1   Running Head: CONSTRUCT VALIDITY OF THE POMS-A

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8   Construct Validity of the Profile of Mood States - Adolescents

9   for use with Adults

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1   Abstract

2   Objectives: The purpose of the present study was to extend the validation of the Profile

3   of Mood States-Adolescents (POMS-A: Terry, P. C., Lane, A. M., Lane, H. J., & Keohane,

4   L. (1999). Development and validation of a mood measure for adolescents. Journal of

5   Sports Sciences, 17, 861-872) from adolescent to adult populations.

6   Design: A strategy of assessing the invariance of the POMS-A factor structure among

7   disparate samples and of testing relationships with concurrent measures was used.

8   Methods: The POMS-A was administered to 2,549 participants from four samples: Adult

9   athletes prior to competition ($\underline{n}$ = 621), adult student athletes in a classroom ($\underline{n}$ = 656),

10   adolescent athletes prior to competition ($\underline{n}$ = 676), and adolescent students in a classroom

11   ($\underline{n}$ = 596). A subset of 382 adult student athletes was used to test the criterion validity of

12   the POMS-A.

13   Results: Confirmatory factor analysis provided support for the factorial validity of a 24-

14   item, six-factor model using both independent and multi-sample analyses. Relationships

15   between POMS-A scores and previously validated measures, that were consistent with

16   theoretical predictions, supported criterion validity.

17   Conclusion: Supporting evidence was found that the psychometric integrity of the

18   POMS-A extended from adolescent to adult populations.

19   Keywords: Measurement; Sport; Structural equations; Model testing; Emotion; Affect

1   Construct validity of the POMS-A for use with adults

2   The psychology of mood and sport performance has been researched extensively

3   over the past thirty years (see LeUnes & Burger, 1998; LeUnes, 2000). Research

4   investigating mood in sport has typically used the Profile of Mood States (POMS: McNair,

5   Lorr, & Droppleman, 1971), a 65-item inventory that assesses six dimensions of the mood

6   construct: anger, confusion, depression, fatigue, tension, and vigour. The brevity required

7   of measures of psychological states in some research environments has spawned many

8   shortened versions of the POMS (e.g., Grove & Prapavessis, 1992; McNair et al., 1992;

9   Shacham, 1983; Terry, Lane, Lane, & Keohane, 1999).

10   Of the shortened versions, the Profile of Mood States-Adolescents (POMS-A:

11   Terry et al., 1999) has been subjected to perhaps the most rigorous validation process. The

12   POMS-A was developed in three stages. Stage 1 established content validity, whereby a

13   panel of experts assessed an initial item pool for comprehensibility by adolescents and a

14   sample of adolescents identified those items that best described each mood dimension. In

15   Stage 2, a 24-item, six-factor structure was tested using confirmatory factor analysis on

16   adolescents in a classroom setting and adolescent athletes before competition. The

17   hypothesised model was supported in both groups independently and simultaneously. In

18   Stage 3, relationships between POMS-A scores and previously validated measures, that

19   were consistent with theoretical predictions, supported criterion validity.

20   Given that the POMS-A has shown encouraging psychometric properties among

21   samples of adolescents, the question arises of whether the measure is equally suitable for

22   use with adults. Conceptually, the answer appears straightforward. The adaptation of the

23   adolescent version from the original adult version (McNair et al., 1971) involved the

24   selection of mood descriptors that were judged to be age-appropriate for adolescents. In

25   essence, the adolescent measure is a simpler and shorter version of the adult measure.

1   There appears to be no compelling reason why the adolescent version would not remain

2   appropriate for use with adults. Indeed, for some adult populations, such as those with

3   intellectual disabilities or limited education, a measure using simple language would seem

4   highly appropriate, with potentially wide-ranging applications. Also, there is nothing in

5   the small body of research literature that has investigated the link between age and mood

6   (e.g., McNeil, Stone, Kozma and Andres, 1994) to suggest that adolescents conceptualise

7   the notion of mood any differently to adults. Nevertheless, Comrey (1988) emphasized

8   that the establishment of factorial validity is a necessary pre-requisite to the use of any

9   scale in a second population and therefore, from a psychometric perspective, it is important

10   to address the question of whether the measurement model for the POMS-A that was

11   supported among adolescent samples would also be supported among adults. This

12   question provided the central focus for the present study.

13   Schutz (1994) has argued that the proliferation of psychometric tests that have not

14   been rigorously validated has led to conceptual confusion about some constructs

15   investigated by sport psychologists. Watson and Tellegen (1985) raised a similar point in

16   their review of mood measures. If the validity of a measure, or the appropriateness of its

17   use in a particular environment, is in doubt then it is not possible to accurately test a related

18   theory. Given that the POMS-A[1] has been used recently with adult samples for both

19   research (e.g., Lane, Terry, Beedie, Curry, & Clark, 2001; Terry, Carron, Pink, Lane,

20   Jones, & Hall, 2000; Terry, Lane, & Warren, 1999) and applied purposes (e.g., Lane &

21   Terry, 1998; Vleck, Garbutt, & Terry, 1998), it appears that evidence of the validity of the

22   scale for use with adults is overdue.

