	-	-	-	-	0.43	-0.33
Going on a blind date	-	-	-	-	0.31	-0.38
Financial Issues						
Credit card turned down at store	-	-	-	-	-	-0.77
Notice of bank overdraft fee	-	-	-	-	-	-0.66
Credit card increases minimum payment	-	-	-	-	-	-0.49
Having to juggle financial pressures	-	-	0.41	-	-	-0.44
Note: loadings <0.30 have been excluded from the table						

Table 1: Factor loadings for principal components analysis with six factor model with oblimin rotation.

As shown across the top of Table 2, subscales resulting from these factors all showed acceptable levels of internal consistency with coefficient alphas ranging from 0.74 to 0.85; the overall score across the 29 items was also internally consistent ($\alpha=0.92$). Table 2 also shows correlations between the ACTS dimensions and total score, and other demographic and stress-related outcomes. The ACTS correlated strongly, but not redundantly, with the PSS. In general, the ACTS

overall score and dimensions positively correlated with stress and use of various avoidance coping strategies. Finally, Table 2 also shows the intercorrelations among the ACTS subscales and total score. Like associations with the PSS, the subscale intercorrelations were strong but non-redundant, suggesting the discriminant validity of the six dimensions.

Variables	Total Appraisal ($\alpha=0.92$)	Conflict Situations ($\alpha=0.83$)	Unexpected Events ($\alpha=0.85$)	Public Speaking ($\alpha=0.83$)	Transport ($\alpha=0.84$)	Social Anxiety ($\alpha=0.74$)	Financial Concerns ($\alpha=0.74$)
Age	-0.09	-0.09	-0.21**	0.07	-0.03	-0.07	-0.05
Gender (1=M; 2=F)	0.24**	0.20**	0.20*	0.16*	0.23**	0.20**	0.05
Perceived Stress Scale	0.51**	0.46**	0.33**	0.35**	0.39**	0.34**	0.42**
Factor 1							
Approach Coping	-0.06	0.01	-	-0.08	-0.07	-0.15	-0.01
Positive Reinterpretation	-0.13	-0.15	0.01	-0.16*	-0.03	-0.23**	-0.05
Active Coping	-0.06	-0.05	-0.03	-0.03	-0.02	-0.09	-0.06
Planning	-0.14	-0.09	-0.09	-0.07	-0.08	-.19*	-0.14
Inst. Social Support	0.03	0.13	0.04	0	-0.03	-0.12	0.07
Suppression of Activities	0.04	0.06	0.02	0.07	-0.03	-0.02	0.11
Emotional Social Support	0.09	.21**	-0.04	0.04	0.05	0.01	0.12
Acceptance	-0.13	-0.14	0.02	-0.11	-0.12	-.21**	-0.04
Restraint	0.01	0.02	0.03	-0.02	0.04	-0.03	-
Religious Coping	0.07	0.1	0.08	-0.02	0.04	0.06	0.01
Humor	-0.17*	-0.13	-0.04	-0.14	-0.23**	-0.14	-0.11
Factor 2							
Avoidance Coping	0.34**	0.39**	0.18*	0.26*	0.19*	0.23**	0.25**
Denial	0.23**	0.28**	0.12	0.20*	0.08	0.14	0.17*
Behavioral Disengage	0.29**	0.32**	0.09	0.27**	0.16*	0.23**	0.22**
Mental Disengagement	0.19*	0.17*	0.19*	0.15*	0.12	0.09	0.11
Substance Use	0.11	0.13	0.04	0.06	0.04	0.07	0.17*
Focus On/Vent Emotions	0.33**	0.41**	0.18*	0.19*	0.25**	0.24**	0.16*
Total Appraisal	-	0.85**	0.72**	0.68**	0.78**	0.73**	0.77**
Conflict Situations	-	-	0.49**	0.52**	0.57**	0.57**	0.59**
Unexpected Events	-	-	-	0.32**	0.56**	0.35**	0.51**
Public Speaking	-	-	-	-	0.38**	0.48**	0.47**
Transport	-	-	-	-	-	0.47**	0.50**
Social Anxiety	-	-	-	-	-	-	0.50**
N=166; *p<0.05, **p<0.01.							

