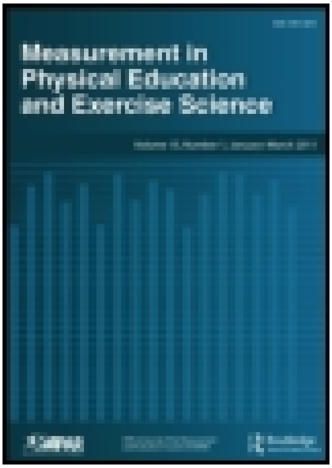

Measurement in Physical Education and Exercise Science
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/hmpe20

Revisiting the Measurement of Exercise-Induced Feeling States: The Physical Activity Affect Scale (PAAS)

Curt L. Lox , Shannon Jackson , Stephen W. Tuholski , David Wasley & Darren C. Treasure

Published online: 18 Nov 2009.

MEASUREMENT IN PHYSICAL EDUCATION AND EXERCISE SCIENCE, *4*(2), 79–95

Revisiting the Measurement of Exercise-Induced Feeling States: The Physical Activity Affect Scale (PAAS)

Curt L. Lox and Shannon Jackson
Department of Kinesiology and Health Education
Southern Illinois University Edwardsville

Stephen W. Tuholski
Department of Psychology
Southern Illinois University Edwardsville

David Wasley
Department of Kinesiology and Health Education
Southern Illinois University Edwardsville

Darren C. Treasure
Department of Exercise Science and Physical Education
Arizona State University

Interest in acute exercise-induced feeling states has intensified in recent years, signaling the need for development of domain-specific measures of these constructs. In response to this call, 2 exercise-specific measures of feeling states have been introduced—namely, the Exercise-Induced Feeling Inventory (EFI; Gauvin & Rejeski, 1993) and the Subjective Exercise Experiences Scale (SEES; McAuley & Courneya, 1994). Although certain subscales of the 2 instruments are unique, a number of similar constructs exist both within and between instruments. The purpose of this study, therefore, was to (a) combine the EFI and SEES scales into a single, more encompassing instrument and (b) investigate potential factor redundancy within and between the 2 instruments. Initial correlational analyses indicated that the Positive Well-Being subscale of the SEES and the revitalization and Positive Engagement subscales of the EFI were highly correlated. Similar results were obtained for the Fatigue (SEES) and Physical Exhaustion (EFI) subscales. These find-

Requests for reprints should be sent to Curt L. Lox, Department of Kinesiology and Health Education, Box 1126, Southern Illinois University Edwardsville, Edwardsville, IL 62026–1126. E-mail: clox@siue.edu

ings provided the impetus for the construction of the Physical Activity Affect Scale (PAAS), an instrument consisting of the Psychological Distress subscale of the SEES and the subscales of the EFI. Exploratory and confirmatory factor analyses demonstrated support for 4 components of exercise-induced affect that were subsequently labeled positive affect, negative affect, fatigue, and tranquility. The PAAS appears to be an improvement over the EFI and SEES in that it is a more encompassing measure of exercise-induced feeling states with less component redundancy than its predecessors.

Key words: exercise, affect, feeling states, measurement

During the 1980s, popular social cognitive models originally proposed by such prominent theorists as Bandura (1977) and Weiner (1979) were reformulated to account for the important role of emotional well-being (Bandura, 1986; Weiner, 1986). Around the same time, Russell (1980), Watson and Tellegen (1985), and Thayer (1989) developed separate theoretical frameworks for better understanding the concepts of emotion, affect, and mood. Based on the early theorizing of Schlosberg (1952), Russell (1980) introduced a circumplex model of affect in which 28 distinct affective states could be represented along the perimeter of a circle incorporating two bipolar axes reflecting pleasure–displeasure and arousal–sleepiness. This bipolar scheme produced at least two important tenets that would lay the foundation for future theory and research focusing on affect. First, affective experiences lie on a continuum from positive to negative hedonic tone. Second, regardless of whether they are positive or negative, affective states lie on a continuum from low to high activation (intensity). A series of studies reported by Russell (1980) provided initial empirical support for the model and indicated that the set of primary affective states could, in fact, be located along the circumplex according to the hedonic tone and intensity properties of each. For example, excitement would fall within the quadrant labeled *positive-high activation*, whereas tranquility would be considered a *positive-low activation state*. Similarly, frustration would represent *negative-high activation affect*, whereas depression would be reflective of a *negative-low activation state.*

Support for Russell's bipolar consideration of affect has also been provided by Thayer (1989), who proposed a model of mood with continuums of high–low energetic arousal and high–low tense arousal. Most notably, Thayer addressed the exercise–mood relation by suggesting that exercise is capable of regulating mood due to the enhancement of energetic arousal and the reduction of tense arousal. Thayer further espoused the importance of exercise by stating that "the single most important natural mood modulator is exercise, and the most effective way of enhancing mood is through increased exercise" (p. 171).

Taken together, the works of these authors have stimulated considerable research in a number of cognitive and social science domains. In the physical activity literature, initial investigations focused solely on the benefits of regular exercise on chronic mood states. More recently, however, researchers have begun to explore acute exercise-induced feeling states due to their potential impact on exercise behavior and certain aspects of mental health (Dishman, 1982; Gauvin & Rejeski, 1993; Rejeski, 1992). To this end, exercise-induced psychological and emotional states have been highlighted as important moderator, mediator, and outcome variables in the field of exercise psychology (Gauvin & Spence, 1998). In other words, feeling states may be operationalized as dependent variables following an exercise bout or as independent mediator and moderator variables used to predict behavior (e.g., long-term physical activity habits).