23   Although tests of factorial validity provide evidence that items in a factor assess the

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[1] The measure reported in some of these studies was the POMS-C (Terry, Keohane, & Lane, 1996). The

name of the questionnaire was changed to POMS-A following the review process of the validation study.

1   same underlying construct, the researcher decides what the factor is called. Therefore, an

2   important step in establishing the validity of a questionnaire is to show that it actually

3   measures the construct it purports to measure. Tests of criterion validity help to clarify the

4   meaning of measured constructs by assessing relationships with other measures against

5   theoretical predictions. Although Terry et al. (1999) tested the POMS-A against three

6   related scales, it is important to test the scale further against criterion measures, especially

7   since the measure is now being applied to a different population. Therefore, the second

8   purpose of the present study was to assess the criterion validity of the POMS-A among

9   adult participants.

10   Considering the proposed importance of a strong theoretical underpinning for

11 psychological tests (Schutz, 1994) it is incumbent upon researchers to establish the

12 theoretical integrity of measures. Extensive conceptual discussion of the mood construct

13 generally, and the model underlying the POMS-A in particular, have been presented

14 elsewhere (Lane & Terry, 2000; McNair et al., 1971; Terry, in press). It is beyond the

15 scope of the present paper to reproduce those theoretical discussions, but to facilitate an

16 appreciation of the proposed item groupings, a general description of the six mood

17 dimensions is presented.

18   Terry et al. (1999) described the factors of the POMS-A in the following way,

19 "Anger is typified by feelings that vary in intensity from mild annoyance or aggravation to

20 fury and rage, and is associated with arousal of the autonomic nervous system

21 (Spielberger, 1991). Confusion is proposed to be a feeling state characterised by

22 bewilderment and uncertainty, associated with a general failure to control attention and

23 emotions. Depression is associated with a negative self-schema characterised by themes

24 such as hopelessness, personal deficiency, worthlessness, and self-blame (Beck & Clark,

25 1988). Fatigue is typified by feelings of mental and physical tiredness. Tension is typified

1   by feelings such as nervousness, apprehension, worry, and anxiety. Vigour is typified by

2   feelings of excitement, alertness, and physical energy" (p.863). Based on the findings of

3   Terry et al., it was hypothesised that, in the present study, depression would show

4   moderate positive relationships with anger, confusion, fatigue and tension, and a weak

5   inverse relationship with vigour; while vigour would show a moderate inverse relationship

6   with fatigue but be unrelated to anger, confusion, and tension.

7   Method

8   1. Model Testing

9   Participants

10   A multi-sample approach was used to test the invariance of the factor structure of

11   the POMS-A among four disparate samples. Given that the central purpose of the study

12   was to test whether the factor structure remained the same among adults and adolescents,

13   two adult samples and two adolescent samples were recruited. Sample 1 comprised 621

14   adult athletes (463 males, 158 females; age: $\underline{M}$ = 27.2 yr., $\underline{SD}$ = 6.6 yr.), recruited from the

15   sports of cycling, distance running, kickboxing, rowing, and swimming, to reflect a wide

16   range of age, experience, and ability. Sixty-five cyclists (age: $\underline{M}$ = 29.6 yr., $\underline{SD}$ = 7.6 yr.)

17   with a mean of six years of racing experience were drawn from a 10-mile time trial; 297

18   distance runners (age: $\underline{M}$ = 31.0 yr., $\underline{SD}$ = 10.1 yr.) with a mean of six years of racing

19   experience were drawn from cross-country, 10 k, 6 miles and marathon events; 89

20   kickboxers (age: $\underline{M}$ = 24.6 yr., $\underline{SD}$ = 4.8 yr.) were drawn from the non-contact, semi-

21   contact and full contact categories at a national championship; 98 rowers (age: $\underline{M}$ = 23.3 yr.,

22   $\underline{SD}$ = 7.2 yr.) were drawn from the 1996 world championships; and 72 swimmers (age: $\underline{M}$ =

23   20.5 yr., $\underline{SD}$ = 2.1 yr.) with a mean of seven years of racing experience were drawn from club

24   events. Sample 2 comprised 656 adult students studying for a degree in sport sciences or a

25   qualification in fitness training and leisure (365 males, 291 females; age: $\underline{M}$ = 24.2 yr., $\underline{SD}$

1   = 3.7 yr.). Participants in Sample 2 were from the sports of basketball, boxing, duathlon,

2   distance running, hockey, karate, rugby league, rugby union, soccer, swimming,

3   taekwondo, tennis, track and field and triathlon. Sample 3 comprised 676 adolescent

4   athletes (301 males, 375 females; age: $\underline{M}$ = 14.7 yr., $\underline{SD}$ = 1.8 yr.) competing in the

5   London Youth Games, from the sports of archery, hockey, judo, netball, soccer, table

6   tennis, track and field, trampolining, triathlon and volleyball. Sample 4 comprised 596

7   adolescent students (313 males, 283 females; age: $\underline{M}$ = 14.7 yr., $\underline{SD}$ = 1.4 yr.) from

8   secondary schools in the west London area.

