Preliminary evaluation of the psychometric properties of the "Hardiness-Resilience Gauge" in an undergraduate sample

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PRELIMINARY EVALUATION OF THE PSYCHOMETRIC PROPERTIES OF THE "HARDINESS-RESILIENCE GAUGE" IN AN UNDERGRADUATE SAMPLE

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Abstract. The purpose of the study was to examine the psychometric properties of a new hardiness scale, the Hardiness-Resilience Gauge (HRG). Data were collected from 280 Greek undergraduates, studying in a social science department. Data analyses included the examination of factorial validity, internal consistency, and correlation with external criteria. Results supported a hierarchical model with three factors (commitment, control, and challenge) nested under the higher-order construct of hardiness. Moderate to high reliability coefficients were reported for the total HRG scale ($\alpha = .89$) and for the three subscales, commitment ($\alpha = .86$), control ($\alpha = .75$), and challenge ($\alpha = .72$). Moreover, HRG's concurrent and predictive validity was supported. These findings provide support for the appropriateness of the scale in Greek undergraduates, suggesting that HRG may be a useful measure of psychological hardiness. Limitations and future research directions are also discussed.

Key words: Challenge, Commitment, Control, Hardiness Scale, Psychological hardiness

INTRODUCTION

A large body of research reveals that stress is a common element in the life of individuals and has a different meaning for different people under different conditions (Fink, 2016). More specifically, academic stress among higher education students has been a topic of interest for many years (Heikkila et al., 2012). Stress, daily stressors, and coping strategies in higher education have received much attention in recent research (Chan et al., 2000;

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Gibbons, 2015; Heikkila et al., 2012; Misra et al., 2000). Excessive stress and difficulties handling these stress situations are associated with poor academic performance (Robotham, 2008; Struthers, Perry, & Menec, 2000), high risk of dropping out (Daugherty & Lane, 1999; Robotham, 2008) and increased risk for the development of physical, social, academic, and psychological health problems (Abbasi et al., 2020; Misra & McKean, 2000; Niemi & Vainiomaki, 1999).

A key role for higher education professionals in relation to stress is the provision of appropriate resources to enable undergraduates to cope effectively with stress (Kamtsios & Karagiannopoulou, 2015). Effective coping with daily stressors can mediate the impact of university related stressors and is associated with positive emotional and behavioral adjustment (Pincus & Friedman, 2004). On the contrary, students' personality characteristics may act effectively to moderate university stressors and daily hassles and can operate quite differently to affect students' adaptation (Kamtsios & Karagiannopoulou, 2020), academic success and task engagement (Duckworth et al., 2007; Kardum, Knezeric, & Krapic, 2012; Maddi et al., 2011) as well as students' psychological adjustment. A personality characteristic that mediates the effects of daily stress and expresses a general tendency of an individual to regard stressful life events as amenable, and to consider changes as a normal and interesting part of life is hardiness (Maddi, 2005, 2006).

Psychological hardiness

Psychological hardiness was first introduced by Kobasa (1979). In her study of telephone executives (a 12-year experiment-Illinois Bell Telephone project), Maddi and Kobasa (1984) hypothesized that prolonged stress increased the overall likelihood of a range of physical illness, mental disorders, and performance breakdown. Their research revealed dramatic differences in individuals' reactions to stressful situations. They recognized a personality characteristic – psychological hardiness – which expresses a general quality of an individual to regard stressful life events as manageable, and to consider changes as a normal and interesting part of life (Kobasa, Maddi, & Kahn, 1982; Maddi, 2005, 2006). Since then, a growing body of research suggests that hardiness has a buffering effect on stress, can influence the types of coping strategies utilized in response to the appraisal of stress (Maddi et al., 2011), and can function as a resilience resource in the encounter with stressful life events (Hystad et al., 2010).

Psychological hardiness (hence on hardiness) is generally regarded as a personality trait (Harris, 2000; Maddi, 2005, 2006; Maddi et al., 2011; Soderstrom et al., 2000) or constellation of personality characteristics (Hystad et al., 2010) that provides the courage, motivation and strategies for turning developmental and imposed stresses from potential disasters into growth opportunities (Maddi, 2005), predominantly through cognitive appraisal and coping behaviors (Cash & Gardener, 2011; Eschleman, Bowling, & Alarcan, 2010). Hardiness has emerged as a composite of interrelated factors (commitment, control, and challenge-3Cs). Individuals strong in commitment believe that it is important to

remain involved with ongoing events and people around them, no matter how stressful things become. People strong in control believe that they can beneficially influence outcomes through effort, and they are unlikely to feel powerless. Individuals strong in challenge see stresses as a normal part of living and an opportunity to learn, develop and grow in wisdom (Kobasa et al., 1982; Maddi, 2005, 2006). Nevertheless, individual differences in the 3Cs do exist, demonstrating that hardiness differs in some occupational groups. Generally, people in jobs that involve helping others such as teaching and nursing, have higher levels of hardiness than people in other less people-oriented jobs (Stein & Bartone, 2020).