Although the theoretical tenets of the general psychology models were readily applicable to the exercise setting, concern emerged that the most popular self-report measurement tools such as the State–Trait Anxiety Inventory (Spielberger, Gorsuch, Luschene, Vagg, & Jacobs, 1983), Profile of Mood States (McNair, Lorr, & Droppleman, 1981), and Positive Affect Negative Affect Schedule (Watson, Clark, & Tellegen, 1988) were not capable of accounting for the unique stimulus properties of exercise (e.g., physical work, bodily movements, and perceptions). In response to this need for domain-specific measures, Hardy and Rejeski (1989) developed the Feeling Scale (FS) as a simple, quick, and global measure of acute exercise-induced feeling states. Unfortunately, the single-item, bipolar design of the scale is problematic for a number of reasons. First, the design contradicts current theoretical positions regarding the multidimensional nature of exercise-induced feeling states. Second, many of the commonly accepted indicators of validity and reliability (e.g., factor analysis, comparing model fit statistics, internal consistency) cannot be ascertained from a single-item scale. Finally, it is not possible to determine the potential mechanism(s) responsible for changes in global “positive” and “negative” feelings that occur as a function of exercise. In other words, the FS cannot address the extent to which improvements in feeling states are generated by physiological (e.g., physical exhaustion) and/or cognitive stimuli (e.g., positive affect).

With these limitations in mind, Gauvin and Rejeski (1993) introduced the Exercise-Induced Feeling Inventory (EFI), a multidimensional measure designed to assess feeling states that occur in conjunction with acute bouts of physical activity. The EFI was designed to capture four distinct feeling states—namely, positive engagement, revitalization, physical exhaustion, and tranquility. Subsequent statistical analyses, however, yielded equivocal support for this conceptualization and suggested that the Positive Engagement and Revitalization subscales may not be discrete factors (Gauvin & Rejeski, 1993; Rejeski, Reboussin, Dunn, King, & Sallis, 1999; Vlachopoulos, Biddle, & Fox, 1996). Support for this proposition is clearly evident in Gauvin and Rejeski’s (1993) initial validation article. First, a relatively large number of items cross-loaded saliently on the positive engagement and revitalization components. Second, the subscale intercorrelation between the two factors was high ($r = .68$, $p < .001$). Finally, an exploratory factor analysis (extracting all components with an eigenvalue greater than 1.0) indicated support for a three-factor structure with a combination of positive engagement and revitalization items representing a single component.

The argument for separate positive engagement and revitalization components was further weakened by the authors' results of the forced extraction factor analysis. The first two components that emerged were clearly representative of physical exhaustion and tranquility. In each case, all items loaded strongly on their respective factor with no salient cross-loadings. The third component consisted of the positive engagement items Enthusiastic and Upbeat as well as the revitalization items Energetic, Refreshed, and Revived. In addition, the positive engagement items Enthusiastic, Upbeat, and Happy, as well as the revitalization item Energetic, loaded saliently on the fourth component extracted. In sum, the results of various factor analytic procedures conducted by the authors of the EFI suggest that significant overlap and component redundancy exist and that positive engagement and revitalization may be best conceptualized as a single component. Unfortunately, researchers employing the EFI (Bozoian, Rejeski, & McAuley, 1994; Gauvin, Rejeski, & Norris, 1996; Rejeski, Gauvin, Hobson, & Norris, 1995; Treasure & Newbery, 1998) have failed to conduct factor analyses to confirm the proposed component structure.

Shortly after publication of the EFI, McAuley and Courneya (1994) proposed the Subjective Exercise Experiences Scale (SEES) as a more global measure of exercise-induced feeling states. Based on the popular two-factor (i.e., Positive and Negative) structure of affect, the SEES comprises positive well-being and psychological distress, as well as a third factor (Fatigue), presumed to be salient in the exercise setting. Subsequent research employing the SEES has provided consistent and strong support for the proposed structure in a number of populations (Lox, McAuley, & Tucker, 1996; Lox & Rudolph, 1994; Markland, Emberton, & Tallon, 1997). Of interest, however, is the authors' suggestion that the subscales of the EFI "may well represent underlying structural aspects of the more general psychological responses assessed by the SEES" (p. 173). Although the Psychological Distress subscale is clearly a unique and highly relevant inclusion, no empirical evidence exists to support the contention that positive well-being and fatigue measure different (i.e., more global) constructs than similar subscales found in the EFI (i.e., positive engagement and physical exhaustion, respectively).