9   <u>Procedures</u>

10   Given the wide range of potential uses to which a simple measure of mood can be

11   applied, it is appropriate that tests of validity are conducted in more than one setting.

12   Investigations of mood responses among athletes have often been conducted at the pre-

13   competition stage, but also in situations away from the competition environment (see

14   LeUnes, Hayward, & Daiss, 1988). Normative data provided by Terry and Lane (2000)

15   demonstrated that, typically, mood responses vary between competitive and non-

16   competitive situations. Therefore, it was decided to assess moods in both situations. Using

17   this strategy, it was possible to determine whether the factor structure of the POMS-A

18   remained invariant across adolescent and adult samples even in situations that differed in

19   degree of ego involvement. Participants in Sample 1 (adult athletes) and Sample 3

20   (adolescent athletes) completed the POMS-A approximately one hour before a competition.

21   Participants in Sample 2 (adult students) and Sample 4 (adolescent students) completed the

22   POMS-A at the start or end of a class. All participants were asked to rate, "How are you

23   feeling right now?" in terms of the 24 mood descriptors, e.g., "alert", "unhappy". The

24   POMS-A has a five-point response scale, from 0 (not at all) to 4 (extremely). The

25   instructions to participants included a reminder to respond to all items and a statement

1   designed to discourage a social desirability bias (c.f., Martens, Vealey, & Burton, 1990).

2   A culturally appropriate, alternative word list (c.f., Albrecht & Ewing, 1989) was made

3   available to participants for reference in case mood descriptors could not be understood.

4   Following the recommendations of Byrne (2000), the hypothesized 24-item, six-

5   factor model of mood was first tested on each sample independently before conducting a

6   multi-sample analysis, in which the hypothesized model was tested on all four samples

7   simultaneously. Confirmatory factor analysis (CFA) using EQS V5 (Bentler & Wu, 1995)

8   was used to test the model, which specified that items were related to their hypothesised

9   factor with the variance of the factor fixed at 1. Consistent with theoretical predictions and

10   previous empirical support, the latent factors anger, confusion, depression, fatigue, and

11   tension were allowed to correlate (see Terry et al., 1999). Vigour was allowed to correlate

12   with depression and fatigue only, as it had been hypothesised that relationships between

13   vigour and anger, confusion, and tension would not differ significantly from zero.

14   The choice of cut-off criteria used to evaluate model adequacy is a contentious

15   issue. Some researchers favour a two-index strategy, with the indices selected on the basis

16   of sample size, model complexity, and the distributional properties of the data (Hu &

17   Bentler, 1999). We followed the approach of Byrne (1998, 2000), Hoyle and Panter

18   (1995) and Kline (1998), all of whom advocated use of a range of fit indices to judge

19   model adequacy. Kline, for example, recommended a "minimal set" that included (a) the

20   χ^2 statistic and its associated degrees of freedom, (b) an index that describes the overall

21   proportion of variance explained, (c) an index that adjusts the proportion of variance

22   explained for model complexity, and (d) an index based on the standardized residuals.

23   We chose a four-index strategy. The first index used to judge model adequacy was

24   the ratio of χ^2 to degrees of freedom. There is disagreement about what size of ratio

25   indicates an acceptable fit, with estimates varying from two to five. Kline (1998) proposed

1   that a ratio of less than three is acceptable. Two incremental fit indices were used; the

2   comparative fit index (CFI: Bentler, 1990) and the non-normed fit index or Tucker-Lewis

3   index (TLI: Tucker & Lewis, 1973). Incremental fit indices are based on comparisons

4   between the hypothesised model and a null model (in which there are no relationships

5   among the observed variables) and are not influenced by sample size. Kline (1998)

6   proposed that values for the CFI and TLI of less than .90 indicate that the hypothesized

7   model could be substantially improved, whereas Hu and Bentler (1999) suggested that, in

8   most circumstances, values should approach .95. The fourth index used was the root mean

9   square error of approximation (RMSEA: Steiger, 1990), which indicates the mean

10   discrepancy between the observed covariances and those implied by the model per degree

11   of freedom, and therefore has the advantage of being sensitive to model complexity.   A

12   value of .05 or lower indicates a good fit and values up to .08 indicate an acceptable fit

13   (Browne & Cudeck, 1993). Byrne (1998) described the RMSEA as "one of the most

14   informative criteria in structural equation modelling" (p. 112).