Table 2: Study 1: Correlations between appraisal scales, stress, and coping (College students).

Study 2 and Study 3

Based on Study 1 findings, we modified the scale slightly for administration to samples 2 and 3. Most notably, and in order to keep the scale to a manageable number of items, we retained only the four best-loading items for each factor. This resulted in a scale that retained the six dimensions described above but with only four items per subscale totaling in 24 items. We administered this version to the second sample of college students and a census of municipal firefighters. Both studies also included additional measures (described above) to assess the convergent and discriminant validity of the ACTS.

Confirmatory factor analyses

We used SPSS AMOS (19.0) to conduct confirmatory factor analyses on the data from Studies 2 and 3. The specific model tested had four items loading on six corresponding factors. The model also specified correlations (i.e., covariances) among the six factors. Table 3 and Figure 1 summarize the results of these analyses. As shown, the model showed reasonably good fit across the two independent samples. Loadings for the items on their respective factors were all relatively high (>0.55) and consistent across samples.

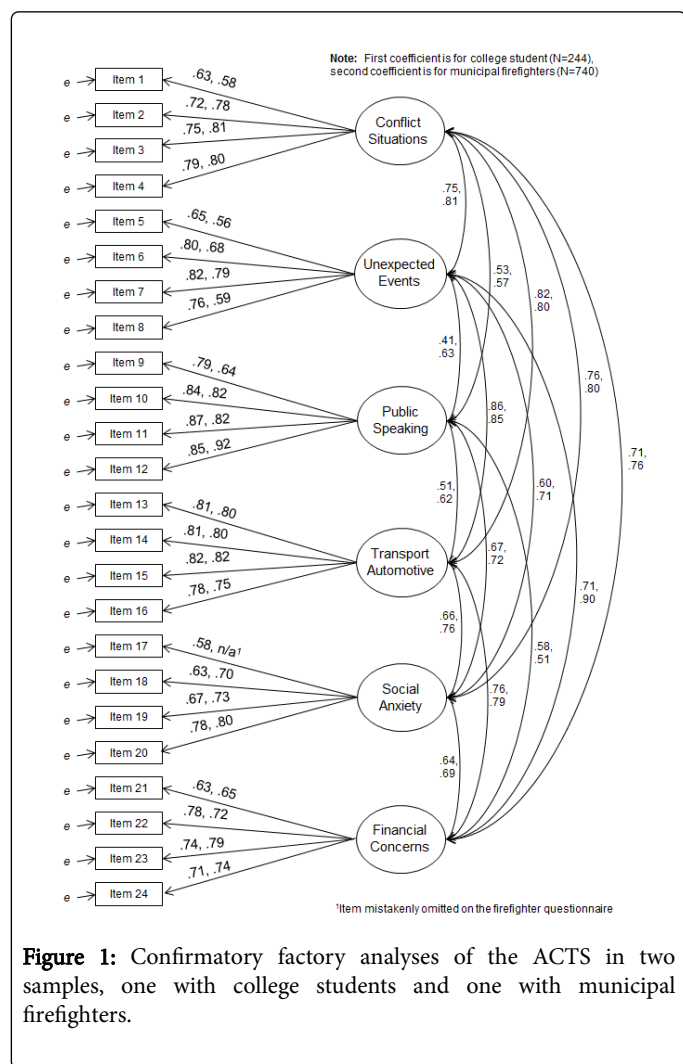


Figure 1: Confirmatory factory analyses of the ACTS in two samples, one with college students and one with municipal firefighters.

Table 3 also shows fit indices for the hypothesized and two alternative models including a single factor model and a hierarchical model. The single factor model specified all items loading on a single latent construct (i.e., “appraisal”), whereas the hierarchical model retained the six dimensions, but also specified a second order latent construct (i.e., “appraisal”) instead of specifying covariances among them. As shown, the goodness of fit indices were relatively poor for the single latent construct model, especially compared with the six correlated factors model. Fit indices for the hierarchical latent construct model were better but still worse than, the six correlated factors model. Overall, the six correlated factors model provides the best fit to the data across the two diverse samples.