The EFI and SEES are important first steps in the attempt to construct a feeling state inventory sensitive to the stimulus properties of exercise. However, both instruments are, according to Russell's (1980) conceptualization of affect, incomplete. Specifically, the EFI lacks a subscale that assesses negative feeling states, whereas the SEES fails to include measures of tranquility and revitalization. Thus, researchers must employ both instruments (each with different response formats) to assess the full domain of affective states predicted by Russell's (1980) model. Accordingly, the purpose of this series of studies was to investigate the utility of merging the EFI and SEES into a single encompassing instrument. The secondary purpose was to investigate potential factor redundancy within and between the two instruments. To accomplish these tasks, this investigation is divided into three separate studies. Study 1 consists of a correlational analysis of the EFI and SEES subscales. Study 2 consists of an exploratory factor analysis of a hybrid EFI–SEES instrument. Finally, Study 3 consists of a series of confirmatory factor analyses comparing the EFI, SEES, and the newly constructed Physical Activity Affect Scale (PAAS), a shortened version of the hybrid instrument utilized in Study 2.

STUDY 1: CORRELATIONAL ANALYSES OF THE EFI AND SEES

Participants and Procedure

To address the propositions put forth by McAuley and Courneya (1994) concerning the relation between the EFI and SEES, the two instruments were administered to 86 male and 220 female university students (*M* age = 23.43, *SD* = 4.72) attending a medium sized public university in the Midwest. Participants were asked to indicate the degree to which they were currently experiencing each of the 16 items by circling a number corresponding to the respective response format of each scale. For the EFI, responses ranged from 0 (*do not feel*) to 4 (*feel very strongly*). SEES responses ranged from 1 (*not at all*) to 7 (*very much so*). Participants were enrolled in one of eight activity courses (walking, jogging, aerobic dance, step aerobics, weight training, badminton, soccer, or cross training), each lasting for a total of 45 min.

Results and Discussion

Descriptive statistics for all items are presented in Table 1. Bivariate correlations indicated that each of the SEES subscales was significantly correlated with each of the EFI subscales (see Table 2), with correlation coefficients ranging from –.291 to .810 (*M* = .500). These results suggest that the EFI and SEES subscales are significantly related, and in some instances, share almost 66% of their variability. Most revealing, however, are the specific relations among (a) positive engagement, revitalization, and positive well-being and (b) physical exhaustion and fatigue. Concerning the former set of factors, results indicate that the EFI subscales (Positive Engagement and Revitalization) share over 63% and 65% of common variability, respectively, with positive well-being (SEES). Additionally, the Revitalization and Positive Engagement subscales share 73% of common variability. These findings suggest that the Revitalization and Positive Engagement subscales represent the same entity and, further, that this entity is significantly correlated, and shares substantial variability, with the Positive Well-Being subscale. In a similar fashion, physical exhaustion (EFI) and fatigue (SEES) were found to share 63% of common

TABLE 1
Descriptive Statistics for All Instrument Items

	EFA				*CFA*			
Item	*M*	*SD*	*S*	*K*	*M*	*SD*	*S*	*K*
Calm[a]	2.25	1.13	–0.281	–0.583	2.50	1.14	–0.450	–0.413
Fatigued[a]	1.23	1.12	0.555	–0.567	1.23	1.11	0.581	–0.422
Enthusiastic[a]	2.11	1.15	–0.373	–0.686	2.43	1.21	–0.554	–0.635
Relaxed[a]	2.03	1.17	–0.033	–0.747	2.36	1.13	–0.312	–0.562
Tired[a]	1.40	1.21	0.440	–0.782	1.47	1.17	0.531	–0.473
Energetic[a]	2.25	1.21	–0.329	–0.767	2.56	1.16	–0.521	–0.527
Peaceful[a]	2.34	1.19	–0.284	–0.709	2.52	1.11	–0.549	–0.306
Worn-out[a]	1.18	1.23	0.752	–0.511	1.36	1.28	0.594	–0.751
Upbeat[a]	2.06	1.23	–0.218	–0.818	2.49	1.17	–0.510	–0.588
Refreshed[a]	2.14	1.22	–0.257	–0.881	2.43	1.12	–0.450	–0.401
Happy[a]	2.55	1.21	–0.604	–0.423	2.84	1.11	–0.780	–0.195
Revived[a]	2.09	1.21	–0.219	–0.886	2.25	1.17	–0.339	–0.727
Awful[b]	0.415	0.855	2.16	4.16	1.82	1.33	1.93	3.40
Crummy[b]	0.384	0.779	2.25	5.19	1.88	1.33	1.79	2.92
Discouraged[b]	0.436	0.812	2.09	4.38	1.93	1.43	1.59	1.78
Miserable[b]	0.378	0.862	2.67	7.23	1.72	1.26	2.05	4.07
Strong[b]	—	—	—	—	4.64	1.50	–0.318	–0.265
Great[b]	—	—	—	—	4.99	1.54	–0.470	–0.416
Positive[b]	—	—	—	—	5.43	1.39	–0.767	0.090
Terrific[b]	—	—	—	—	4.81	1.63	–0.440	–0.604
Exhausted[b]	—	—	—	—	2.99	1.76	0.534	–0.748
Fatigued[b]	—	—	—	—	2.81	1.71	0.665	–0.543
Tired[b]	—	—	—	—	3.23	1.82	0.475	–0.847
Drained[b]	—	—	—	—	3.08	1.72	0.383	–0.806

Note. EFA = exploratory factor analysis; CFA = confirmatory factor analysis; S = skewness; K = kurtosis.
[a]Exercise-Induced Feeling Inventory. [b]Subjective Exercise Experiences Scale.

