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Psychometric Properties of the Intrinsic Motivation Inventory in a Competitive Sport Setting: A Confirmatory Factor Analysis

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The present study was designed to assess selected psychometric properties of the Intrinsic Motivation Inventory (IMI) (Ryan, 1982), a multidimensional measure of subjects' experience with regard to experimental tasks. Subjects (N = 116) competed in a basketball free-throw shooting game, following which they completed the IMI. The LISREL VI computer program was employed to conduct a confirmatory factor analysis to assess the tenability of a five factor hierarchical model representing four first-order factors or dimensions and a second-order general factor representing intrinsic motivation. Indices of model acceptability tentatively suggest that the sport data adequately fit the hypothesized five factor hierarchical model. Alternative models were tested but did not result in significant improvements in the goodness-of-fit indices, suggesting the proposed model to be the most accurate of the models tested. Coefficient alphas for the four dimensions and the overall scale indicated adequate reliability. The results are discussed with regard to the importance of accurate assessment of psychological constructs and the use of linear structural equations in confirming the factor structures of measures.

Key words: Intrinsic Motivation Inventory (IMI), confirmatory factor analysis, LISREL, hierarchical models

Why is it that so many millions of people engage in vigorous physical activity suffering through pain, exhaustion, and sometimes injury for no apparent rewards other than the joy and satisfaction of that participation? Why do intercollegiate athletes who have their college education paid for in exchange for their athletic services seemingly become "burned-out" with their sport, enjoy it less, and perceive it more as work than play? Does an activity that was previously enjoyable become more or less enjoyable as a function of introducing competition to that activity? These are a few of the questions that researchers in sport and other achievement domains have attempted to answer over the last decade in studies dealing with intrinsic motivation, its antecedents, and its consequences. Exercise, sport, and physical activity settings provide excellent settings for attempting to answer the many questions posed regarding intrinsic motivation.

Intrinsic motivation has been investigated from numerous perspectives including, the effects of positive and negative feedback (Vallerand, 1983), the use of external rewards as incentives (Halliwell, 1978; Orlick & Mosher, 1978; E. Ryan, 1977, 1980), and the effects of competition on intrinsic motivation (Deci, Betely, Kahle, Abrahms, & Porac, 1981; Weinberg & Ragan, 1979). The reader is referred to Ryan, Vallerand, and Deci (1984) for a comprehensive review of the sport-related intrinsic motivation literature. In order to effectively examine, understand, and predict the role of any psychological construct in human behavior it is of paramount importance to be able to accurately measure that construct.

Accurate measurement is often hampered by the lack of standardized operational definitions resulting in equivocal findings. Some of the equivocality in the intrinsic motivation literature, can be partially attributed to the inconsistent measurement of the construct. For example, Weinberg and Ragan (1979) reported that male subjects engaged in a competitive task were more intrinsically motivated than their noncompetitive counterparts. Conversely, Deci et al. (1981) reported that subjects, who competed against an opponent, displayed significantly less intrinsic motivation for the task than subjects who did not compete.

The incongruent results of the previous two studies can be directly related to the measurement of intrinsic motivation (Ryan et al., 1984). Ryan and his colleagues (1984) argue that Deci et al. (1981) examined motivation to continue the activity while Weinberg and Ragan

1979) were actually measuring motivation to continue competing. Indeed, intrinsic motivation was operationally defined in the Weinberg and Ragan study as the amount of future experimental time subjects volunteered for under the same conditions (i. e., competition). Subjects' motivation to volunteer for future experimental research under the same conditions may have been affected by such factors as extra credit, pleasing the researcher, or continued competition. Thus the validity of the measurement of intrinsic motivation could be called into question.

Early assessments of intrinsic motivation were purely behavioral in nature (e. g., Lepper & Greene, 1975) and consisted of experimenters surreptitiously observing subjects' time on task following an experimental intervention, usually provision of reward for participation. Still others have attempted to measure intrinsic motivation by simply asking subjects, for example, how much they enjoyed the activity and how often they participated in the activity in their free time (i. e., in the absence of any remuneration) (E. Ryan, 1977, 1980).

In addition to behavioral measures of motivation, systematic attempts have been made to cognitively assess levels of intrinsic motivation (Vallerand, 1983; Weiss, Bredemeier, & Shewchuk, 1985). One such measure, the Mayo (1977) Task Reaction Questionnaire (TRQ) was designed to assess motivation for performance on a stabilometer task. Mayo (1977) demonstrated adequate reliability and validity for the measure but, although it has been successfully adapted for use in sport settings such as ice-hockey (Vallerand, 1983), it was designed for a specific activity, the stabilometer. Given that our interests in understanding intrinsic motivation stretch beyond the laboratory setting in general, the TRQ represents a useful but limiting advance in the measurement of the construct.