15   Multi-sample CFA was used to test the strength of the factor solution in all four

16   samples simultaneously. In multi-sample analysis, it is assumed that data from more than

17   one sample provide comparable information about the hypothesised model. This

18   assumption is tested by analysing data from different samples simultaneously to verify

19   whether the model reproduces the data of each sample to within sampling accuracy

20   (Bentler, 1995). Bentler recommended that hypothesis testing in multi-sample analysis

21   should be sequential. Hence, the first hypothesis was that the factor solution would remain

22   the same in all four samples. This hypothesis was tested with no equality constraints in

23   place, to establish a baseline against which to compare subsequent, more constrained,

24   models. The second hypothesis tested was that factor loadings would remain invariant in

25   all four samples. The third hypothesis was that factor loadings and inter-correlations

1   among factors would remain invariant in all four samples.

2   2. Test of Criterion Validity

3   Participants

4   A total of 382 adult student athletes completed the POMS-A and a second

5   questionnaire. Ninety-one participants (Age: $\underline{M}$ = 21.0 yr. $\underline{SD}$ = 5.2 yr.) completed the

6   original POMS (McNair et al., 1971), 84 participants (Age: $\underline{M}$ = 23.3 yr., $\underline{SD}$ = 3.5 yr.)

7   completed the Positive and Negative Affect Schedule (PANAS: Watson, Clark, &

8   Tellegen, 1988), 97 participants (Age: $\underline{M}$ = 23.5 yr.; $\underline{SD}$ = 3.4 yr.) completed the state

9   anger scale of the State-Trait Anger-expression Inventory (STAXI: Spielberger, 1991); and

10   110 participants (Age: $\underline{M}$ = 25.9 yr., $\underline{SD}$ = 10.4 yr.) completed the depression scale of the

11   Hospital Anxiety and Depression Scale (HADS: Zigmond & Snaith, 1983). Participants

12   completed the questionnaires in accordance with the procedure used for the student athletes

13   in Stage 1.

14   Criterion Measures

15   Two considerations are particularly salient when choosing appropriate criterion

16   measures. First, a criterion scale should itself be a valid, reliable measure. Second, it

17   should be possible to predict the relationship between scores on the measure being

18   validated and the criterion measure. All the criterion measures selected meet these two

19   considerations. The original POMS was an obvious choice as it assesses the same six

20   mood dimensions as the POMS-A. The PANAS was selected because it assesses two

21   broad affective dimensions that are conceptually related in a predictable way to the POMS-

22   A scales. The STAXI and the HADS were selected because they assess specific constructs

23   that form part of the POMS-A and therefore should show strong relationships with some

24   scales of the POMS-A but not with others. It is acknowledged that these arguments would

25   apply equally to other potential criterion measures.

1   Profile of Mood States (McNair et al., 1971)

2   The 65-item POMS was developed via six factor analytic studies. McNair et al.

3   showed evidence of concurrent and predictive validity, and produced normative data for

4   students and psychiatric outpatients. McNair et al. (1992) claimed that the POMS was

5   valid for use in sport and exercise environments and provided a summary of findings from

6   these domains in support of this proposition. A response set of "How are you feeling right

7   now" was used in the present study. Given that the POMS-A is a derivative of the original

8   POMS, strong positive relationships were hypothesised between the respective anger,

9   confusion, depression, fatigue, and tension scales. A moderate positive relationship was

10   hypothesised between the two vigour scales because the original scale assesses a fairly

11   broad-based positive mood (including items such as "cheerful" and "carefree") whereas the

12   POMS-A vigour scale assesses a narrower construct ("active", "alert", "energetic",

13   "lively").

14   Positive and Negative Affect Schedule (Watson et al., 1988)

15   Watson et al. developed the 20-item PANAS to assess independent markers of

16   positive and negative affect.   Validation studies for the PANAS involved 3,554

17   applications of the scale. The two factors showed strong content validity, with all items

18   loading at .50 or higher onto their hypothesised factor. PANAS items are rated on a 5-

19   point scale, from 1 (not at all) to 5 (extremely). Examples of positive affect items include

20   "excited", "enthusiastic" and "determined." Examples of negative affect items include

21   "distressed", "guilty" and "scared." Recent research has supported the factor structure of

22   the PANAS among a sample of young athletes (Crocker, 1997). In the present study, it

23   was hypothesised that the POMS-A vigour scale would correlate with the positive affect

24   scale of the PANAS, while the POMS-A tension, depression, anger, fatigue, and confusion

25   scales would correlate with the PANAS negative affect scale.

1   State-Trait Anger-expression Inventory (Spielberger, 1991)

2   The 10-item state anger scale was validated on a sample of 550 participants.

3   Exploratory factor analysis identified a single factor with an alpha coefficient (Cronbach,

4   1951) of .93. STAXI items are rated on a 4-point scale, from 1 (almost never) to 4 (very

5   often). In the present study, it was hypothesised that the POMS-A anger scale would be

6   highly correlated with STAXI scores, whereas the other five POMS-A scales would be

7   unrelated or moderately correlated with the STAXI scale.