During the many years of hardiness research, several studies showed that hardiness is a predictor of effective coping (Chan, 2000; Clarke, 1995; Lease, 1999; Sadaghiani, 2011), and protecting individuals against the ill effects of stress on health (Bartone, 1989; Bartone, Valdes, & Sandrik, 2016; Hsieh et al., 2004; Lambert, Lambert, & Yamase, 2003; Maddi & Kobasa, 1984; Tugade & Fredrickson, 2002). Consistent with the results of the original executive studies by Maddi and Kobasa (1984), many studies have shown the positive effect of hardiness in various samples of individuals and social groups such as bus drivers (Bartone, 1989), firefighters (Giatras, 2000), lawyers (Kobasa, 1982), nursing staff (Keane, Ducette, & Adler, 1985) and students (Kamtsios & Karagiannopoulou, 2020; Lifton, Seay, & Bushko, 2000; Maddi, 2005). Similarly, multiple studies have reported a relationship between hardiness and performance, leadership ability, improved mood, and individual health (Florian, Milkulincer, & Taubman, 1995; Kobasa et al., 1982; Pollock, Christian, & Sands, 1990; Topf, 1989). There are also studies of hardiness focusing on the successful management of various stressful stimuli in performance-related sports activities (Chroni, Theodorakis, & Hatzigeorgiadis, 2004; Hanton, Evans, & Neil, 2003; Lancer, 2000; Maddi & Hess, 1992).

Hardiness has also been investigated in the field of education (Benishek & Lopez, 2001; Benishek, Feldman, Shipon, et al., 2005; Kamtsios & Karagiannopoulou, 2013a). Together, Kobasa's (1979) hardiness theory and Dweck's (2000) theory of academic motivation led to the notion of academic hardiness (Benishek et al., 2005), providing a framework for understanding how students and undergraduates may react to academic challenges (Karagiannopoulou & Kamtsios, 2016) and how hardy academic students will be motivated to learning class material and be more strongly engaged with their lessons (Cole, Field, & Harris, 2004). Academic hardiness, as a personality trait, has been associated with students'/undergraduates' performance (Kamtsios & Karagiannopoulou, 2015; Sheard & Golby, 2007), students' achievement motivation and task or learning orientation (Busato et al., 2000; Kamtsios & Karagiannopoulou, 2016), positive attitudes towards university (Maddi et al., 2011), students' learning self-efficacy (Wong, Liang, & Tsai, 2019) and positive academic emotions (Kamtsios & Karagiannopoulou, 2020).

Psychological hardiness measures

During the 40 years of research on the construct of psychological hardiness, several measures/scales have been developed to assess hardiness dimensions, namely: (a) Personal Views Survey (PVS) (Kobasa, 1982); (b) PVS II, PVS III, PVS III-R (Maddi et al., 2006); (c) Dispositional Resilience Scale (DRS) (Bartone et al., 1989); (d) Occupational Hardiness Questionnaire (Moreno-Jimenez et al., 2014); (e) Health-Related Hardiness Scale (Pollock, & Duffy, 1990), and (f) the Cognitive Hardiness Scale (Nowack, 1989). In addition, several academic hardiness scales were developed including: (a) the Academic Hardiness Scale (Benishek & Lopez, 2001; Benishek et al., 2005); (b) Dimensions of Academic Hardiness Questionnaire (Kamtsios, 2012; Kamtsios & Karagiannoulou, 2013b), and (c) Children's Hardiness Scale (Soheili, Hosseinian, & Abdollahi, 2020).

However, in several studies, concerning the general personality hardiness measures, there has been difficulty in confirming the factorial structure of the three-factor construct (Funk, 1992). This has led to debate as to whether hardiness is a single or several characteristics (Funk, 1992). For example, Carver (1989) and Creed, Conlon, and Dhaliwal (2013) have argued that the components of multidimensional constructs, such as psychological hardiness, must be examined separately, since different components may exert their effects in different ways.

Furthermore, items of the original-personality hardiness scales were negatively worded, raising questions about whether the scales were measuring the absence of maladaptive traits (e.g., neuroticism) rather than the presence of adaptive traits (see the most recent version of hardiness scale-Personal Views Survey II-revised, which appears to have partially addressed these issues) (Wiebe, 2013).

Bartone (1989) developed a modified version (a 45-item measure) of hardiness questionnaire, the Dispositional Resilience Scale (DRS), which addressed specific problems of earlier studies (e.g., lack of positively worded items). This scale, contained a balance of positively and negatively worded items, and, according to Funk (1992), was the most acceptable measure of personality hardiness at the time. Later, improved versions of the DRS were developed, which ended up in the development of the DRS-15 item version (Bartone, 1995). The DRS-15 was used extensively in studies, which have verified the scale's reliability and validity (Bartone et al., 2008; Bartone, Roland, Picano, & Williams, 2008; Johnsen et al., 2013) in several samples with respect to both health and performance under stressful conditions (Bartone, 2007; Picardi et al., 2012). However, DRS still has several limitations. For example, all three factors have only five items each and this limited number of items raises concerns regarding the broader conceptualization of DRS subfactors. Researchers also have doubted whether the existing questions fully reflect the characteristics and the complexity of the hardiness dimensions, namely, commitment, control, and challenge.