Recently, Ryan (1982) and his colleagues from the Rochester Motivation Research Group (Plant & Ryan, 1985; Ryan, Mims, & Koestner, 1983) have developed a multidimensional measure of subjects' experience with regard to experimental tasks, The Intrinsic Motivation Inventory (IMI). The measure is a flexible assessment tool that determines subjects' levels of intrinsic motivation as an additive function of the underlying dimensions of interest-enjoyment, perceived competence, effort, and pressure-tension. A fifth dimension, perceived choice, has recently been added to the inventory but has yet to be validated. What appears to be unique about the IMI is that the total 27 items have rarely been used, and the inclusion or exclusion of any one factor (dimension) fails to adversely affect the remaining factors. Furthermore, shorter versions of each subscale have been utilized and are apparently reliable, thus, redundant items can be excluded. A final aspect of interest concerns the malleability of the items, which can be easily modified to fit a wide variety of activities. For example, the generic scale item, "I was pretty skilled at this activity" can be changed to "I was pretty skilled at serving the tennis ball," to better reflect the situation of interest.

The post-experimental IMI has been employed in such diverse settings as reading, learning, writing, and hidden figure puzzle tasks. The IMI has not, as yet, been employed in the extant intrinsic motivation literature dealing with exercise and sport activities. The purpose of the present study was to examine selected psychometric properties of the IMI in a competitive sport setting. Specifically, the internal consistency and the tenability of the hypothesized factor structure of the instrument were assessed in a competitive basketball shooting task.

Method

Subjects

A total of 116 undergraduate male (n = 80) and female (n = 36) students enrolled in a required physical education class volunteered to participate in the experiment. The mean age of the subjects was 21.35 years.

Task

The task consisted of a modified version of the popular basketball shooting game, "HORSE." The object of the game is to successfully make a basketball shot of one's choice and have one's opponent successfully replicate the shot. Failure to successfully make the replicated shot results in the assessment of the first letter of the word "HORSE" to the player missing the shot. Continued failure to make subsequent shots results in the gradual accumulation of all the letters of the word and loss of the game. The original game of "HORSE" was modified in two ways. First the game was shortened to overcome a potential time problem, thus we arrived at "DOG," which constituted a three-miss loss instead of a five-miss loss. The second modification concerned the types of shot permitted in the competition. Shot selection was restricted to jump shots ranging from 5 to 15 ft from the basket. This limitation allowed the investigators to more accurately assess the ability level of the subjects and match subjects accordingly. Assessment of ability level based on all facets of basketball shooting would have been an onerous and perhaps futile task. It was therefore deemed appropriate to limit shot selection to the jump shot within the delineated boundaries.

Procedures

The experiment consisted of two phases. In the first phase, subjects were assigned to an individual appointment time, at which they reported to a gymnasium, read and signed an informed consent form, and then performed the LSU Long and Short Test (Nelson, 1967), which measures jump shooting ability. The court was marked with tape in a 4.572 m arc from the endline on either side of the basket to the top of the free-throw line. This line served as a restraining line for the long shots. Subjects waited behind the restraining line with a basketball and upon the experimenter's "GO!" signal, attempted a long jump shot. Regardless of whether or not the shot was successful, the subject rushed forward to rebound the ball and attempted a jump shot from inside the arc. Upon completion of the short shot, the ball was rebounded and dribbled beyond the 4.572 m arc for another long jump shot. This routine continued for 1 min. Subjects were allowed two 1-min trials with the total points scored over the two trials reflecting the subject's ability score. Subjects were later matched by ability and gender for the competitive phase of the experiment.

A few days later, subjects were contacted by telephone and given an appointed time to report to the gymnasium to participate in the competitive phase. Subjects were tested in pairs, and, after a brief warm-up period, were informed that they had been matched on ability and instructed in the modified game of "HORSE," its rules, and regulations. Arcs of 1.524 and 4.572 m radius were taped onto the floor to clearly indicate the shooting boundaries. A coin toss determined which subject shot first. Once an outcome was determined subjects completed the Intrinsic Motivation Inventory (Ryan, 1982).

Measures

The version of the IMI employed in this study is shown in Table 1. It consisted of 18 items scored on a Likert scale from strongly disagree (1) to strongly agree (7). As can be seen, the generic label "activity" has been suitably reworded to reflect the nature of the current task, basketball. As indicated earlier, the original IMI consists of 27 items. Four of these items assess the dimension of perceived choice which is still undergoing development and was therefore excluded from this study. Six other items were considered to be redundant and also excluded. Ryan (1982) has noted that some items within the subscales overlap considerably, and that the incremental R for each item over 4 for any given dimension is small. Thus, we felt justified in reducing the number of items without unduly sacrificing the internal consistency. The 18-item scale consisted of a minimum of four items per subscale and was considered of a practical length from an administration perspective. Negatively worded items were rescaled prior to the analysis of the data.

