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Hierarchical confirmatory factor analysis of the Flow State Scale in an exercise setting

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Abstract

In this study, we examined the factor structure and internal consistency of the Flow State Scale using responses of exercise participants. This self-report questionnaire consists of nine subscales designed to assess flow in sport and physical activity settings. It was administered to 1, 231 aerobic dance exercise participants. Confirmatory factor analyses (CFA) were used to test three competing measurement models of the flow construct: a single-factor model, a nine factor model, and a hierarchical model positing a higher-order flow factor to explain the intercorrelations between the nine first-order factors. The single-factor model showed a poor fit to the data. The nine-factor model and the hierarchical model did not show an adequate fit to the data. All FSS subscales displayed acceptable internal consistency indices (a > .70) with the exception of transformation of time (a = .65). Collectively, the present results did not provide support for the tenability of the single- factor, nine-factor or hierarchical FSS measurement models in an exercise setting.

Introduction

Evidence of the benefits of physical activity (Biddle, 1995; International Society of Sport Psychology, 1992; Leon and Norstrom, 1995; Mutrie, 1997; Shephard, 1995; Weyerer and Kupfer, 1994) and of the high rates of withdrawal from exercise programmes (Brawley and Rodgers, 1993; Dishman, 1994) has prompted detailed investigation of those factors that influence adherence to exercise. According to Jackson (1996), flow experience (see Csikszentmihalyi, 1975, 1990, 1993, 1997; Csikszentmihalyi and Csikszentmihalyi, 1988) during exercise can lead to high levels of enjoyment which, in turn, seem to play an important role in exercise adherence (Dishman, Sallis, and Orenstein, 1985; Martin and Dubbert, 1982; Wankel, 1985); empirical research has substantiated this prediction (Ryan, Frederick, Lepes, Rubio, and Sheldon, 1997). Hence, an understanding of factors that promote flow states in exercise will inform the strategies of exercise practitioners who are interested in promoting enjoyment and adherence to exercise. In addition, Kimiecik and Harris (1996) suggested that flow leads to positive affective reactions, which they equate with enjoyment. Their suggestion is based on a conceptualization of flow as an optimal psychological state that comprises several cognitive components such as clear goals, intense concentration and a perception of a balance between the challenge and the skill of the participant. Therefore, understanding the psychology of optimal performance during exercise participation is a desirable goal for those who are interested in promoting the enjoyment of exercise, positive affective experiences, and adherence.

Many researchers have attempted to elucidate the precise nature of flow experiences (Jackson, 1992, 1995, 1996; Jackson and Roberts, 1992; Jackson, Kimiecik, Ford, and Marsh, 1998; Kimiecik and Stein, 1992; Stein, Kimiecik, Daniels, and Jackson, 1995). There is a consensus that flow is a state in which one is totally absorbed in the task, leading to optimal physical and mental functioning. It is seen as an altered state of awareness in which one feels deeply involved in the activity and where mind and body operate harmoniously. Jackson and Marsh (1996) developed the Flow State Scale (FSS), a self-report questionnaire designed to assess flow in sport and physical activity settings. The FSS comprises nine subscales assessing the flow elements: *Challenge–skill balance*: refers to a sense of balance between the perceived demands of the activity and the skills of the participant. *Action–awareness merging*: refers to a deep level of involvement when the activity feels spontaneous and automatic. *Clear goals*: refers to the extent to which the participant knows exactly what s/he is going to do. *Unambiguous feedback*: refers to the feedback inherent in the activity allowing the participant to know that they are performing well. *Concentration on task at hand*: refers to a total focus on the activity by the participant. *Sense of control*: refers to control over the demands of the activity without conscious effort. *Loss of self–consciousness*: refers to a sense of not being concerned with oneself while engaging in the activity. According to Jackson and Marsh (1996), the person still knows what is happening in mind and body but does not use the information normally used to represent oneself. *Transformation of time*: refers to the sense of time being distorted – either speeding up or slowing down – hence, experienced differently to normal. Finally, *autotelic experience*: refers to an enjoyable experience that is intrinsically rewarding. Ostensibly, the activity is enjoyable in its own right and is not engaged in for the derivation of external rewards and benefits. The aforementioned flow elements are experienced when a sport or exercise participant is said to be in flow.