Recently, Bartone and his colleagues introduced an improved hardiness measurement tool, the Hardiness Resilience Gauge (HRG) (Bartone et al., 2019; Stein & Bartone, 2020). Compared to previous versions, the new scale shows increased reliability

and validity of the total scale and subscales and captures the hardiness dimension of challenge more effectively. The HRG provides valuable insight into an individual's level of hardiness, and measures how effectively a person can cope with stress. HRG encompasses cognitive (thinking), emotional (feeling) and behavioral (active) qualities related to commitment, control, and challenge, and can be used in a variety of contexts (workplace, high-stress occupations, athletes, academic institutions-undergraduates). For example, a recent study by White et al. (2020) found the HRG to be an effective measure of hardiness in medical school students working under high stress conditions.

Given that psychological hardiness has been found to be associated with various adaptive and healthy outcomes (Bartone et al., 2016; Hsieh et al., 2004; Lambert et al., 2003), and expresses a general quality of an individual to regard stressful life events as amenable and to consider changes as a normal and interesting part of life (Kobasa et al., 1982), it would be of great importance to have reliable and valid tools for measuring and evaluating undergraduates' psychological hardiness. This specific population experiences a variety of stress-related situations (Heikilla et al., 2012; Hystad et al., 2009; Kamtsios & Karagiannopoulou, 2015; Maddi et al., 2011; Misra & McKean, 2000; Rodotham, 2008) and rapid life changes in a competitive, pressurized, and high work-load academic environment (Kamtsios & Karagiannopoulou, 2015), a learning environment in which exams loom and performance goals dominate over learning goals (Karagiannopoulou & Milienos, 2013). The use of suitable scales/questionnaires, like the HRG, can provide valuable insights into students' cognitive, emotional, and behavioral qualities, having important implications for student counseling programs.

The present study

To our knowledge there is no effective scale measuring psychological hardiness adapted to Greek undergraduates. Therefore, there is a need for an appropriate measure in assessing the construct in this age group, so that undergraduates' counselors and educators evaluate and strengthen students' psychological hardiness. Hardiness, as a personality characteristic, may help students to use previous experiences to face university challenges and difficulties ahead and turn them into growth opportunities (Soheili et al., 2020), to tolerate anxiety stemming from their studies and the need for constant adaptation to a changing environment, and to engage in educational action instead of avoidance, denial, or procrastination.

The aim of this study was to validate a Greek adaptation of the Hardiness-Resilience Gauge (HRG), and replicate prior findings (Bartone et al., 2019) concerning the factorial structure of the questionnaire. Furthermore, the study aimed to investigate the HRG's concurrent and predictive validity.

The study hypotheses were as follows:

1. Confirmatory factor analysis (CFA) is expected to confirm a hierarchical model with three factors (commitment, control, and challenge) under a general hardiness factor.
2. Internal consistency reliability based on Cronbach's α coefficient for the three HRG subscales is expected to be high, supporting the psychometric properties of the scale.
3. HRG's concurrent validity, based on the correlations between the HRG factors and the revised Academic Hardiness Scale factors, is expected to be confirmed. Furthermore, HRG's predictive validity is expected to be supported from regression analysis results between commitment, control, challenge, on the one hand, and academic buoyancy scores.

METHOD

Participants and Procedure

The overall sample ($N = 280$) consisted of 14.6% ($n = 41$) male and 85.4% ($n = 239$) female undergraduates, studying in a Department of Psychology. The mean age of the participants was 21.97 years ($SD = 4.87$). The difference in the number of males and females is due to the gender ratio in social sciences schools in Greece, which is overwhelmingly in favor of women. Of the participants 12.1% ($n = 34$) were first year, 19.6% ($n = 55$) second year, 21.8% ($n = 61$) third year, 25% ($n = 70$) fourth year, and 21.4% ($n = 60$) fifth year students. Participants were informed about the purpose of the survey and how to complete the questionnaire. They were assured of the anonymity and confidentiality of the responses, and that the results of the study would be used purely for research purposes. Participation in the study was voluntary and the duration of completing the questionnaires was about 15-20 minutes. All procedures performed in the study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Translation process

To derive a scale that is psychometrically valid and reliable for use in Greek research, the back-translation technique was adopted, following the suggestions recommended by the International Test Commission Guidelines for test adaptation (Hambleton, 2001). Initially, two bilingual translators (see Beaton et al., 2007) (the first translator was aware of the

concepts of the questionnaire intended to be measured, whereas the second translator was unaware of the topics of the questionnaire) translated the HRG items into Greek. Following Tsang, Royse, and Terkawi (2017) suggestions, discrepancies between the two translators were discussed and resolved by consensus. The initial translation was next back-translated (into the original language) by two other independent translators, who were not aware of the intended concepts the questionnaire is meant to measure (Beaton et al., 2007; Tsang et al., 2017). Subsequently, the two English versions (original and translated version) of the HRG scale were compared, with no significant differences in the way the questions were presented nor in the way in which the translated version rendered the conceptual content of the questions.