8   Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983)

9   The HADS includes seven items to assess depression among medical outpatients

10   and the general population. Items are rated on a 4-point scale, from 0 (not at all, or only

11   occasionally) to 3 (most of the time, or a great deal of the time). Validation of the HADS

12   used 100 outpatients who completed the scale as part of a psychiatric interview. The

13   authors reported an alpha coefficient of .60 for the depression scale. Concurrent validity

14   was assessed against information given in a 20-minute interview to an interviewer blind to

15   the HADS scores. This technique produced a correlation coefficient of .79 for the

16   depression scale. The HADS anxiety scale was not used in the present study. Given the

17   proposed pivotal position of depressed mood in mood-performance relationships (see Lane

18   & Terry, 2000), the criterion validity of the POMS-A depression scale was of particular

19   interest. As depressed mood was assessed using two different response sets ("How are you

20   feeling right now?" for the POMS-A and "How have you been feeling during the past

21   week?" for the HADS) it was hypothesised that the two scales would be moderately, rather

22   than highly correlated. It was also hypothesised that the other five POMS-A scales would

23   be unrelated or be weakly correlated with the HADS depression scale.

1   Results

2   Single-sample Confirmatory Factor Analysis

3   Prior to analysis, each data set was screened to check that the assumptions of

4   univariate and multivariate normality had been met. Evidence of non-normality was found

5   for some variables. Inspection of cases identified as outliers suggested that although the

6   response patterns for these individuals were unusual, they were nevertheless plausible, so

7   no attempt was made to transform variables or to trim the data set. To compensate for the

8   non-normality, the Satorra-Bentler χ^2, a statistic that includes a downward correction for

9   degree of observed kurtosis (Satorra & Bentler, 1994), was used to test the model fit for

10   individual groups. This strategy was supported in a recent review of research methods in

11   sport and exercise psychology (Biddle, Markland, Gilbourne, Chatzisarantis, & Sparkes,

12   2001).

13   Overall, fit indices showed moderate support for the tenability of the hypothesised

14   model (see Table 1). Generally, the four groups showed similar fit, although the indices

15   were somewhat lower for the adolescent student group. Modification indices suggested a

16   number of ways by which fit could be improved, but only one change was implemented.

17   This change allowed the error terms for the fatigue indicators "sleepy" and "tired" to

18   covary. A χ^2-difference test showed that this modification significantly improved fit for all

19   groups but had the greatest impact on the fit indices for the adolescent athletes (CFI = .936,

20   TLI = .926, RMSEA = .054) and adolescent students (CFI = .936, TLI = .948, RMSEA =

21   .046). From a theoretical point of view, it made sense to allow these terms to covary

22   because the presence of unique variance within the fatigue factor suggested that the

23   adolescent samples had difficulty separating the meaning of "sleepy" and "tired".

24   As shown in Table 1, even without this modification, the χ^2 /df ratios met the

25   criterion value for a good fit in all samples, RMSEA values were acceptable, while the CFI

1   and TLI values fell between traditional and recent benchmarks. Factor loadings were all

2   highly significant. More importantly, the magnitude of the factor loadings (72% were

3   above .70) further supported the validity of the factor structure (see Table 2).

4   Correlations among mood dimensions are contained in Table 3. The direction and

5   magnitude of relationships was consistent with the hypothesised model and with those

6   reported by Terry et al. (1999). The Lagrange multiplier test indicated that the fit of the

7   model would not be improved by allowing vigour to correlate with anger, tension and

8   confusion. Collectively, single-sample CFA results provided support for the tenability of

9   the hypothesised model, and hence the next step was to examine the congruency of the

10   hypothesised model against data in the four samples simultaneously, using multi-sample

11   CFA.

12   <u>Multi-sample Confirmatory Factor Analysis</u>

13   The results of the multi-sample CFA are contained in Table 4. The fit of the

14   baseline model with no equality constraints imposed was encouraging whereas the fit of

15   the more constrained models was marginal. Modification indices suggested a number of

16   potential changes to all models. At this point, the researchers were confronted with the

17   task of identifying those parts of the model that needed re-specification to achieve better

18   fit. However, problems associated with <u>post-hoc</u> modifications have been emphasized

19   recently (Biddle et al., 2001) and, indeed, specialists in structural equation modelling (e.g.,

20   Gerbing & Hamilton, 1996) have pointed out that <u>post-hoc </u>modifications are more

21   exploratory than confirmatory. In fact, exploratory factor analysis (EFA) is considered a

22   viable alternative to attempting to adjust the confirmatory model. Gorsuch (1997)

23   proposed that in situations where model fit is difficult because of many small deviations

24   from the hypothesized model, a situation we were faced with in the present analysis, EFA

25   is "an appropriate alternative to attempting to adjust the confirmatory model" (p. 536).

1   Mindful of this advice, and mindful also of advice from other researchers (e.g., Comrey,

2   1988; Gerbing & Hamilton, 1996) that CFA and EFA should be used together in scale

3   construction and validation, we decided to use EFA with each of the groups separately to

4   see how the items loaded when totally unconstrained, apart from the stipulation that the

5   number of factors must equal six. The maximum likelihood method was used with oblique

6   rotation.