Model	CMIN/DF	NFI	CFI	RMSEA
Six Correlated Factors (Baseline Model)				
Study 2 588/255	2.3	0.9	0.94	0.073
Study 3 753/209	3.6	0.93	0.95	0.059
Single Latent Construct/One Factor Model				
Study 2 1006/245	4.11	0.73	0.77	0.113
Study 3 2096/224	9.35	0.79	0.81	0.106
Hierarchical Latent Construct Model				
Study 2 648/264	2.46	0.89	0.93	0.077
Study 3 876/218	4.02	0.91	0.93	0.064
n=244; n=740				

Table 3: Fit indices for alternative models derived from study 2 data.

Construct validity student and fire-fighter samples

Table 4 shows scale reliabilities and correlations between ACTS total and dimensional scores and various demographic and stress-and-coping-related measures among our second sample of students. This analysis included only two primary coping dimensions from the COPE, identified using principal components analyses. ACTS subscales again showed acceptable levels of internal consistency with coefficient alphas ranging from 0.77 to 0.88 for each of the four-item subscales and the overall score based on 24 items reaching 0.94. Consistent positive correlations with gender again suggested that women appraised the events as more threatening (i.e., less challenging) than did men. The ACTS related consistently and positively to the experience of stress as assessed by the PSS. The ACTS was also associated with reports of the greater use of both approach and avoidance-focused coping, although associations with avoidance coping were consistently larger. As expected, the ACTS negatively related to the experience of challenge, as assessed by the CAS Challenge subscale, and positively related to the experience of threat, as assessed by the CAS Threat subscale. The ACTS related consistently to measures of well-being, including positive associations with reports of PTSD symptoms and correspondingly negative associations with life satisfaction. Finally, Table 4 shows the intercorrelations among the ACTS subscales and total score. The subscale intercorrelations again suggest considerable, but non-redundant, overlap among the six dimensions.

Variables	Total Appraisal (α=0.94)	Conflict Situations (α=0.81)	Unexpected Events (α=0.85)	Public Speaking (α=0.86)	Transport (α=0.88)	Social Anxiety (α=0.77)	Financial Concerns (α=0.81)
Gender	0.25*	0.21*	0.30*	0.11*	0.28*	0.13*	0.12*
Income	-0.06	-0.06	0.03	-0.12	-0.07	-0.05	-0.02
PSS Stress	0.47*	0.40*	0.36*	0.34*	0.34*	0.32*	0.48*
Avoidance Coping	0.30*	0.30*	0.14*	0.21*	0.21*	0.26*	0.32*
Approach Coping	0.17*	0.19*	0.21*	0.03	0.20*	0.03	0.15*
CAS Challenge	-0.31*	-0.27*	-0.17*	-0.25*	-0.24*	-0.28*	-0.29*
CAS Threat	0.41*	0.42*	0.22*	0.35*	0.27*	0.38*	0.34*
PTSD Symptoms	0.28*	0.24*	0.20*	0.24*	0.21*	0.21*	0.24*
Life Satisfaction	-0.23*	-0.26*	-0.11*	-0.18*	-0.13*	-0.20*	-0.22*
Total Appraisal	-	0.84*	0.78*	0.73*	0.85*	0.75*	0.80*
Conflict Situations	-	-	0.61*	0.48*	0.69*	0.58*	0.62*
Unexpected Events	-	-	-	0.37*	0.72*	0.44*	0.56*
Public Speaking	-	-	-	-	0.48*	0.57*	0.52*
Transport	-	-	-	-	-	0.50*	0.63*
Social Anxiety	-	-	-	-	-	-	0.49*

Note: *Correlation is significant at p<0.05; PSS=Perceived Stress Scale, CAS=Cognitive Appraisal Scale

Table 4: Study 2: Correlations between ACTS dimensions and other variables and intercorrelations among ACTS subscales among college students.