Measures

To meet the purposes of the research, undergraduates completed the following scales:

Hardiness-Resilience Gauge

The Hardiness-Resilience Gauge (Bartone et al., 2019) (Multi-Health Systems: Psychological Assessments and Services; used with permission) is a 28-item questionnaire which provides insight into individuals' hardiness levels and their ability to cope with stressful and unexpected situations. The scale includes items drawn from the earlier DRS-15 (Bartone, 1995) with some modifications for clarity, as well as new items corresponding to the three hardiness facets (commitment, control, and challenge). The final questionnaire consists of 28 items that correspond to commitment (ten items, e.g., "I spend most of my life doing things that are meaningful"), control (eight items, e.g., "I can achieve my goals if I work hard") and challenge (ten items, e.g., "I do not like to make changes in my regular activities"). Participants responded on a 4-point Likert scale, ranging from 1 (not at all true) to 4 (completely true).

Revised Academic Hardiness Scale

The Revised Academic Hardiness Scale-RAHS (Beniskek et al., 2005) is a 40-item self-report scale developed to assess students' behavioral, affective, and cognitive reactions to general and challenging academic situations (Weigold et al., 2015). RAHS measures three dimensions of Academic Hardiness: Commitment (13 items, e.g., "Won't go out with friends if I need to study"), Control (16 items, e.g., "Can stay calm and learn from mistakes") and Challenge (11 items, e.g., "Enjoy the challenge of difficult classes"), on a 4-point Likert scale. Higher scores indicate higher levels of academic hardiness. The psychometric properties of the scale have been established in samples of late elementary school children (Kamtsios & Karagiannopoulou, 2011), college students (Weigold et al.,

2015) and undergraduates (Creed et al., 2013; Kamtsios & Karagiannopoulou, 2015; Karagiannopoulou & Kamtsios, 2016). In the present study, Cronbach's α coefficients were satisfactory for the three RAH subscales (Commitment, α = .76, Control, α = .78, Challenge, α = .78). RAHS was used as a criterion of concurrent validity.

Academic Buoyancy Scale

The 4-item Academic Buoyancy Scale (ABS) (Martin & Marsh, 2008) was used as a criterion measure for predictive validity. The ABS evaluates the extent to which students can deal effectively with daily academic hassles (Datu & Yuen, 2018). ABS is a unidimensional scale (sample item: "I'm good at dealing with setbacks, e.g., bad marks, negative feedback on my work"). Responses are on a 7-point Likert scale, ranged from 1 (strongly disagree) to 7 (strongly agree). Evidence for reliability and validity of this measure was reported previously (Martin & March, 2008, 2009; Putwain et al., 2012). In the present study the reliability coefficient was .82 and confirmatory factor analysis of the one-factor model indicated that the model fit the data well: NFI = .98, IFI = .99, CFI = .99, SRMR = .04.

Data analyses

Descriptive statistics were used to examine the means and standard deviations of the scales (HRG, RAHS & ABS) and their subscales. Confirmatory factor analysis (CFA) was performed for the purpose of validating and confirming the goodness of fit of several alternative HRG models. CFA enables the systematic testing of rival models and provides stronger evidence regarding validity compared to sole reliance on exploratory factor analysis (Liau et al., 2011).

The CFA measurement model was developed based on the factor loadings reported in an earlier study (Bartone et al., 2019). Because data appeared to be fairly univariately and multivariately normally distributed, maximum likelihood (ML) estimation was used to address the possibility of non-normal distribution (Cantoni & Ronchetti, 2006) and to estimate the model parameters and the fit indices.

Three models were tested. The first was a single factor model in which all items loaded on one hardiness factor (Model A). Next was an orthogonal 3-factor model comprising of the dimensions of commitment, control, and challenge (Model B). Finally, a hierarchical model was tested with three factors (commitment, control, and challenge) nested under a broad hardiness factor (Model C).

Both absolute and incremental fit indices were used to evaluate the models tested. Items were specified to load on only one factor each. Following recommended procedures, multiple fit indices were used to determine the appropriateness of each model (Hu & Bentler, 1998), including model chi-square, normed fit index (NFI), comparative fit index

(CFI), incremental fit index (IFI), Root Mean Squared Error of Approximation (RMSEA), Akaike information criterion (AIC), and Bayesian information criterion (BIC). By convention, an RMSEA value of less than .06 indicates a good fit (Hu & Bentler, 1999). CFI values of .90 and .93 represent an acceptable and a good fit, respectively (Byrne, 1994; Hayle & Panter, 1995). Lower AIC and BIC values also indicate a better fit.

The reliability of the scales and the subscales was established by the computation of Cronbach's alpha coefficient. Furthermore, to investigate relationships between the study variables, Pearson correlation analysis and regression analysis were used on the mean scores of each of the measures.

RESULTS

Reliability

Cronbach's alpha of the overall questionnaire was .89. The internal consistency for the three factors was .86, .75 and .72 for commitment, control, and challenge, respectively (Table 1). Item-total correlations ranged from .15 to .67 (Table 1).