In general, a number of studies examining flow across a variety of contexts have demonstrated that flow is an optimal and thoroughly enjoyable experience (Csikszentmihalyi and Lefevre, 1989; Jackson, 1992, 1996; Mannell, Zuzanek, and Larson, 1988; Scanlan, Stein, and Ravizza, 1989). It is important that such investigations be extended to the context of exercise given the potential ramifications for the enhancement of physical and mental health. Jackson et al. (1998) have suggested that experiencing flow states frequently when involved in a specific activity promotes the desire to perform the activity for its own sake. In other words, the activity becomes autotelic (Csikszentmihalyi, 1975, 1990); that is, the reasons for participation are grounded in the *process* of involvement in the activity and not in attaining goals that are external to the activity. Hence, it seems that attaining flow during exercise may promote intrinsic motivation which, in turn, has been shown to enhance persistence in participation (Ryan et al., 1997; Vallerand and Losier, 1999).

An understanding of the elements that constitute flow state in the exercise context will assist exercise leaders in adopting practices that promote flow. For example, the exercise leader in cooperation with the exercise participant can promote the element of challenge–skill balance with a careful selection of the task. The exercise leader can promote the elements of clear goals and unambiguous feedback. They can clarify the goals that the participant is to achieve while feedback can be received both automatically from the activity during the activity (i.e., internal feedback) and from the exercise leader (i.e., external feedback). Finally, the element of the experience being autotelic (i.e., enjoyable for its own sake) can be promoted if the participant perceives the task to be challenging and he or she experiences a sense of choice in participating in the activity (Vallerand, 1997).

Jackson and Marsh (1996) provided satisfactory initial evidence for the psychometric properties of the FSS based on the responses of 394 athletes from the USA and Australia. They used confirmatory factor analyses (CFA) to test three alternative factor structures: first, a model positing a single first-order factor representing a unidimensional flow construct; second, a model positing nine intercorrelated first-order factors; and third, a model positing a higher-order factor explaining the intercorrelations between the nine first-order factors. The second and third models assume a multidimensional flow construct. Jackson and Marsh's results showed that the model positing a first-order factor demonstrated a poor fit to the data; rejecting the notion that flow is unidimensional. The two remaining models provided a reasonably good fit to the data, with the nine first-order correlated factors model providing a slightly better fit compared to the hierarchical model (non-normed fit index of .904 vs. .892).

Examination of the first-order factor loadings showed that all loadings were adequate (i.e., >0.5; see Jackson and Marsh, 1996). Also, an examination of the higher-order factor loadings showed that the highest loading was for the sense of control factor with the challenge–skill balance, clear goals, and concentration factors next highest. Transformation of time and loss of self-consciousness had the lowest loadings. The fact that a considerable number of the FSS first-order factors had non-negligible residual variances led Jackson and Marsh (1996) to conclude that employing nine FSS scores can better represent the variance in responses when compared to the global flow score. Further, the internal consistency coefficients for all the subscales were satisfactory ($a > .70$).

The aim of the present study was to examine the factor structure, the integrity of the item–factor loadings and the internal consistency of the FSS subscales based on responses from aerobic dance exercise participants. There are at least two reasons to confirm empirically the appropriateness of the FSS factor structure for an exercise context. First, the attainment of flow in an exercise context has been considered a motivating factor as flow can lead to high levels of enjoyment (Jackson, 1996). Therefore, given that theory, measurement, empirical research, and practice are inextricably linked (Marsh, 1997), the validity of the FSS must first be established in an exercise context prior to the advancement of theory-driven research and intervention strategies in this context. Second, despite the fact that Jackson and Marsh (1996) have stated that the FSS is an appropriate measure to assess the construct of state flow in sport and physical activity settings, only 5% of participants from their sample were drawn from aerobic dance exercise. Therefore, the evidence that they have provided with regard to the factor structure of the FSS is more applicable to sport participants than exercise participants.