TABLE 2
Correlation Matrix for Exercise-Induced Feeling Inventory (EFI) and Subjective Exercise Experiences Scale (SEES) Subscales

Scales	*PHSX*	*PENG*	*RVIT*	*TRNQ*	*FTG*	*PWB*	*PD*
EFI							
Physical Exhaustion (PHSX)	—	–.316**	–.378**	–.170*	.791**	–.328**	.463**
Positive Engagement (PENG)	–.316**	—	.857**	.529**	–.376**	.783**	–.459**
Revitalization (RVIT)	–.378**	.857**	—	.547**	–.449**	.810**	–.421**
Tranquility (TRNQ)	–.170*	.529**	.547**	—	–.291**	.484**	–.344**
SEES							
Fatigue (FTG)	.791**	–.376**	–.449**	–.291**	—	–.375**	.544**
Positive Well-Being (PWB)	–.328**	.783**	.810**	.484**	–.375**	—	–.525**
Psychological Distress (PD)	.463**	–.459**	–.421**	–.344**	.544**	–.525**	—

**$p < .01$. *$p < .05$.

variability, suggesting that these two subscales may also be measuring a common, underlying construct. This proposition is further supported by the rather simplistic observation that both the Physical Exhaustion and Fatigue subscales contain the items Tired and Fatigued.

In summary, the findings reported earlier refute the proposition that the EFI and SEES measure different levels of affective response (McAuley & Courneya, 1994). Indeed, tremendous overlap appears to exist between the two instruments. Given this, a merging of the two instruments was deemed to be an appropriate and acceptable procedure for constructing a more encompassing measure of exercise-induced feeling states.

STUDY 2: EXPLORATORY FACTOR ANALYSIS OF THE HYBRID INSTRUMENT

Participants and Procedure

The first step in the development of the proposed instrument was to combine the four items from the Psychological Distress subscale of the SEES (Awful, Crummy, Discouraged, and Miserable) with the 12 items (four subscales) of the EFI. The hybrid instrument was administered to 68 male and 129 female university students (*M* age = 23.16 years, *SD* = 5.41) enrolled in one of six activity courses (walking, jogging, aerobic dance, step aerobics, weight training, or cross training), each lasting for a total of 45 min.

Results and Discussion

A maximum likelihood exploratory factor analysis with promax rotation was performed on the 16-item hybrid instrument with forced extraction of four factors. Results demonstrated support for such a structure (no salient cross loading present) with components reflecting positive affect, negative affect, fatigue, and tranquility (Table 3). This solution accounted for 71.98% of the total variance and manifested good to excellent internal consistency. Specifically, alpha coefficients for positive affect, negative affect, fatigue, and tranquility were .94, .86, .91, and .84, respectively.

The first factor extracted, Positive Affect, contained all items from the Revitalization (EFI) and Positive Engagement (EFI) subscales. Negative Affect was extracted next and comprised all items from the Psychological Distress (SEES) subscale. Fatigue, the third factor, consisted of all items from the Physical Exhaustion (EFI) subscale. Finally, Tranquility comprised two items from the Tranquility (EFI) subscale (Calm, Relaxed), with Peaceful falling just below the .40 criteria for inclusion. In short, the results of the exploratory factor analysis support those of the correlational analyses in Study 1 and suggest that the Positive Engagement

TABLE 3
Maximum Likelihood Exploratory Factor Analysis With Promax Rotation (Hybrid Instrument)

	Extraction of Four Factors					
	1	*2*	*3*	*4*	*M*	*SD*
Positive Affect						
Refreshed	**.646**	.031	–.176	.145	2.14	1.22
Enthusiastic	**.947**	–.046	.141	–.038	2.11	1.15
Energetic	**.803**	.046	–.066	.067	2.25	1.21
Happy	**.704**	–.174	.155	.049	2.55	1.21
Revived	**.763**	.172	–.169	–.017	2.09	1.21
Upbeat	**.902**	.036	.053	–.186	2.06	1.23
Negative Affect						
Awful	.002	**.690**	.054	.068	0.415	0.855
Crummy	–.048	**.888**	.013	.058	0.384	0.779
Discouraged	.115	**.697**	–.030	–.069	0.436	0.812
Miserable	–.039	**.778**	.066	–.031	0.378	0.862
Fatigue						
Fatigued	.093	–.039	**.857**	.018	1.23	1.12
Tired	–.083	.067	**.741**	.081	1.40	1.21
Worn-out	.012	.136	**.703**	–.066	1.18	1.23
Tranquility						
Calm	–.071	.033	.038	**1.00**	2.25	1.13
Relaxed	.266	.018	–.057	**.512**	2.03	1.17
Peaceful	.335	–.097	.073	.381	2.51	1.08
Eigenvalue	5.92	3.22	1.36	1.01		
% variance	37.01	20.12	8.51	6.33		

Note. Total variance explained by rotated components = 71.98%; all loadings of .40 and higher are presented in bold.

and Revitalization subscales are best conceptualized as a single factor. The findings also offer preliminary support for a hybrid instrument that assesses four discrete components of exercise-induced affect.