Results from Confirmatory Factor Analysis

CFA was used to test the viability of three postulated models. Initially, a single model was tested. The one-factor model had all 28 items loading on a single factor. Subsequently, an orthogonal 3-factor model, comprising commitment, control, and challenge as factors, was evaluated and, lastly, a hierarchical model with three factors (commitment, control, and challenge) nested under a broad hardiness factor was tested. After the inspection of the modification indices in all three models, different error terms with high modification indices were allowed to correlate with the aim to minimize the redundancy of items in measuring the same construct. For example, analysis indicated that allowing unique variances of items scores within a particular subscale to correlate (e.g., er17 with er2, er15 with er26, er23 with er9), would improve the fit of the model. Models' re-specification of correlated errors seemed to make statistical and substantive sense (Lowe, Grumbein, & Raad, 2011). Error covariances represented correlated errors among items on the same sub-scale. After allowing for error covariances, the fit indices (for all three models) improved.

Table 1: Statistical description of the Hardiness-Resilience Gauge items (Means, SD, Corrected item-total, skewness and kurtosis)

HRG items	M	SD	Corrected Item-total	Skewness	Kurtosis
1. I spend most of my life doing things that are meaningful.	2.79	.66	.55	-.121	-.082
2. I can achieve my goals if I work hard.	3.49	.56	.41	-.508	-.772
3. I don't like to make changes in my regular activities.	2.75	.69	.30	-.474	.365
4. How things go in my life depends on my own actions.	2.91	.63	.32	-.189	.197
5. Changes in routine are interesting to me.	2.61	.72	.38	.083	-.329
6. I look forward to my daily activities.	2.58	.70	.50	-.111	-.195
7. I don't think I can influence my future.	3.59	.56	.32	-.127	.949
8. I enjoy the challenge when I have to do more than one thing at a time	2.51	.79	.30	.135	-.453
9. Life is interesting and exciting to me.	2.99	.76	.67	-.276	-.542
10. It is up to me to decide how the rest of my life will go.	3.11	.68	.33	-.352	-.114
11. Life in general is boring to me.	3.46	.74	.52	.347	.380
12. My choices make a real difference in how things turn out in the end.	2.93	.70	.30	-.270	-.060
13. I have a clear sense of purpose in my life.	2.73	.77	.47	-.381	-.079
14. I am responsible for my own success in life.	3.22	.57	.45	-.035	.326
15. Unexpected challenges provide me with learning opportunities.	2.98	.65	.46	-.371	.530
16. I enjoy my day-to-day tasks.	2.65	.67	.53	.048	-.272
17. I am confident I can accomplish whatever I set out to do.	3.09	.70	.52	-.495	.297
18. I find the positives in any life change.	2.77	.68	.43	-.329	.179
19. I immerse myself in the things I do.	2.88	.66	.48	-.154	-.052
20. Even if I fail at something, I look for ways to improve.	2.96	.67	.43	-.381	.428
21. My daily activities are important to me.	2.90	.63	.47	-.342	.563
22. When things go wrong, I try to learn something useful to apply in the future	3.03	.67	.45	-.454	.554
23. I feel energized about life.	2.88	.76	.66	-.318	-.228
24. Mistakes are opportunities to learn and improve.	3.41	.58	.40	-.382	-.731
25. I fully involve myself in all aspects of my life (e.g., family, friends, work)	3.00	.75	.48	-.148	-.803
26. Big life changes excite me.	2.50	.83	.37	.301	-.570
27. When I set out to do something, I am certain I can get it done.	2.64	.70	.51	-.028	-.244
28. I am good at dealing with adversity.	2.69	.63	.51	.037	-.277

The CFA confirmed that the hierarchical model provided a better fit to the data than did the one-factor model (Table 2). CFA results also revealed that the orthogonal three factor model fit the data well (CFI = .91, IFI = .91, RMSEA = .05). Nevertheless, compared to the hierarchical model, some of the fit indices of the orthogonal model were lower than those obtained in the hierarchical model (e.g., CFI and RMSEA). Moreover, the remarkable drop of the AIC and BIC values by about 9.2% and 9.5%, respectively, indicated that the hierarchical model provided a better fit to the data than the orthogonal model and was the most appropriate to represent undergraduates' responses to the HRG questionnaire. The standardized estimates and path diagram of the model are shown in Figure 1.

Table 2: The fit indices of the three models tested

	NFI	IFI	CFI	RMSEA	AIC	BIC	χ^2
Single factor model	.88	.89	.88	.05 [LO .04, HI .05]	748.39	775.07	518.39, df = .319, $p < .001$
Orthogonal three-factor model	.80	.91	.91	.05 [LO .04, HI .05]	744.48	770.47	520.48, df = .322, $p < .001$
Hierarchical model	.82	.91	.92	.04 [LO .03, HI .05]	676.06	696.94	496.06, df = .316, $p < .001$

Concurrent validity

Concurrent validity indicates the amount of agreement between two different assessments of a construct. To provide preliminary estimates of concurrent validity, the study examined the relationship of HRG subscales with RAH subscales. RAHS served as a criterion measure. HRG and RAHS are theoretically measures which are based on a common theoretical concept, the concept of psychological hardiness, originally developed by Maddi and Kobasa (1984). The HRG assesses psychological hardiness. As a personal characteristic hardiness protects individuals against the ill effects of stress on health and performance (Bartone, 1999), whereas RAHS assesses the positive impact that hardiness may have in academic settings, assuming a correspondence between the hardiness dimensions and forms of behaviors that concern learning and performance in high school students and undergraduates (Benishek & Lopez, 2001; Kamtsios & Karagiannopoulou, 2013; Karagiannopoulou & Kamtsios, 2016).