In order to test the relationships between the FSS variables, three measurement models will be tested using CFA. First, a single-factor model specifying that all FSS items load on a single flow factor; this model tests the hypothesis that flow is a unidimensional construct. Second, a measurement model with nine first-order intercorrelated factors where items will load only on the factor they are intended to define; this model tests the hypothesis that flow is a multidimensional construct. Third, a hierarchical model in which a higher-order factor will explain the intercorrelations between the nine first-order factors; this model tests the hypothesis that the variance in FSS responses can be explained in terms of a higher-order flow factor. Based on theory and previous research (Jackson and Marsh, 1996), it is expected that the nine factor and the hierarchical models will demonstrate a good fit to the data while the single factor model will display a poor fit to the data. In addition, it is expected that all the FSS items will have considerable factor loadings on the factors they intend to define and, consequently, high alpha coefficients will emerge for all the subscales.

Method

Participants

Data were collected from 1, 231 aerobic dance exercise participants at three large health and fitness clubs in the west and central London areas, England. Participants' ages ranged from 18 to 70 years (mean $\pm$ *s*: 31.43 $\pm$ 9.1 yrs.). They were mainly of Caucasian or Afro-Caribbean origin. One hundred and twenty participants did not report their age and six participants did not report their gender. Of those who did report their gender, 211 were males and 1, 014 were females.

Instrumentation: Flow State Scale

The Flow State Scale (FSS; Jackson and Marsh, 1996) assesses the degree to which participants experienced a flow state. This 36-item instrument has nine subscales of four items each, labelled challenge–skill balance (e.g., “I was challenged, but I believed my skills would allow me to meet the challenge”), action–awareness merging (e.g., “I made the correct movements without thinking about trying to do so”), clear goals (e.g., “I knew clearly what I wanted to do”), unambiguous feedback (e.g., “It was really clear to me that I was doing well”), concentration on task at hand (e.g., “My attention was focused entirely on what I was doing”), sense of control (e.g., “I felt in total control of what I was doing”), loss of self-consciousness (e.g., “I was not concerned with what others may have been thinking of me”), transformation of time (e.g., “It felt like time stopped while I was performing”), and autotelic experience (e.g., “I found the experience extremely rewarding”). Respondents indicate the extent to which they agree with each statement on a 5-point Likert-type scale anchored by 1 = “strongly disagree” and 5 = “strongly agree”.

Procedures

Participants were approached by the research team just before the start of the aerobics class and asked to participate in a study to investigate their thoughts and feelings during the forthcoming class. They first completed an informed consent form confirming their agreement to participate in the study. Confidentiality of responses was assured and participants were reminded of their right to discontinue involvement at any time. In accordance with the recommendations of Jackson and Marsh (1996), the participants completed the FSS immediately after finishing their class. Participants completed the questionnaire at their own discretion while the research team was available to answer any questions. The research team comprised two senior researchers and three assistants all of whom were trained in the administration of the scale. To keep the data collection procedures consistent across the data collection sites, the senior researchers accompanied the assistants at all times.

Data analysis

Structural equation modelling techniques were used for data analysis using the EQS software (Bentler, 1995). The data analysis steps followed were as follows: (a) examination of the invariance of the FSS covariance matrices across sexes to reach a decision about whether to combine the data of males and females; (b) examination of the distributional properties of the variables and selection of an appropriate estimator; (c) examination of three alternative measurement models of FSS responses using confirmatory factor analytic procedures; and (d) examination of the internal consistency indices of the nine FSS subscales using the Cronbach’s alpha coefficient (Cronbach, 1951).

Following the recommendations of Hoyle and Panter (1995) regarding evaluation of model fit, absolute and incremental fit indices were employed to assess the adequacy of the models. Absolute indices assess the degree to which the covariances specified by the model match the observed covariances. The greater the match between the covariances, the closer the value is to zero. The absolute fit index used was the χ^2 statistic, as it is also appropriate for the comparison of nested models (e.g., nine-factor vs. hierarchical). However, the χ^2 statistic is sensitive to sample size; that is, with a large sample even a model with a small misspecification is likely to be rejected (Hu and Bentler, 1995). For this reason, two incremental indices were also used to assess the fit of the model. Incremental indices assess the degree to which the specified model is superior to a model which specifies no covariances. The incremental fit indices used were the non-normed fit Index (NNFI) and the comparative fit index (CFI). In addition, the standardized root mean squared residual (SRMR) and the root mean squared error of approximation (RMSEA) were used to examine the residuals (i.e., the difference between the observed and the implied covariance matrices). Finally, the 90% confidence interval associated with the RMSEA is an index of its stability in other samples.