Table 1
The Intrinsic Motivation Inventory: Items Employed to Assess Basketball Jump Shooting Intrinsic Motivation[a]

1. I enjoyed this basketball game very much (INT-ENJ)
2. I think I am pretty good at basketball (COMP)
3. I put a lot of effort into this basketball game (EFF-IMP)
4. It was important to me to do well at this game (EFF-IMP)
5. I felt tense while playing the basketball game (TEN-PRES)
6. I tried very hard while playing basketball (EFF-IMP)
7. Playing the basketball game was fun (INT-ENJ)
8. I would describe this game as very interesting (INT-ENJ)
9. I am satisfied with my performance at this game (COMP)
10. I felt pressured while playing basketball (TEN-PRES)
11. I was anxious while playing the basketball game (TEN-PRES)
12. I didn't try very hard at playing basketball (EFF-IMP)
13. While playing basketball, I was thinking about how much I enjoyed it (INT-ENJ)
14. After playing the basketball game for a while, I felt pretty competent (COMP)
15. I was very relaxed while playing basketball (TEN-PRES)
16. I am pretty skilled at basketball (COMP)
17. This game did not hold my attention (INT-ENJ)
18. I couldn't play this game very well (COMP)

[a] The proposed dimension of each item is shown in parentheses. Abbreviations are explained below.

INT-ENJ = Interest-enjoyment dimension
COMP = Perceived competence dimension
EFF-IMP = Effort-importance dimension
TEN-PRES = Tension-pressure dimension

Data Analysis

A primary objective of the present study was to determine how well these data fit the hypothetical factor structure of the Intrinsic Motivation Inventory (Ryan, 1982). If indeed the data fit the proposed factor structure adequately, the modification of the IMI to accommodate the sport situation would appear to be a suitable measure for assessing intrinsic motivation in the physical domain.

The IMI constitutes a hierarchical factor model of four moderately related dimensions which collectively assess the construct of intrinsic motivation. The LISREL VI (Jöreskog & Sörbom, 1984) computer program was employed to verify the proposed hierarchical model. Analysis of covariance structures is a very versatile approach to the examination of causal models with multiple indicators of latent (unobserved) variables. A common approach to confirmatory factor analysis has been to test the underlying factor structure of a hypothesized model and to report some index of the goodness-of-fit of that model to the data. Recent methodological advances have led to a number of prominent researchers suggesting that the hypothesized model should also be compared to other models (Bentler & Bonett, 1980; Hocevar, Khattab, & Michael, 1987; Marsh & Hocevar, 1985). In an effort to be comprehensive in our analyses we compared the five factor hierarchical model to a four factor (dimensions only), a single factor (intrinsic motivation), and a null model (one in which no common factors are assumed and measurements are considered completely independent).

Once these analyses are conducted there are a number of methods available which allow one to determine how well the data fit the hypothesized factor structure and for assessing whether the fit can be improved as a function of testing an alternative model. Three common indices of fit are the chi-square goodness-of-fit test, a goodness-of-fit index, and the root mean square residual (RMSR). The goodness-of-fit index is a measure of the relative degree to which the variances and covariances are jointly accounted for by the model, and the RMSR is an indicant of the average of the residual variances and covariances.

Although the chi-square measure may be derived theoretically as a likelihood ratio test statistic for testing the fit of a specified model, such a use of the chi-square is not valid in many cases. Instead of regarding the chi-square as a test statistic, it should be used as a goodness-of-fit measure in the sense that large values of chi-square correspond to a bad fit and small values to a good fit. However, the degrees of freedom served as a standard by which to judge whether the chi-square is large or small. Jöreskog (1969) and Saris and Stronkhorst (1984) have suggested that the ratio between the chi-square and its degrees of freedom is a more accurate indicator of the fit of the model. Ratio values below 2.0 are considered to represent very good fits of the model to the data.

Several individuals (Bentler & Bonett, 1980; Hocevar et al., 1987) have suggested that in small samples, various competing models might be equally acceptable, and other indices of goodness-of-fit may be more appropriate. Bentler and Bonett (1980), recommend testing the hypothesized model against alternative and null models and then testing for a significant change in the difference between chi-square values for each competing model. Typically, the null model assumes complete independence among the models' observed variables. Because the null model is a nested case of the more substantive hierarchical model, it is possible, through the use of incremental fit indices, to statistically compare it with the theoretical model of interest. Bentler and Bonett (1980) proposed a fit index (coefficient delta) for multivariate models which is given by the formula: $\Delta = (Fo - F_k)/F_o$. In this equation F is any fit function (e.g., X^2 value), F_o corresponds to the function evaluated under the null model, and F_k corresponds to the fit function for the hierarchical model. Coefficient delta provides a normed fit index ranging from 0.0 to 1.0 with values greater than .90 generally being indicative of a very good overall fit of the model to the data. In sum, we report the delta coefficient and a chi-square difference test between competing models as well as the more commonly reported statistics.