Pearson correlational analysis showed interesting results. A moderate to strong validity coefficient, r = .52, was found between the HRG total score and the RAHS total score. A moderate correlation coefficient of .43 was found between HRG-commitment and RAHS-control. Moreover, a weak to moderate coefficient was reported between the HRG-

control sub-scale score and the RAHS-control score, $r = .39$. A weak to moderate coefficients was also found between HRG-challenge sub-scale scores and RAHS-control score, $r = .37$. Two of the three HRG sub-scores (commitment and control) had weak but statistically significant correlations with RAHS-commitment, $r = .22$, RAHS-challenge, $r = .25$, and RAHS-control, $r = .21$, respectively (Table 3).

Table 3: Correlations between the study variables

Factors	2	3	4	5	6	7	8	9	*M*	*SD*
1. HRG-total score	.52**	.88***	.75***	.85***	.25**	.48**	.25*	.40**	2.93	.34
2. RAHS-total score		.47**	.40**	.40**	.56**	.73**	.64**	.51**	2.72	.24
3. HRG-Commitment			.51**	.60**	.22*	.43**	.25**	.35**	2.86	.47
4. HRG-Control				.48**	.21**	.39**	.16	.33**	3.12	.38
5. HRG-Challenge					.20**	.37**	.20*	.30**	2.82	.37
6. RAHS_Commitment						.09	.18	.001	2.94	.37
7. RAHS-Control							.27**	.74**	2.71	.34
8. RAHS-Challenge								.21**	2.49	.43
9. Academic Bouyancy									5.05	1.15

Note: $*p < .05$; $**p < .01$; $***p < .001$

Predictive validity

Academic buoyancy served as a criterion measure to assess the predictive validity of the HRG. Academic buoyancy items represent a general tendency towards adaptive and successful forms of coping (Putwain et al., 2012). Scores from HRG sub-factors and academic buoyancy total score were hypothesized to be correlated because psychological hardiness, as an individual resilience resource (Bartone, Hystad, Eid, & Brevik, 2012), is associated with forms of coping (Soderstrom et al., 2000). As expected, commitment, control, and challenge scores were significantly correlated with academic buoyancy scores (Table 3).