STUDY 3: CONFIRMATORY FACTOR ANALYSES OF THE EFI, SEES, AND PAAS

Participants and Procedure

Because it was desirable to achieve consistency in the number of subscale items of the PAAS, further modification of the instrument was required. To reduce the number of items in each of the positive and negative affect subscales, we retained those items with the highest loadings in each case. With this in mind, the items Enthusiastic, Energetic, and Upbeat were chosen to make up the Positive Affect subscale; Discouraged, Crummy, and Miserable were selected for the Negative Affect subscale. In addition, three items each from the Tranquility (Calm, Peaceful, Relaxed) and Physical Exhaustion (Tired, Fatigued, Worn-out) subscales of the EFI were included. Thus, the newly constructed PAAS consists of four subscales (Positive Affect, Negative Affect, Fatigue, Tranquility), each containing three items (see Appendix).

The instruments were administered to 89 male and 203 female university students (*M* age = 22.56 years, *SD* = 5.07) immediately following participation in one of eight activities (walking, jogging, aerobic dance, step aerobics, weight training, badminton, soccer, or cross training), each lasting for a total of 45 min.

Results and Discussion

Employing the PROC CALIS procedure within the SAS statistical software program (Statistical Analysis Systems Institute, 1990), three maximum likelihood confirmatory factor analyses were performed on the correlation matrix to assess the fit of the PAAS model and compare the adequacy of the PAAS with the EFI and SEES (see Figures 1, 2, and 3). Five indexes of fit were examined including the root mean square residual (RMSR), the root mean square error approximation (RMSEA), the goodness of fit index (GFI), the comparative fit index (CFI), and the expected cross-validation index (ECVI). Based on the criteria proposed by Browne and Cudeck (1993), an RMSR or RMSEA of .05 or less was considered a good fit with values between .05 and .08 representing an acceptable fit. GFI and CFI calculations of .90 and above were considered to be a good fit. Finally, ECVI estimates were computed on each model. The ECVI estimate is an indicator of how well a model, based on the current sample covariance matrix, would fit in a cross-validation sample of the same size. To interpret this statistic, the ECVI is computed for a number of competing models, and the model that produces the lowest ECVI estimate is said to be more desirable (Jöreskog & Sörbom, 1993). It should be noted that, although this estimate allows the researcher to rank order particular models in terms of desirability, it does not provide an absolute measure of fit.

An examination of the individual descriptive statistics indicated a moderate amount of univariate skewness and kurtosis in some items (see Table 1). Because excessive departures from multivariate normality can result in less valid fit indexes and estimated model parameters (Hoyle & Panter, 1995), analyses on transformed data were performed before proceeding with further statistical procedures. Several analyses were conducted using log and square root transformations of individual items. Transformations were applied to all variables, including those that did not show high levels of skewness and/or kurtosis. Although the transformations were successful for reducing these levels in all variables, they were particularly helpful for those maintaining the highest degrees of skewness and kurtosis. In each case, there were no significant departures in fit indexes or model parameters

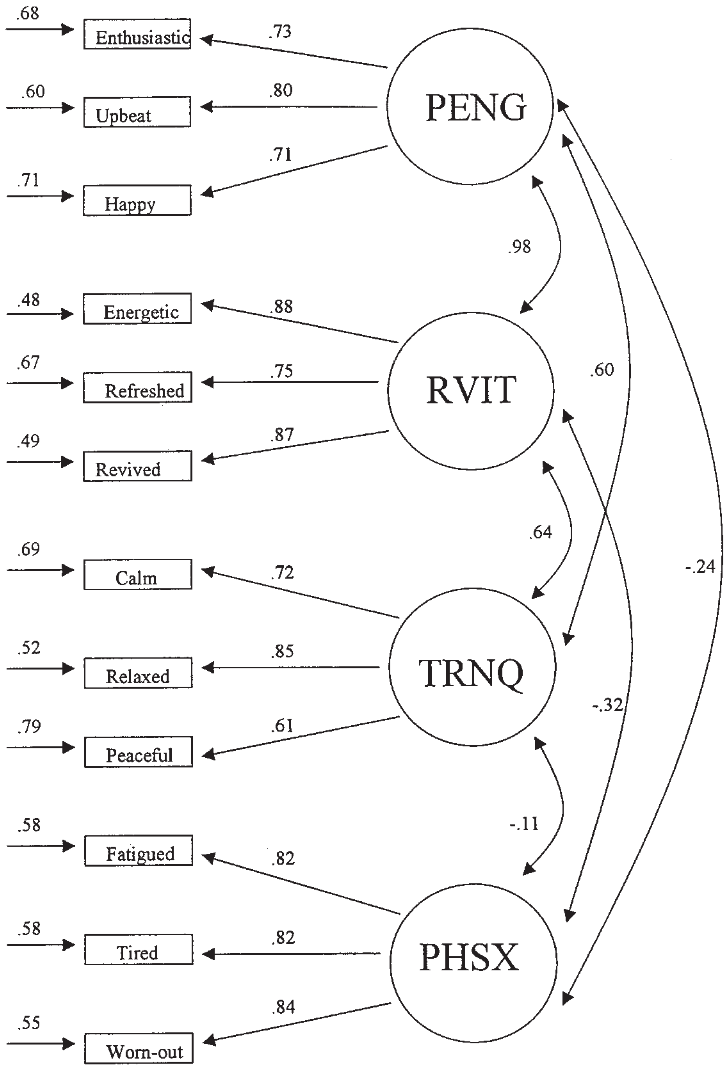

FIGURE 1 Confirmatory factor analytic model for the Exercise-Induced Feeling Inventory.

from the original, nontransformed data analyses reported later. Thus, for the sake of brevity and interpretation, we report only those analyses obtained from the original, nontransformed data.