Results

Before progressing with the findings of the confirmatory factor analyses it is necessary to consider the internal consistency of the four subscales and the overall Intrinsic Motivation Inventory. Reliabilities of these measures were determined by coefficient alpha (Cronbach, 1951). Internal consistency for the four subscales was generally quite adequate with the alpha coefficient for each of the following scales shown in parentheses: interest-enjoyment (α = .78); perceived competence (α = .80); effort (α = .84); and pressure-tension (α = .68). The overall scale also appears to be internally consistent with an alpha coefficient of .85. While these item analyses appear to be indicative of adequate reliability, further inspections of the data provided some interesting findings.

Item deletion procedures suggested that the alpha coefficient for the interest-enjoyment subscale could be increased to .80 from .78 with the deletion of item #13 ("While playing this basketball game, I was thinking about how much I enjoyed it"). Given the nature of the setting, a relatively short competitive event, subjects may not have been actually "thinking" about enjoyment but, nonetheless, be enjoying the game. Further investigation indicated that the internal consistency of the perceived competence dimension could be increased from .80 to .87 with the deletion of item #9 ("I am satisfied with my performance at this game"). Examination of these aberrant items with regard to item-total correlations revealed relatively low correlations between the overall scale and item #13 ($r = .32$) and item #9 ($r = .22$). Deletion of these two items did not affect the overall reliability of the total IMI. The impact of these changes in reliability on the confirmatory factor analyses will be addressed in due course.

Confirmatory Factor Analyses

In exploratory factor analysis, an attempt is made to extract a minimum number of factors which will account for the correlations among the observed variables. The loadings on these factors are then transformed (rotated) in the hope that these factors will have a negligible influence on as many of the observed variables as possible. In confirmatory factor analysis however, the researcher a priori decides the number and influence of factors in the model based upon sound theoretical reasoning. In addition, confirmatory factor analysis allows for the estimation of standard errors of specified parameters which are used for statistical significance testing. Through the use of maximum likelihood estimation, predicted relationships are compared to observed correlations among the observed variables. A chi-square goodness-of-fit test is then conducted. If this chi-square is nonsignificant, the model can be considered to adequately approximate the intervariable relationship.

Several authors (e.g., Olsson, 1979) have cautioned against the use of maximum likelihood estimation with Likert responses pointing out that the chi-square can be considered a valid test statistic only when the observed variables have a multivariate normal distribution. An examination of the distribution of the scores and a statistical test to compare the distribution of the Intrinsic Motivation Inventory to a normal distribution was nonsignificant. Thus, as the distribution does not deviate significantly from the normal population we employed maximum likelihood estimation.

The confirmatory factor analyses were conducted in two phases. In phase one we compared the fit of the hypothesized five factor hierarchical model (four underlying dimensions and a second-order general factor of intrinsic motivation) to a four or first-order factor model (dimensions only), a single factor model (intrinsic motivation), and a completely independent null model. Then, given our earlier concern with items #9 and #13 having low item-total correlations and improved internal consistency with their deletion, we conducted phase two. This second phase tested the fit of the models detailed previously using only 16 items (#9 and #13 deleted). Table 2 represents the correlations between the 18 items upon which the confirmatory factor analyses were conducted.

Table 2
Correlation Matrix for the 18-Item Intrinsic Motivation Inventory

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2	.12																	
3	.14	.21																
4	.15	.29	.54															
5	-.08	.05	.24	.41														
6	.22	.12	.69	.60	.36													
7	.25	.39	.34	.42	.08	.25												
8	.14	.21	.45	.45	.15	.36	.54											
9	.01	.09	.22	.11	.02	.21	.11	.12										
10	.01	.06	.22	.44	.50	.37	.13	.11	.00									
11	.02	.00	.23	.40	.39	.34	.25	.43	-.04	.34								
12	.09	.29	.50	.44	.32	.57	.20	.25	.26	.20	.10							
13	.27	.21	.20	.14	.07	.14	.32	.20	.18	.13	.08	.11						
14	.20	.44	.34	.39	.17	.37	.37	.32	.39	.16	.22	.31	.29					
15	-.10	-.19	-.06	.05	.25	.17	-.26	-.10	-.21	.38	.19	.13	-.12	-.12				
16	.10	.91	.27	.35	.04	.10	.34	.18	.03	.11	.02	.23	.26	.44	-.20			
17	.07	.05	.52	.34	.11	.36	.41	.48	.23	.05	.28	.35	.15	.30	-.06	.02		
18	.03	.73	.22	.18	-.00	.12	.24	.21	.26	.06	.01	.31	.15	.40	-.05	.70	.22	

Note: These correlations are rounded to the second decimal place. The confirmatory factor analyses were based on a correlation matrix generated with correlations accurate to seven decimal places.