Finally, hierarchical regression analysis (using the stepwise method) was conducted with the aim of examining which of the 3Cs (HRG sub-factors) can significantly predict undergraduates' academic buoyancy. Initially, to check multicollinearity, the variance inflation factor (VIF) and tolerance statistics were calculated (Field, 2009) for each independent variable. VIF values were below 1.00 and tolerance statistics were .74 for commitment and control and .64 for challenge. Based on these results multicollinearity was not biasing the regression model. In step 1, commitment was positive predictor of academic buoyancy, $F = 39.61$, $p = .001$. In step 2, commitment emerged as the strongest positive predictor of academic buoyancy, followed by control, $F = 25.83$, $p = .001$ (Table 4). Hardiness challenge was not a significant predictor in the final model.
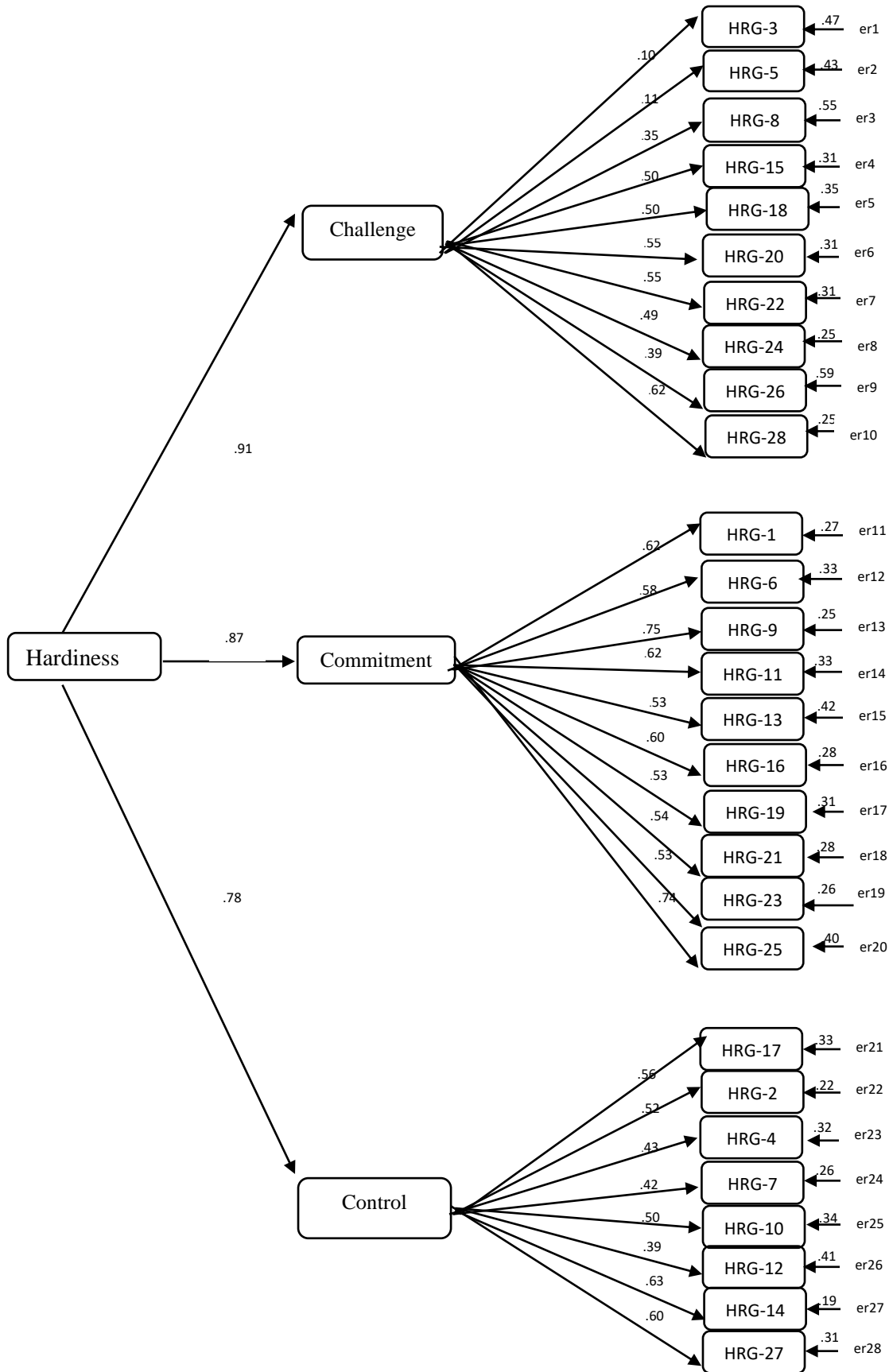
Figure 1: Hierarchical model of Hardiness Resilience Gauge (standardized estimates)

Table 4: Hierarchical regression analysis of HRG sub-scales on academic buoyancy

Variables	R	R^2	Adj R^2	β	t	p
First step						
HRG-Commitment	.355	.126	.123	.355	6.32	.001
Second step						
HRG-Commitment	.396	.157	.151	.250	3.90	.001
HRG-Control				.206	3.21	.001

DISCUSSION

The purpose of the present research was to validate (in a context of Greek university undergraduates) a new measure of psychological hardiness, the Hardiness Resilience Gauge, employing appropriate statistical procedures for construct validation, such as CFA procedure (Liau et al., 2011). Initially, a translation process was conducted (from English to Greek and back to English) with no inconsistency between the two versions. A field test was conducted to examine the wording and clarity of the scale. The reliability of the questionnaire was assessed by the Cronbach's α coefficient. Results of the study indicate that HRG has satisfactory internal consistency. Total HRG reliability as well as sub-factors' internal consistency were comparable to internal consistency results reported in a previous study, that used the same questionnaire in different cultural settings (Bartone et al., 2019). The Cronbach's α for the total HRG scale was .89, whereas α values for commitment, control, and challenge were .86, .75, and .72, respectively. Internal consistency among a set of items suggests that they share common variance, and in this case that the HRG's sub-factors are measuring a single, coherent construct (Spector, 1992). The average interitem correlations for all factors are well above the acceptable level (≥ .30) for internal consistency, indicating the items within each subscale are highly correlated and coherent (Sun et al., 2011).

Further, confirmatory factor analysis was conducted to verify the existence of the three factors and to assess the hierarchical factor structure of the HRG. Three models were tested. The hierarchical model with three factors (commitment, control, and challenge) nested under a broad hardiness factor showed the best fit to the data, confirming previous research results (Bartone et al., 2019; Hystad et al., 2010). All indices met the recommended thresholds for an adequate fit. Nevertheless, differences between the indicators of the hierarchical model and the orthogonal three-factor model were not very high. This may indicate that one level has a more important part in some phenomena, whereas a second level is more important for other phenomena (Hystad et al., 2010). For example, recent research revealed that the effects of hardiness in students' performance is best described by the commitment sub-factor, rather than the general hardiness score

(Kamtsios & Karagiannopoulou, 2015). Another study also supports the suggestion that commitment may act separately and somewhat independently from control and challenge, as commitment seems to serve as a buffer between university related stressors and university students' academic performance (Karagiannopoulou & Kamtsios, 2016). In some cases, it would make more sense to examine and focus on the individual sub-factors rather than the global construct. This means that hardiness 3Cs should be interpreted individually (Creed et al., 2013; Karagiannopoulou & Kamtsios, 2016; Sinclair & Tetrick, 2000). However, in some situations there may be a need for developing educational or training interventions or/and programs aimed at increasing overall hardiness levels (Hystad et al., 2010). Conceptualizing psychological hardiness as a broad personality characteristic comprising three more specific factors can make it easier to tailor developmental programs aimed at increasing hardiness (Hystad et al., 2010; Maddi et al., 2009).