7   When EFA is used for confirmatory purposes, the expectation is that the

8   hypothesised factor structure of the scale will be recovered in all samples, just as it would

9   be in a CFA (Gorsuch, 1997). In the case of the POMS-A, the expectation was that each of

10   the 24 items should have a large loading on its associated factor and negligible loadings

11   (cross-loadings) on all other factors. By convention, factor loadings below .30 are usually

12   considered to be non-significant (e.g., Tabachnick & Fidell, 1996). In the present analyses,

13   we adopted a more rigorous criterion of .20. In other words, cross-loadings of .20 or more

14   were counted as evidence of misfit and likely sources of the model misspecification in the

15   CFA section of our analyses.

16   The results showed that for three of the four samples, the expected factor pattern

17   emerged. That is, all six factors emerged clearly with each factor defined solely by

18   appropriate marker items. Explained variance for the four samples ranged from 56% to

19   63%. Furthermore, the patterns for three of the samples supported the hypothesized model.

20   For the adult athletes, only the item "uncertain" cross-loaded above .20, with a loading of

21   .31 on tension and .51 on confusion. For the adult students, an identical pattern emerged

22   with "uncertain" loading on both tension (.36) and confusion (.39) but no other cross-

23   loadings above .20. For the adolescent athlete group, three cross-loadings were found. The

24   item "downhearted" loaded on anger (.22) and depression (.56); "muddled" loaded on

25   depression (.33) and confusion (.54); and "uncertain" loaded on tension (.28) and

1   confusion (.54). Thus, for these three groups, apart from a small number of cross-loading

2   items, the derived factor structure was exactly as hypothesized.

3   Some variation to this pattern was observed with the adolescent student sample. As

4   was the case with the two adult samples, "uncertain" was the only item with a cross

5   loading (.25 on tension and .53 on confusion). However, the fatigue dimension split into

6   two correlated ($\underline{r}$ = .51) factors with "exhausted" and "worn out" defining one factor and

7   "sleepy" and "tired" the other. This tendency had already been detected in the CFA and

8   was modelled by fitting a covariance pathway to the error terms for "sleepy" and "tired".

9   To compensate for this additional factor, the analysis was re-run, this time requesting

10   seven factors. When this was done, with the exception of the cross loading for the item

11   "uncertain", the hypothesized factors emerged for anger, confusion, depression, tension

12   and vigour, plus two fatigue factors of two items each.

13   Overall, the combined results of the confirmatory and exploratory analyses add

14   weight to the notion that the hypothesised factor structure of the POMS-A can be

15   reproduced in disparate samples, thereby supporting the factorial validity of the measure.

16   Criterion Validity

17   Relationships between scores on the POMS-A and criterion measures are contained

18   in Table 5. Correlations between the POMS-A and the original POMS support the notion

19   that, generally, the scales measure the same thing. The moderate relationship between the

20   two vigour scales suggests that they assess slightly different constructs. The POMS-A

21   vigour scale, which includes the items "active", "alert", "energetic" and "lively", may

22   provide a more focused measure of the vigour construct than the original POMS scale,

23   which includes items such as "cheerful" and "carefree".

24   The strong relationship between the depression scales of the POMS-A and the

25   original POMS suggests that they assess a very similar construct. Kline (1998) cautioned

1   that reducing the number of items in a scale might yield a collection of items almost

2   identical in meaning, thereby boosting internal consistency. The present results are

3   consistent with the notion that the POMS-A depression scale of four items assesses

4   essentially the same construct as the original POMS depression scale, which includes 15

5   items. The POMS-A depression scale and the HADS depression scale were, as

6   hypothesized, moderately correlated.

7   It should be noted that the POMS-A provides a measure of depressed mood at a

8   given point in time <u>not</u> a measure of clinical depression. For clinical depression, Tennen,

9   Hall, and Affleck (1995) proposed that self-report measures should be used in conjunction

10 with follow-up interviews. Therefore, the validity of the POMS-A for use with clinical

11 populations is unknown.

12   As hypothesised, PANAS scores for positive affect showed a strong positive

13 correlation with scores on the POMS-A vigour scale but minimal correlation with the other

14 POMS-A scales.   Also as hypothesised, PANAS scores for negative affect correlated with

15 POMS-A scores for anger, confusion, depression, fatigue and tension but were unrelated to

16 scores for vigour. Further, STAXI scores correlated strongly with POMS-A scores for

17 anger. Overall, correlations between scores on the POMS-A, the PANAS, and the STAXI

18 were consistent with those reported by Terry et al. (1999). Collectively, it is proposed that

19 the pattern of correlations between scores on the POMS-A and criterion measures provides

20 strong evidence of concurrent validity.

21   Discussion

22   The purpose of the present study was to validate the POMS-A for use with adult

23 athletes. Individual CFAs suggested that the measurement model underlying the POMS-A

24 provided an adequate fit to the data for each of the four samples in this study. Lagrange

25 multiplier (LM) tests indicated a number of ways in which fit could be improved.