Variables	Total Appraisal (α=0.93)	Conflict Situations (α=0.82)	Unexpected Events (α=0.85)	Public Speaking (α=0.86)	Transport (α=88)	Social Anxiety (α=72)	Financial concerns (α=0.81)
Age	-0.09*	-0.08*	-0.12**	-0.02	-0.07*	-0.03	-0.12**
Perceived Stress Scale	0.47**	0.41**	0.35**	0.29**	0.39**	0.40**	0.44**
Approach Coping	0.16**	0.15**	0.16**	0.05	0.13**	0.13**	0.17**
Avoidance Coping	0.32**	0.30**	0.23**	0.19**	0.29**	0.28**	0.27**
Support Coping	0.10**	0.12**	0.11**	0.01	0.10**	0.06	0.06
Total Appraisal	-	0.85**	0.80**	0.74**	0.85**	0.80**	0.81**
Conflict Situations	-	-	0.63**	0.49**	0.69**	0.65**	0.64**
Unexpected Events	-	-	-	0.50**	0.65**	0.50**	0.65**
Public Speaking	-	-	-	-	0.52**	0.60**	0.44**
Transport	-	-	-	-	-	0.62**	0.67**
Social Anxiety	-	-	-	-	-	-	0.55**

N=704; *p<0.05, **p<0.01

Table 5: Study 3. Correlations between ACTS dimensions and other variables and intercorrelations among ACTS subscales (Municipal fire fighters).

Table 5 shows the results of similar analyses conducted on the municipal firefighter sample. Here, the principal components analysis of the cope subscales revealed an additional factor, Support Coping, which consisted of instrumental and emotional support joined with religion. As shown across the top of Table 5, the subscales again showed acceptable levels of internal consistency with coefficient alphas ranging from 0.72 to 0.88 for each of the four-item subscales and the 24-item total scale score reaching 0.93.

The ACTS inversely related with age, with younger firefighters reporting greater propensity to make threat appraisals than older firefighters. The ACTS related positively to the experience of stress as assessed by the PSS. The ACTS was again positively associated with report of coping, both approach and avoidance-focused. Again, associations with avoidance coping were more consistently larger. Correlations of threat appraisal with support coping were small but generally positive. Finally, Table 5 shows the intercorrelations among the subscales and total score. The subscale intercorrelations again suggest considerable, but non-redundant, overlap among the six dimensions.

Independent prediction of stress-related outcomes

One indicator of a new measure's utility is its ability to predict variance in outcomes above that predicted by existing measures. To assess this, we examined how the ACTS related to symptoms associated with depression and post-traumatic stress disorder independent of stress as assessed by the PSS [9]. As described above, zero-order analyses showed that both the ACTS and the PSS related to these outcomes at the univariate level (r 's ranging between 0.38 and 0.64, all $p < 0.001$). Hierarchical multiple regression analyses controlling for PSS levels indicated that the ACTS predicted variance in depression (R-Square Change=0.02; $b=0.16$, $p < 0.001$) and post-traumatic stress (R-Square change=0.03, $b=0.19$, $p < 0.001$) over and above that predicted by the PSS. The results suggest that cognitive appraisal tendencies that favor the appraisal of life events as threatening (i.e., perceived demands in excess of coping abilities) assess a unique component of these potentially clinical conditions.

Discussion

Overall, the results of the three studies described above provided consistent evidence for the reliability and validity of the Appraisal of Challenge and Threat Scale (ACTS) as a measure of individual differences in the tendency to make threat or challenge appraisals overall and within several life domains. Three independent samples, two of college students and the third of municipal firefighters, showed the instrument to be highly reliable and to have a consistent factor structure assessing threat or challenge. Intercorrelations among the subscales suggested consistency, but non-redundancy among the domain measures.

The three studies also provided considerable evidence for the construct validity of the ACTS. Specifically, the ACTS correlated sufficiently and non-redundantly with other scales measuring perceived stress [9], the experience of threat and challenge [34,40], and coping [39]. The ACTS also correlated expectedly with stress-related outcomes including PTSD symptoms and life satisfaction. Finally, hierarchical regression analyses showed the ability of the ACTS to assess unique variance in stress-related outcomes.