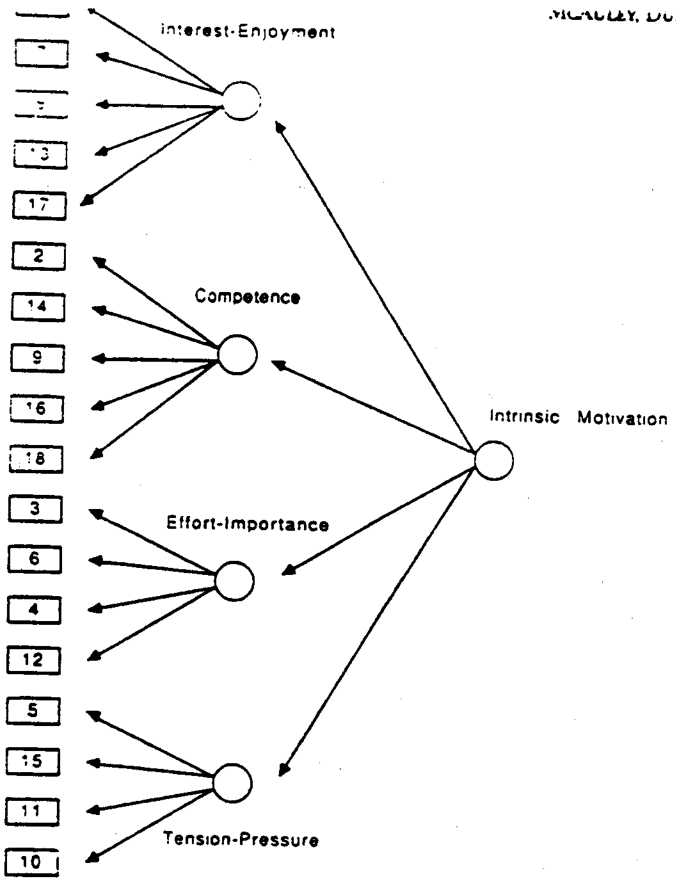

Figure 1—Structural diagram for the hierarchical covariance structure analysis model. The squares presented in Figure 1 correspond to the 18 observed variables (items), and the circles to unobserved latent constructs (dimensions). The circles in the center of the figure are linked to specific observed variables and are considered first-order factors. The paths between the circle labeled intrinsic motivation and the first-order factors indicate the assumption of a second-order factor which is hypothesized to account for the covariation among the first-order factors.

Higher-order factor models follow a structure similar to first-order factor models, however, the covariances among the first-order factors (dimensions) are hypothesized to be explained by a single higher or second-order factor (intrinsic motivation). As can be seen in Figure 1, four first-order and a single second-order factor are hypothesized with the 18 observed variables loading on the four first-order factors. In the higher-order model, the covariances among the first-order factors are set to zero, and each of the four first-order factors is hypothesized to load on a single higher-order factor, intrinsic motivation.

Table 3 reports means and standard deviations for the 18 intrinsic motivation items. Table 4 presents the standardized maximum likelihood factor loadings of items on the latent variables (dimensions) for the first and second-order models.

All maximum likelihood estimations were based upon oblique factor structures unless otherwise indicated. Intercorrelations among the factors for both the 16-item and the 18-item measures are shown in Table 5. As can be seen, most of the subscales, with the exception of pressure-tension, correlate moderately with each other.

Phase One. Table 6 details the results of the model fitting procedures showing the chi-square goodness-of-fit test, the goodness-of-fit index, the chi-square difference test for competing models, the root mean square residual, and coefficient delta for the 18-item measure. As was shown in Table 3, the loadings between the observed variables (items) and the latent constructs (dimensions) are nearly identical for both the first and second-order factor models. It is important to emphasize that even if the hierarchical model is able to account for all of the covariation among the four first-order factors, the goodness-of-fit indices cannot be improved over those of the first-order factor model. However, if the fit indices for the hierarchical model approach those of the corresponding first-order model then the hierarchical model can be interpreted as being a more parsimonious model (Marsh, 1985). As can be seen in Table 6, the difference in chi-square values between the models was statistically significant, however, the relative differences between the indices of the goodness-of-fit index and coefficient delta for the competing models are negligible, suggesting that the hierarchical model provides an adequate approximation of the data.