Our knowledge concerning the factorial validity of the HRG is based on the results of extensive research in which 2,021 men and women (aged 18 to 67 years) across the United States participated (Bartone et al., 2019). Results of the present study confirm the applicability of HRG to a sample outside America's cultural context, indicating HRG's generalizability to other cultures. An important finding of the present study also is that the three-dimensional factor of the HRG was confirmed in an educational setting.

Investigation of the concurrent validity of the Greek version of the HRG was accomplished by examining its relationship with students' academic buoyancy scores. Academic buoyancy refers to a general tendency towards adaptive and successful forms of coping (Putwain et al., 2012) and is positively related to adaptive educational outcomes (i.e., persistence, planning, lower anxiety) (Comeford, Batteson, & Tormey, 2015; Putwain et al., 2012), students' academic success and personal well-being (Datu & Yuen, 2018). The positive correlations between HRG sub-scales with academic buoyancy score are in line with previous research and the reported relationship of psychological hardiness and adaptive ways of coping (Bartone et al., 2012; Cash, & Gardener, 2011; Eschleman et al., 2010). These findings are theoretically consistent and support the concurrent validity of the HRG. Further, concurrent validity results between HRG and RAHS total scores and sub-scores support a considerable amount of agreement between the two theoretical constructs. A moderate to strong validity coefficient was found between HRG and RAHS total scores and weak to moderate, but statistically significant, correlations between both scales' sub-factors.

Moreover, HRG's predictive validity was strengthened by regression analysis results, in which commitment and control predicted students' academic buoyancy. An interesting finding which makes theoretical sense is that challenge did not enter the regression equation after commitment and control. In other words, challenge was not an independent predictor of academic buoyancy, that is, the capability of students to cope effectively and keep "afloat" when faced with common setbacks encountered on a regular basis (Datu & Yuen, 2018). In the academic setting, challenge is probably most useful in motivated performance situations (i.e., goal orientation situation) (Fonseca, Blascovich, & Garcia-Marques, 2014) and after the evaluations of students' personal resources (e.g., personal skills, previous knowledge) (Blascovich, 2008; Fonseca et al., 2014). Greek

undergraduates must cope with sometimes overwhelming course loads and experience a rigid exam-oriented system. Their primary aim concerns their efforts towards passing the examinations (this is the case not only in the undergraduate studies, but also in previous stages of education, in the secondary education), as the successful completion of undergraduate studies is based on written exams (Karagiannopoulou, 2006). From this point of view, task or goal-oriented situations are rare, and students' behaviors are largely extrinsically motivated. They usually adapt their learning strategies to the examination requirements, reproducing the lesson material literally. In this context, it is difficult for them to treat problems in learning or failure in exams as challenges (Karagiannopoulou, 2006). One might hypothesize that, under these educational conditions, high challenge tendencies are not a big advantage, possibly because a portion of undergraduates may appraise university stressful situations as threatening (Kamtsios & Karagiannopoulou, 2020).

Despite these findings and given that challenge scores are not substantially lower than commitment and control scores, we cannot claim that challenge is irrelevant. On the contrary, this study's results concerning the regression analysis in which challenge did not enter the regression model predicting academic buoyancy, may have to do with the fact that the three hardiness facets overlap somewhat both conceptually and empirically (as evidenced by the hierarchical CFA results). In this line of thinking it is not unusual to see one or two hardiness facets coming out in a regression analysis as completely unique predictors. This finding does not necessarily mean that challenge is unrelated to academic buoyancy or unimportant for academic performance, given that the three hardiness facets intercorrelate to some degree, usually substantially so.

Overall, the results of this study represent an important step in assessing the reliability and validity of the Hardiness Resilience Gauge and its potential use in educational settings. Results support the appropriateness of the scale with students. The satisfactory psychometric properties of the scale suggest that HRG is a useful tool, a promising measure of psychological hardiness, for research and assessment purposes in higher education. Researchers and educators may use this scale with confidence as a measure of psychological hardiness in university undergraduates.

Limitations and future research directions

Our study has several limitations. Study participants were drawn from a social science department, which suggests caution in generalizing the findings. Future research using different sampling procedures (i.e., a stratified sampling), or involving larger and more heterogenous samples would be helpful. A test-retest reliability study also would have given a more complete psychometric picture of scale reliability. Replication of the study with a larger number of students from different university departments would also lend support to the present findings. Future research may apply the scale addressing further validity issues such as its invariance among years of study (given that students' experience

and maturity develop through the years of studying), gender and contexts (students from different university departments and academic subjects). Additional studies should also continue to examine associations of HRG with external criterion validity measures, such as undergraduates' academic burnout, stress and anxiety levels, and passion for their studies.

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