1 However, bearing in mind that the large samples used in this study rendered the LM tests

2 particularly powerful, we would argue that although statistically significant, many of these

3 differences are not of great practical or theoretical importance.

4   The one concession to the LM tests was the fitting of a pathway between the error

5 terms for "tired" and "sleepy". This modification was suggested for all samples but it had

6 its greatest impact on the fit statistics for the adolescent students. The inference we draw

7 from this modification is that detection of the semantic gap between "tired" and "sleepy" is

8 more problematic for adolescents than adults. In other words, adolescents may have

9 difficulty distinguishing between these two mood descriptors. Context is important here.

10 In a sport setting, "tired" and "sleepy" have very different meanings whereas in a

11 classroom setting, these two descriptors could mean almost the same thing. This reinforces

12 our strategy of checking for consistency across settings as well as across age groups.

13 Having items with such an overlap does not damage the psychometric properties of the

14 instrument but, as we have demonstrated, the overlap needs to be modelled. Solutions to

15 this problem would include dropping one of the items, combining them to form a parcel or,

16 as we recommend, allowing their error terms to covary.

17   A multi-sample CFA provided some support for the notion that the factor structure

18 of the POMS-A, the factor loadings of the items, and the inter-correlations among

19 subscales did not vary greatly in the four different samples. Fit statistics were judged to be

20 adequate when factor structure was constrained to be equal across samples, but were

21 considered marginal when factor loadings and factor covariances were also constrained to

22 be equal. Again, LM tests indicated a number of potential modifications. To assist in

23 identifying potentially important differences among samples, EFA was used. The results

24 of the EFAs helped to clarify the differences between samples. They demonstrated that the

25 structure of the POMS-A was easily recovered for all samples, and showed that the cross-

1   loadings that caused some of the misfit in the CFAs were relatively minor. Indeed, they

2   would have been ignored had EFA been used initially to assess the factor structure of the

3   POMS-A. The EFAs also highlighted a problem that has already been noted, that is, the

4   difficulty of trying to fit a single factor to the markers for fatigue. It is problematic for the

5   adolescent students because of the conceptual overlap between the items "tired" and

6   "sleepy". Finally, the EFAs suggested that for all samples, but especially the older ones,

7   allowing the item "uncertain" to load on both tension (minor loading) and confusion

8   (major loading) would improve the measurement model.

9   In summary, these findings indicated that factorial validity was generally

10   supported among disparate samples and the hypothesised relationships among mood

11   dimensions were demonstrated. It should be noted that model fit was actually stronger

12   among adults than among adolescents. Collectively, findings supported the notion that the

13   POMS-A has shown acceptable indicators of validity as a measure of mood among adults

14   as well as adolescents.

15   Criterion validity was supported by the relationships between POMS-A scores and

16   other measures taken concurrently. Comrey (1988) stressed the importance of developing

17   a nomothetic network of evidence supporting claims that the instrument measures what it

18   is intended to measure. In the words of Anastasi: "It is only through the empirical

19   investigation of the relationship of test scores to other external data that we can discover

20   what a test measures" (cited in Comrey, 1988). In a sense, the validation of a test never

21   ends. In the present study, we have demonstrated that the constructs measured by POMS-

22   A have predictable relationships with positive and negative affect as measured by PANAS,

23   anger as measured by the STAXI, depression as measured by the HADS, and mood states

24   as measured by the original version of the POMS.

25   It is suggested that the POMS-A is an appropriate tool with which to test mood

1   theory. Importantly, the brevity of the POMS-A facilitates mood assessment in research

2   environments where there is a limited amount of time available for data collection. One

3   such line of investigation is the assessment of mood before sport competition.

4   Examination of the mood and performance relationship has been prominent in sport

5   psychology (see LeUnes & Burger, 1998; LeUnes, 2000 for reviews) and recent research

6   has started to examine the mechanisms underlying mood-performance relationships (Lane

7   & Terry, 2000).

8   In conclusion, the purpose of the study was to extend the validation of a measure of

9   mood from adolescent to adult samples. Confirmatory procedures offered support for the

10 tenability of a six-factor model using both independent and multi-sample analyses.

11 Criterion validity was supported via relationships with previously validated inventories.

12 Overall, it is suggested that the construct validity of the POMS-A has been shown to be

13 satisfactory, and therefore the scale may provide a useful measure of mood for future

14 research or applied work.