Table 3
Descriptive Statistics
for the 18 Intrinsic Motivation Items

Dimension (Factor)	Item	Mean	SD
Interest-Enjoyment	1	5.31	1.36
	7	5.63	1.24
	8	4.75	1.48
	13	3.45	1.57
	17	4.72	1.55
Perceived Competence	2	4.34	1.65
	14	4.44	1.46
	9	4.14	1.88
	16	4.20	1.80
	18	4.73	1.74
Effort-Importance	3	4.27	1.40
	6	4.47	1.48
	4	4.34	1.40
	12	4.80	1.49
Tension-Pressure	5	2.66	1.37
	15	2.88	1.38
	11	3.60	1.53
	10	3.03	1.57

Table 4
First and Second-Order Standardized Factor Loadings for the 18-Item and 16-Item Models

		First-Order Standardized Loadings			
		18-Item		16-Item	
Dimension (Factor)	Item	Model M_4	Model M_5	Model M_4	Model M_5
Interest-Enjoyment	1	.798	.775	.782	.756
	7	.785	.760	.778	.753
	8	.680	.664	.695	.679
	13	.397	.386		
	17	.605	.588	.620	.601
Perceived Competence	2	.973	.964	.973	.964
	14	.469	.466	.468	.464
	9	.102	.099		
	16	.943	.938	.943	.938
	18	.760	.754	.759	.753
Effort-Importance	3	.789	.665	.789	.657
	6	.847	.792	.845	.789
	4	.741	.668	.743	.668
	12	.644	.602	.644	.600
Tension-Pressure	5	.714	.689	.714	.689
	15	.412	.372	.412	.371
	11	.526	.543	.524	.544
	10	.716	.713	.717	.710

	Second-Order Standardized Loadings	
	18-Item	16-Item
	Model M_5	Model M_5
Interest-Enjoyment	.694	.694
Perceived Competence	.357	.345
Effort-Importance	.752	.761
Tension-Pressure	.517	.522

M_5 = Five Factor Model
M_4 = Four Factor Model

Phase Two. Table 6 also details the results of the confirmatory factor analyses and model comparisons for the 16-item version of the IMI. Once again the loadings between the observed variables (items) and the latent constructs (dimensions) are nearly identical. These values also suggest that a single higher-order factor is able to adequately explain the covariances among the first-order factors. Deletion of the two previously mentioned items resulted in improvements in the goodness-of-fit index and in coefficient delta. Once again, the differences between the fit indices for the five factor and four factor model were minimal.

Although the goodness-of-fit indices appear adequate, it is important to also examine the root mean square residual (RMSR) and the residual correlations. The RMSR for the five and the four factor models in both the 18-item and 16-item analyses were quite similar (see Table 6). However, the magnitude of the RMSR and some of the residual correlations suggest that alternative models may provide a more accurate reproduction of the original correlations.

Table 5
Inter-factor Correlations for the 18-Item and 16-Item Versions of the Intrinsic Motivation Inventory Based Upon a Five Factor Hierarchical Model

18-Item Version

	ENJOY	COMP	EFFORT	PRESSURE
ENJOY	1.000			
COMP	.247	1.000		
EFFORT	.522	.268	1.000	
PRESSURE	.359	.184	.389	1.000

16-Item Version

	ENJOY	COMP	EFFORT	PRESSURE
ENJOY	1.000			
COMP	.240	1.000		
EFFORT	.528	.263	1.000	
PRESSURE	.362	.180	.398	1.000

Enjoy = Interest-Enjoyment
Comp = Perceived Competence
Effort = Effort-Importance
Pressure = Pressure-Tension

Discussion

The construction of the Intrinsic Motivation Inventory (Ryan, 1982) is an "ad hoc" multidimensional measure consisting of 27 items assessing several dimensions of intrinsic motivation. The user can select as many or as few of the items as he/she wishes without overly deleterious effects on the psychometric properties of the scale. Furthermore, the items are all generically worded allowing the researcher to substitute the activity/task of interest into the item structure. The purpose of this study was to determine the robustness of the factor structure and the reliability of an 18-item and then a 16-item version of the IMI in a competitive sport setting. These versions of the scale assessed one component measure of intrinsic motivation that is supported by four moderately related dimensions.

In general, the reliability estimates of the total IMI and three of its four dimensional subscales exceeds those recommended for research contexts (Nunnally, 1978). However, in the case of the perceived competence and interest-enjoyment dimensions, deletion of an item resulted in more powerful internal consistency. Thus, it appears that the 16-item version of the scale, as used here, is a more internally consistent representation of the underlying dimensions of intrinsic motivation. Naturally, further application of the IMI in sport settings will be necessary to replicate these findings.

Use of linear structural relationships confirmed the factor structure of the IMI and represents an approach to measurement that has largely been ignored in the field of sport psychology (exceptions are McAuley & Gill [1983] and Weiss, Bredemeier, & Shewchuk [1985]). The technique allows one to maximize the fit of the factor model to the data, is relatively robust to statistical violations, and provides the researcher with a number of indices that describe the adequacy of a proposed factor structure. The goodness-of-fit index and coefficient delta indicated that the factor structure of the 16-item version of the IMI appears tenable in the competitive sport environment examined, a basketball jump shooting competition.