The results of the confirmatory factor analyses are presented in Table 4. In general, the results indicated that (a) the SEES model exhibited slightly better fit in-

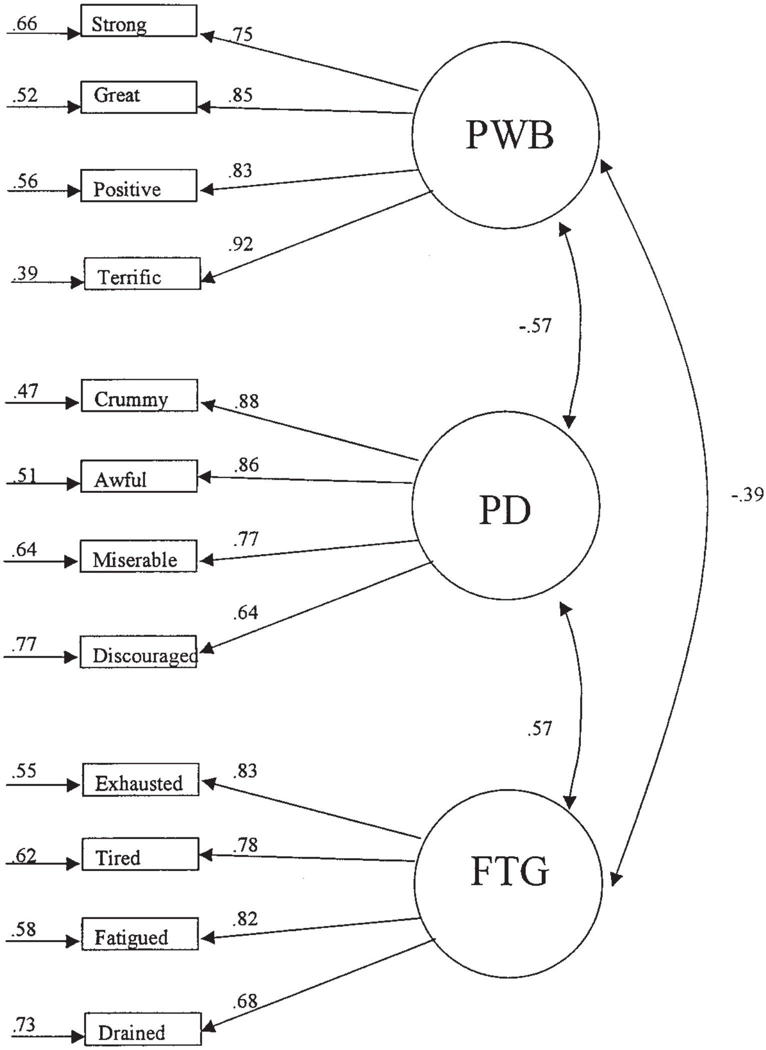

FIGURE 2 Confirmatory factor analytic model for the Subjective Exercise Experiences Scale.

dexes than the PAAS and (b) the PAAS and SEES models both exhibited a better overall fit of the data than the EFI model. Because we were unable to conduct chi-square difference tests (see Loehlin, 1987, for a discussion), the aforementioned model comparisons may only be interpreted descriptively.

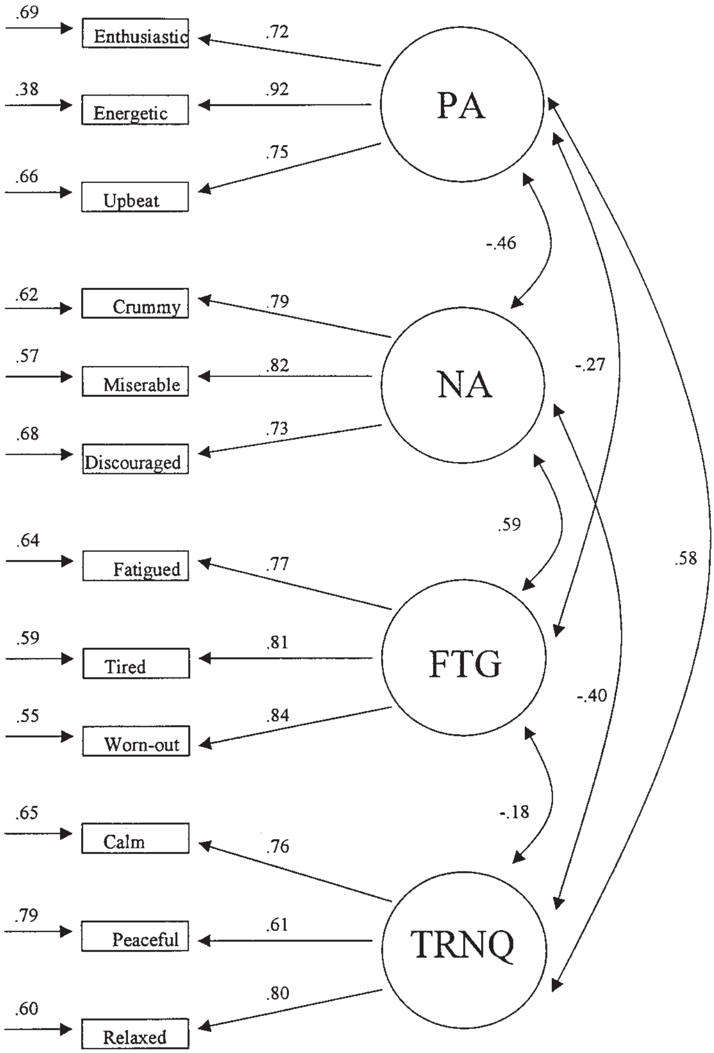

FIGURE 3 Confirmatory factor analytic model for the Physical Activity Affect Scale.