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1   Table 1

2   Confirmatory Factor Analysis of the POMS-A with Adult and Adolescent Samples

Fit Indices	Sample			
	Sample 1 ($\underline{n}$ = 621)	Sample 2 ($\underline{n}$ = 656)	Sample 3 ($\underline{n}$ = 676)	Sample 4 ($\underline{n}$ = 596)
χ^2 ($\underline{df}$ = 240)	524.761	521.484	424.785	373.800
χ^2:$\underline{df}$ ratio	2.203	2.191	1.783	1.574
CFI	.923	.941	.914	.930
TLI	.912	.932	.901	.919
RMSEA	.059	.061	.062	.057

3   Note. All χ^2 values are significant at $\underline{p}$ < .01.

4   Sample 1 = adult athletes, Sample 2 = adult students, Sample 3 = adolescent athletes,

5   Sample 4 = adolescent students.

1   Table 2

2   Standardised Solution for Factor Loadings for a 24-item, Six-factor Model of the POMS-A

3   Tested on Athletes and Adolescents

Scale	Item	Sample 1 (n = 621)	Sample 2 (n = 656)	Sample 3 (n = 676)	Sample 4 (n = 596)
Anger					
	Angry	.735	.881	.814	.765
	Annoyed	.810	.789	.829	.753
	Bad-tempered	.609	.763	.671	.722
	Bitter	.647	.782	.634	.619
Confusion					
	Confused	.631	.725	.641	.605
	Mixed-up	.737	.839	.775	.794
	Muddled	.768	.837	.766	.815
	Uncertain	.639	.718	.616	.702
Depression					
	Depressed	.800	.840	.841	.761
	Downhearted	.791	.838	.719	.795
	Miserable	.591	.715	.775	.755
	Unhappy	.762	.854	.766	.764
Fatigue					
	Exhausted	.838	.886	.893	.864
	Sleepy	.715	.743	.544	.530
	Tired	.471	.811	.645	.649
	Worn-out	.848	.898	.863	.912
Tension					
	Anxious	.792	.756	.456	.594
	Nervous	.768	.669	.736	.828
	Panicky	.652	.506	.713	.706

Worried	.814	.841	.798	.833
Vigour				
Active	.865	.846	.777	.815
Alert	.753	.594	.509	.489
Energetic	.875	.899	.840	.797
Lively	.725	.694	.652	.688

1   Note. All factor loadings are significant at p < .01.

2   Sample 1 = adult athletes, Sample 2 = adult students, Sample 3 = adolescent athletes,

3   Sample 4 = adolescent students.

4

1   Table 3

2   Correlations Coefficients Among POMS-A Scales in Adult Athletes (n = 621),

3   Adult Students (n = 656), Adolescent Athletes (n = 676), and Adolescent Students (n =

4   596)

Scale	Anger	Confusion	Depression	Fatigue
Confusion				
Adult Athletes	.490			
Adult Students	.578			
Adolescent Athletes	.613			
Adolescent Students	.587			
Depression				
Adult Athletes	.653	.631		
Adult Students	.736	.725		
Adolescent Athletes	.804	.730		
Adolescent Students	.786	.700		
Fatigue				
Adult Athletes	.387	.363	.503	
Adult Students	.295	.406	.446	
Adolescent Athletes	.273	.299	.372	
Adolescent Students	.356	.387	.275	
Tension				
Adult Athletes	.228	.561	.317	.220
Adult Students	.571	.855	.707	.413
Adolescent Athletes	.316	.512	.444	.196
Adolescent Students	.174	.492	.292	.182
Vigour				
Adult Athletes	x	x	-.220	-.351
Adult Students	x	x	-.115	-.273
Adolescent Athletes	x	x	-.149	-.336
Adolescent Students	x	x	-.079	-.276

1   Table 4

2   Multi-sample Confirmatory Factor Analysis of the POMS-A

Fit Statistics	Model 1 (df = 960)	Model 2 (df = 1014)	Model 3 (df = 1050)
χ^2	3156.799	3623.700	3966.494
χ^2:df ratio	3.288	3.570	3.778
CFI	.928	.915	.905
TLI	.917	.907	.900
RMSEA	.030	.032	.033

3   Note. All χ^2 values are significant at $p < .01$.

4   Model 1 = unconstrained; Model 2 = equal factor loadings; Model 3 = equal factor

5   loadings and inter-correlations among mood dimensions.

1   Table 5

2   <u>Correlations between POMS-A Scales and Criterion Measures</u>

	POMS-A					
Criterion Measure	Anger	Confusion	Depression	Fatigue	Tension	Vigour
POMS Anger	**.89***	.50*	.64*	.49*	.38*	-.10
POMS Confusion	.48*	**.78***	.63*	.53*	.64*	-.17
POMS Depression	.64*	.65*	**.88***	.51*	.75*	-.28*
POMS Fatigue	.36*	.51*	.41*	**.90***	.40*	-.15
POMS Tension	.32*	.55*	.62*	.43*	**.76***	-.24*
POMS Vigour	-.15	-.24*	-.26*	-.26*	-.12	**.67***
STAXI Anger	**.73***	.35*	.32*	.09	.32*	.34*
PANAS Positive	-.15	.18	-.21	-.22	.04	.78*
PANAS Negative	.67*	.80*	.66*	.58*	.80*	-.03
HADS Depression	.26*	.29*	**.57***	.17	.23	-.18

3   * $\underline{p} < .01$