The 16-item model testing the hypothesized four first-order factors (each underlying dimensions) and a single second-order factor (intrinsic motivation) appears to explain the relationship among the variables adequately. The fact that the hierarchical model provided the most parsimonious fit can be interpreted as the global factor of intrinsic motivation reflecting differences in composite levels of intrinsic motivation, which, in turn, represents fundamental differences across the four underlying dimensions of the construct. Consequently, it may be concluded from these analyses that the Intrinsic Motivation Inventory (Ryan, 1982) measures both specific components of intrinsic motivation, as well as reflecting the overall levels of intrinsic motivation one experiences as a function of engaging in the task.

Future applications of the IMI may be able to demonstrate an even better fit to the data with the inclusion of a fifth dimension, perceived choice, which at this time is still in the developmental and validation stages. Perceived choice has been identified as an important determinant of intrinsic motivation in past research (E. Ryan, 1980; Lepper & Greene, 1975; Thompson & Wankel, 1980). In addition, the present investigation focused upon models which follow prescribed simple structure, i. e., each observed variable is hypothesized to be an indicant of a specific factor. However, confirmatory factor analysis does allow the researcher to consider variables which are factorially complex. That is, models in which each variable is hypothesized to be characterized by a general generic property, of which all items are indicators, as well as properties that reflect mutually exclusive factors underlying the general construct of interest (McDonald, 1985).

Table 6
Comparison of the Fit Indices of the Five Factor Hierarchical Model and Alternative Models for the 18-Item and 16-Item Intrinsic Motivation Inventory

18-Item Intrinsic Motivation Inventory

	X^2 Fit Test				X^2 Difference Test			
Model	X^2	df	GF[a]	RMSR[b]	Model Comparison	X^2	df	delta
M_5	233.65	132	.759	.138	M_5 - M_0	805.25	39	.71
M_4	314.24	129	.770	.119	M_4 - M_0	823.66	42	.72
M_1	734.71	136	.478	.225	M_1 - M_0	403.19	35	.35
M_0	1137.90	171	.303	.295				

16-Item Intrinsic Motivation Inventory

	X^2 Fit Test				X^2 Difference Test			
Model	X^2	df	GF[a]	RMSR[b]	Model Comparison	X^2	df	delta
M_5	252.36	101	.788	.136	M_5 - M_0	783.99	35	.76
M_4	234.21	98	.800	.112	M_4 - M_0	802.14	38	.77
M_1	607.52	105	.586	.182	M_1 - M_0	428.83	31	.41
M_0	1036.35	136	.374	.314				

Note: All Chi-square values are significant ($p<.05$)

LEGEND
[a] Goodness-of-Fit Index
[b] Root Mean Square Residual
M_5 Five Factor Model
M_4 Four Factor Model
M_1 Single Factor Model
M_0 Null Model

The current investigation can be considered of some importance from two perspectives. First, it examined the psychometric properties of an instrument that may have considerable potential for adding to the existing knowledge of the role of intrinsic motivation in sport, exercise, and physical activity. Second, we employed some statistical methods that allowed comparisons of the utility of competing models nested within the more substantive proposed model. Intrinsic motivation has been one of the more systematically tested theories in the sport psychology literature (Landers, 1983). While the theory has continued to develop and be applied to a wide array of behaviors and domains, the measurement of the construct has been less well-developed from a psychometric perspective. The recent development of the IMI and the findings reported here will perhaps encourage other sport and social scientists to further validate and test the measure. It should be noted that the measure is still in a developmental stage, and future modifications may serve to strengthen its psychometric properties. However, at this point we are conservatively optimistic about the ability of the IMI to assess intrinsic motivation from a multidimensional perspective.

The use of confirmatory factor analyses to test and compare alternative models that are nested within the IMI's items represents a unique approach to measurement in the sport sciences. Rather than simply confirm the four factor structure, we progressed beyond the first-order factors to test a more complex hierarchical model that reflected the four first-order factors as underlying a second-order factor of general or global intrinsic motivation. Futhermore, we present some alternative indices for assessing the goodness-of-fit of the models to the data beyond the commonly reported chi-square.

In summary, the motivational underpinnings of sport participation are diverse and complicated necessitating the accurate measurement of such constructs as intrinsic motivation. The IMI represents a promising advance in the assessment of this construct. The present findings suggest that the measure is a step in the right direction, but that replications, modifications, and further validation of Ryan's (1982) instrument will hopefully lead to a more accurate assessment and, consequently, understanding of intrinsic motivation.

References

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness-of-fit in covariance structures. *Psychological Bulletin, 88,* 588-606.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16,* 296-334.

Deci, E. L., Betely, G., Kahle, J., Abrahms, L., & Porac, J. (1981). When trying to win: Competition and intrinsic motivation. *Personality and Social Psychology Bulletin, 7,* 79-83.