GENERAL DISCUSSION

Based on the pioneering work of Gauvin and Rejeski (1993) and McAuley and Courneya (1994), the purpose of this study was to (a) merge the two most recent and promising measures of exercise-induced feeling states into a single, encom-

TABLE 4
Confirmatory Factor Analyses for Exercise-Induced Feeling Inventory (EFI), Subjective Exercise Experiences Scale (SEES), and Physical Activity Affect Scale (PAAS) Models

Model	*RMSR*	*RMSEA*	*GFI*	*CFI*	*ECVI*
EFI	.07	.13	.83	.86	1.28
SEES	.04	.07	.92	.95	.69
PAAS	.05	.09	.90	.92	.82

Note. RMSR = root mean square residual; RMSEA = root mean square error of approximation; GFI = goodness of fit index; CFI = comparative fit index; ECVI = expected cross-validation index.

passing instrument and (b) explore potential factor redundancy in the EFI and SEES instruments. Correlational and factor analytic results from this study have produced two important conclusions. First, several factors within and across the instruments are highly correlated. Indeed, it appears that the Revitalization and Positive Engagement subscales may be better conceptualized as a single component of exercise-induced feeling states. Furthermore, these factors appear to also be redundant with respect to the Positive Well-Being subscale of the SEES. In a similar vein, Physical Exhaustion (EFI) and Fatigue (SEES) were found to essentially measure the same construct. In short, the validity of the original four-factor structure of the EFI, and the proposed conceptual differences between the SEES and EFI, remain in question.

Second, the results of this study offer preliminary evidence of a more encompassing measure of exercise-induced feeling states that (a) corrects for the redundancy in factors described earlier, (b) effectively merges the EFI and SEES instruments, and (c) boasts fit indexes that are comparable (i.e., SEES), if not superior (i.e., EFI), to those of its predecessors. The factor structure of the PAAS is also well supported, theoretically, by the four quadrants of the circumplex model of affect proposed by Russell (1980). Specifically, positive affect items would be expected to fall within the positive-high activation quadrant, negative affect items are predicted to fall within the negative-high activation quadrant, fatigue items should be contained within the negative-low activation quadrant, and tranquility items are hypothesized to fall within the positive-low activation quadrant. Further support for domain-specific measures of affect such as the PAAS, EFI, and SEES may be obtained when the predictive utility of popular theoretical models incorporating affect has been enhanced. For instance, in a test of Bandura’s (1986) social cognitive theory, exercise-specific self-efficacy may be a better predictor of affective states known to be influenced by exercise than more general affective states assessed by instruments such as the PANAS, POMS, or STAI.

From a utility standpoint, the brevity of the EFI and SEES has been maintained in the PAAS, thereby satisfying the researcher’s need for a multidimensional measure of exercise-induced affect that requires very little time to complete. This issue becomes particularly salient when multiple assessments of affect are required in the research design. For example, the scale would be well-suited for assessments of affect taken at various times before (baseline), during, and after exercise. Such a design would allow researchers to go beyond simply describing affective experiences following exercise by providing a measure of affective change. Additionally, because the response format of the EFI has also been maintained in the PAAS, researchers should find the PAAS just as easy to administer and interpret as its predecessors. Finally, on a more practical note, the use of the term *physical activity* in the naming of the PAAS was somewhat strategic in that we believe future research will not be limited to traditional definitions of exercise and physical education (i.e., sport and fitness activities). Instead, activities such as yoga, tai chi, dancing, and hiking may comprise additional modalities from which assessments of affect may be obtained.

Although we believe that the PAAS is an advancement in exercise-induced feeling state measurement, considerable validation work still remains. Specifically, additional investigations should be performed to examine the stability of the PAAS component structure as a function of factors such as mode and intensity of exercise and participant characteristics including age, gender, fitness level, and stage of exercise behavior (Gauvin & Spence, 1998). It may also be a worthwhile endeavor to modify the instructions to assess more chronic feeling states. For example, it would be of interest to examine whether or not relatively permanent changes have occurred in the PAAS feeling states following a prolonged regimen (weeks, months) of regular exercise.

REFERENCES

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*, 191–215.

Bandura, A. (1986). *Social foundations of thought and action*. Englewood Cliffs, NJ: Prentice Hall.

Bozoian, S., Rejeski, W. J., & McAuley, E. (1994). Self-efficacy influences feeling states associated with acute exercise. *Journal of Sport and Exercise Psychology*, *16*, 326–333.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136–162). Newbury Park, CA: Sage.

Dishman, R. K. (1982). Compliance/adherence in health-related exercise. *Health Psychology, 2,* 237–267.