One of the most consistent findings was that higher ACTS scores (indicative of threat appraisal) were associated with greater use of

avoidant forms of coping—whether assessed as individual coping strategies as in Study 1 or as composite variables (Studies 2 and 3). Collectively, avoidant forms of coping include such things as substance use coping, behavioral disengagement, and mental disengagement. ACTS scores also correlated with approach forms coping. Specifically, although Study 1 showed only weak associations between ACTS scores and individual approach-related coping dimensions, Studies 2 and 3 provided more consistent evidence using a composite and more reliable indicator of approach coping.

The associations between ACTS scores and coping activities are noteworthy for two reasons. First, they are consistent with laboratory analogs of coping which consistently showed threat appraisal (relative to challenge) to be associated with poor behavioral coping (i.e., task performance) [6,11,16,44]. The laboratory studies speculated that challenge appraisal led to problem-focused coping, whereas, threat appraisal led to emotion-focused coping. Viewed this way, the pattern of correlations between the ACTS and avoidance coping (i.e., emotion-focused coping) support the laboratory study contentions.

Second, the approach coping results may tell something unique regarding how threat and challenge appraisal tendencies relate to real-world coping. Specifically, the positive associations of threat appraisal with approach (and avoidance) coping suggest more coping in threat appraisal rather than qualitatively different coping. In other words, threat appraisal may lead not just to a preference for emotion-focused coping as suggested above, but the need to engage multiple coping efforts, both emotion- and problem-focused. Factors such as poorer execution of initial coping efforts, or failure to choose coping strategies that meet the demands of the situation, and hence the subsequent need to apply more strategies, may underlie these effects. In contrast, challenge appraisal may be associated with less coping because of greater initial success and/or more judicious matching of coping efforts to situational demands.

Future studies might address a number of issues. The first is the temporal stability of the instrument. Despite high internal consistency, the present studies did not address the temporal stability of ACTS scores. Overall, one might expect the ACTS to have temporal stability in proportion to other stress-related constructs. Stress varies with time and experience and ACTS scores might reflect such variability. It is also possible that ACTS scores would show considerable stability over time and situations, reflecting more stable aspects of personality.

Reducing appraisal of challenge or threat to a unidimensional scale can obfuscate some results related to both primary and secondary appraisals. However, unidimensional reduction is a common approach in statistical applications. Additionally, this approach is consistent with definitions of challenge and threat in laboratory experiments. Dimensionality reduction can allow for a more thorough analysis of challenge/threat appraisal while simplifying results, providing a better understanding of overall outcomes [45]. Further analyses may determine the relative importance of primary and secondary appraisals for those who are interested.

Another issue for future research might be the developmental antecedents of the tendency toward threat or challenge appraisal. For example, how do early experiences with stressful situations shape later appraisal tendencies? Indeed, Dienstbier's [46] model of physiological toughness suggests that success experiences with controllable stressors lead to challenge appraisals and physiological toughness. In contrast, uncontrollable stress and failure to cope lead to threat and learned

helplessness. Do similar processes shape the development of individual differences in threat and challenge appraisal as assessed by the ACTS?

Future research should also address how ACTS scores relate to appraisals and stress experiences in acute laboratory situations. Presumably, ACTS scores should predict situational appraisals and responses in a manner consistent with those seen in laboratory studies of threat and challenge, the phenomenon that led to the development of the ACTS in the first place.

Finally, future studies should examine whether and how ACTS scores predict short- and long-term health outcomes, including studies of the potential mechanisms of disease. Here a study linking ACTS scores to biological mechanisms such as corticosteroids and cytokines would be particularly pertinent. Parallel studies might address psychological outcomes, including stress disorder, depression, or life satisfaction.

Conclusion

In summary, the ACTS assesses individual differences in cognitive appraisal of threat and challenge using items that are not confounded with other stress-related constructs, including affective reactions, behavioral reactions, and stress consequences, coping, and personality. The ACTS should enhance research in not only the fields of stress, emotion, and coping, but also social, personality, and health psychology; and clinical research areas including trauma, depression and emotional disorders. Overall, we hope that this instrument opens up new avenues for research on these important stress-related constructs.

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