Halliwell, W. R. (1978). The effect of cognitive judgment on children's perceptions of intrinsically motivated behavior. In D. M. Landers and R. W. Christina (Eds.), *Psychology of motor behavior and sport - 1977* (pp. 403-419). Champaign, IL: Human Kinetics.

Hocevar, D., Khattab, A. M., & Michael, W. B. (1987). Significance testing and efficiency in LISREL measurement models. *Educational and Psychological Measurement, 47,* 45-49.

Jöreskog, K. G. (1969). A general approach to confirmatory maximum likelihood factor analysis. *Psychometrika, 34,* 183-202.

Jöreskog, K. G., & Sörbom, D. (1984). *LISREL: Analysis of linear structural relationships by the method of maximum likelihood.* (Version VI). Mooresville, IN: Scientific Software.

Landers, D. M. (1983). Whatever happened to theory testing in sport psychology? *Journal of Sport Psychology, 5,* 135-151.

Lepper, M., & Greene, D. (1975). Turning play into work: Effects of adult surveillance and intrinsic rewards on children's intrinsic motivation. *Journal of Personality and Social Psychology, 31,* 479-486.

Marsh, H. (1985). The structure of masculinity/femininity: An application of confirmatory factor analysis to higher-order factor structures and factorial invariance. *Multivariate Behavioral Research, 20,* 427-449.

Marsh, H., & Hocevar, D. (1985). Application of confirmatory factor analysis to the study of self-concept: First and higher order factor models and their invariance across groups. *Psychological Bulletin, 7,* 562-582.

Mayo, R. J. (1977). The development and construct validation of a measure of intrinsic motivation. *Dissertation Abstracts International, 37,* 5417B.

McAuley, E., & Gill, D. L. (1983). Reliability and validity of the Physical Self-Efficacy Scale in a competitive sport setting. *Journal of Sport Psychology, 5,* 410-418.

McDonald, R. P. (1985). *Factor analysis and related methods.* NJ: Lawrence Erlbaum Associates, Inc.

Nelson, J. (1967). *The measurement of shooting and passing skills in basketball.* Unpublished manuscript, Louisiana State University.

Nunnally, J. C. (1978). *Psychometric theory* (2nd Ed.). NY: McGraw-Hill.

Olsson, V. (1979). Maximum likelihood estimation of the polychoric correlation coefficient. *Psychometrika, 44,* 443-460.

Orlick, T. D., & Mosher, R. (1978). Extrinsic rewards and participant motivation in a sport related task. *Journal of Sport Psychology, 9,* 27-39.

Plant, R., & Ryan, R. M. (1985). Self-consciousness, self-awareness, ego-involvement, and intrinsic motivation: An investigation of internally controlling styles. *Journal of Personality, 53,* 435-449.

Ryan, E. D. (1977). Attribution, intrinsic motivation, and athletics. In L. I. Gedvilas and M. E. Kneer (Eds.), *Proceedings of NCPEAM/NAPECW National Conference, 1977* (pp. 346-353). Chicago: Office of Publication Services, University of Illinois at Chicago Circle.

Ryan, E. D. (1980). Attribution, intrinsic motivation, and athletics: A replication and extension. In C. H. Nadeau, W. R. Halliwell, K. M. Newell, & G. L. Roberts (Eds.), *Psychology of motor behavior and sport - 1979* (pp. 19-26). Champaign, IL: Human Kinetics Publishers Inc.

Ryan, R. M. (1982). Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology, 43,* 450-461.

Ryan, R. M., Mims, V., & Koestner, R. (1983). Relation of reward contingency and interpersonal context to intrinsic motivation: A review and test using cognitive evaluation theory. *Journal of Personality and Social Psychology, 45,* 736-750.

Ryan, R. M., Vallerand, R. J., & Deci, E. L. (1984). Intrinsic motivation in sport: A cognitive evaluation theory interpretation. In W. Straub & J. Williams (Eds.), *Cognitive sport psychology* (pp. 230-242). New York: Sport Science Associates.

Saris, W., & Stronkhorst, L. H. (1984). *Causal modeling in nonexperimental research: An introduction to the LISREL approach.* Amsterdam: Sociometric Research Foundation.

Thompson, C. E., & Wankel, L. M. (1980). The effect of perceived activity choice upon frequency of exercise behavior. *Journal of Applied Social Psychology, 10,* 436-443.

Vallerand, R. J. (1983). The effects of differential amounts of positive verbal feedback on intrinsic motivation of male hockey players. *Journal of Sport Psychology,* 5, 100-107.

Weinberg, R., & Ragan, J. (1979). Effects of competition, success/failure, and sex on intrinsic motivation. *Research Quarterly, 50,* 503-510.

Weiss, M. R., Bredemeier, B. J., & Shewchuk, R. M. (1985). An intrinsic/extrinsic motivation scale for the youth sport setting: A confirmatory factor analysis. *Journal of Sport Psychology, 7,* 75-91.

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