Gauvin, L., & Rejeski, W. J. (1993). The exercise-induced feeling inventory: Development and initial validation. *Journal of Sport and Exercise Psychology, 15*, 403–423.

Gauvin, L., Rejeski, W. J., & Norris, J. L. (1996). A naturalistic study of the impact of acute physical activity on feeling states and affect in women. *Health Psychology, 15*, 391–397.

Gauvin, L., & Spence, J. C. (1998). Measurement of exercise-induced changes in feeling states, affect, mood, and emotions. In J. L. Duda (Ed.), *Advances in sport and exercise psychology measurement* (pp. 325–336). Morgantown, WV: Fitness Information Technology.

Hardy, C. J., & Rejeski, W. J. (1989). Not what, but how one feels: The measurement of affect during exercise. *Journal of Sport & Exercise Psychology, 11,* 304–317.

Hoyle, R. H., & Panter, A. T. (1995). Writing about structural equation models. In R. H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 158–176). Thousand Oaks, CA: Sage.

Jöreskog, K., & Sörbom, D. (1993). *LISREL 8: Structural equation modeling with the SIMPLIS command language*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Loehlin, J. C. (1987). *Latent variable models*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Lox, C. L., McAuley, E., & Tucker, R. S. (1996). Physical training effects on acute exercise-induced feeling states in HIV–1–positive individuals. *Journal of Health Psychology, 1*, 235–240.

Lox, C. L., & Rudolph, D. L. (1994). The Subjective Exercise Experiences Scale (SEES): Factorial validity and effects of acute exercise. *Journal of Social Behavior and Personality, 9*, 837–844.

Markland, D., Emberton, M., & Tallon, R. (1997). Confirmatory factor analysis of the Subjective Exercise Experiences Scale among children. *Journal of Sport and Exercise Psychology, 19*, 418–433.

McAuley, E., & Courneya, K. S. (1994). The subjective exercise experiences scale (SEES): Development and preliminary validation. *Journal of Sport and Exercise Psychology, 16*, 163–177.

McNair, D. M., Lorr, M., & Droppleman, L. F. (1981). Profile of Mood States. San Diego, CA: Educational and Industrial Testing Service.

Rejeski, W. J. (1992). Motivation for exercise behavior: A critique of theoretical directions. In G. C. Roberts (Ed.), *Motivation in sport and exercise* (pp. 129–158). Champaign, IL: Human Kinetics.

Rejeski, W. J., Gauvin, L., Hobson, M. L., & Norris, J. L. (1995). Effects of baseline responses, in-task feelings, and duration of activity on exercise-induced feeling states in women. *Health Psychology, 14*, 291–300.

Rejeski, W. J., Reboussin, B. A., Dunn, A. L., King, A. C., & Sallis, J. F. (1999). A modified exercise-induced feeling inventory for chronic training and baseline profiles of participants in the Activity Counseling Trial. *Journal of Health Psychology, 4*, 97–108.

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology, 39*, 1161–1178.

Schlosberg, H. (1952). The description of facial expressions in terms of two dimensions. *Journal of Experimental Psychology, 44*, 229–237.

Spielberger, C. D., Gorsuch, R. L., Luschene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State–Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists.

Statistical Analysis Systems Institute. (1990). *SAS/STAT user's guide* (Vol. 2). Cary, NC: Author.

Thayer, R. E. (1989). *The biopsychology of mood and arousal*. New York: Oxford University Press.

Treasure, D. C., & Newbery, D. M. (1998). Relationship between self-efficacy, exercise intensity, and feeling states in a sedentary population during and following an acute bout of exercise. *Journal of Sport and Exercise Psychology, 20*, 1–11.

Vlachopoulos, S., Biddle, S., & Fox, K. (1996). A social-cognitive investigation into the mechanisms of affect generation in children's physical activity. *Journal of Sport and Exercise Psychology, 18*, 174–193.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*, 1063–1070.

Watson, D. A., & Tellegen, A. (1985). Toward a consensual structure of mood. *Psychological Bulletin, 98*, 219–235.

Weiner, B. (1979). A theory of motivation for some classroom experience. *Journal of Educational Psychology, 71*, 3–25.

Weiner, B. (1986). *An attributional theory of motivation and emotion*. New York: Springer-Verlag.

APPENDIX

Instructions: Please use the following scale to indicate the extent to which each word below describes how you feel at this moment in time. Record your responses by circling the appropriate number.

	Do Not Feel	*Feel Slightly*	*Feel Moderately*	*Feel Strongly*	*Feel Very Strongly*
1. Upbeat	0	1	2	3	4
2. Calm	0	1	2	3	4
3. Energetic	0	1	2	3	4
4. Tired	0	1	2	3	4
5. Peaceful	0	1	2	3	4
6. Miserable	0	1	2	3	4
7. Worn-out	0	1	2	3	4
8. Relaxed	0	1	2	3	4
9. Fatigued	0	1	2	3	4
10. Discouraged	0	1	2	3	4
11. Enthusiastic	0	1	2	3	4
12. Crummy	0	1	2	3	4

Note. Subscales and corresponding items are as follows: Positive Affect (1, 3, 11); Negative Affect (6, 10, 12); Fatigue (4, 7, 9); Tranquility (2, 5, 8).