These four indices are some of the indices that have been suggested by Hu and Bentler (1999) for use when evaluating model fit. Among the indices suggested by Hu and Bentler, only the NNFI, the CFI, the SRMR and the RMSEA are provided by the EQS software. According to these authors, the cut-off value needed before one can conclude a relatively good fit between the hypothesized model and the observed data should be close to .95 for the NNFI and the CFI, close to .08 for the SRMR and close to 0.06 for the RMSEA. Therefore, these indices were assessed to evaluate the adequacy of the fit of the models.

Results

Invariance of the sex covariance matrices

To examine whether the FSS covariance matrices for males and females were invariant, a model was specified based on constraining all the elements of the FSS covariance matrices for male and females as invariant. Examination of the model fit was based on the NNFI, the CFI, the SRMR and the RMSEA (see Hu and Bentler, 1999). A good fit for this model would suggest that the FSS covariance matrices are invariant across the sexes and it would justify combining the male and female data for the remaining analyses. The fit indices showed that the data fitted the model adequately (χ^2 = 1127.63, d.f. = 666, P < .001, NNFI = .959, CFI = .979, SRMR = .055, RMSEA = .024 and 90% confidence interval for RMSEA = .021-.026); consequently, the male and female data were combined for the remaining analyses.

Distributions of the variables

After combining male and female FSS data, the distributional properties of the variables were examined to determine the extent of multivariate non-normality in the data. The univariate skewness values of the FSS items ranged from –1.03 to 0.32 (skewness across 36 items = –0.54 $\pm$ 0.28, n = 1, 231) while the univariate kurtosis values ranged from –0.62 to 1.86 (kurtosis across 36 items = 0.39 $\pm$ 0.66, n = 1, 231). Also, the extent of multivariate non-normality was assessed using the Mardia's coefficient of multivariate kurtosis (Mardia, 1970). Results showed that the data displayed multivariate normality as Mardia's coefficient was 333 for 36 FSS items. This value is smaller than the cutoff point of 1, 368 suggested by the formula, $p(p + 2)$ for estimating the limit of departure from multivariate normality. In this formula, p equals the number of observed variables (see Bollen, 1989). In addition, examination of the skewness and kurtosis values of the individual items showed that the item responses were in general, normally distributed. This led to the decision to employ the maximum likelihood method of estimation in data analysis, as it is appropriate when data are normally distributed.

Confirmatory factor analyses

The adequacy of the factor structure of the FSS was examined using CFA. Three alternative models were examined to assess their effectiveness in representing FSS responses.

Single-factor model

This model specified all FSS items loading on one first-order factor. Such a model tests a unidimensional conceptualization of the flow construct, that is, testing the assumption that all items measure a single construct, rejecting the theory that flow consists of nine distinct elements (e.g., challenge–skill balance, clear goals, etc.). Examination of the fit indices showed that the model had a poor fit to the data as the NNFI, the CFI and the RMSEA did not reach the desirable cutoff values (see Table 1). This suggests that the 36 FSS items assess more than just a single construct. Consistent with the results obtained by Jackson and Marsh (1996), the poor fit of the single-factor model demonstrates that responses cannot be adequately explained using a single FSS score.

****Table 1 near here****

Nine-factor model

In this model, items were allowed to correlate only with the factor they were proposed to define while their loading on the remaining factors was fixed at zero. The nine factors were allowed to correlate freely. A good fit for this model would imply that different items measure theoretically distinct components of the flow experience. This model did not show an adequate fit to the data as two out of the four indices - the

NNFI and the CFI did not reach the desirable cut-off values (see Table 1). All factor loadings were greater than 0.5, providing evidence of the integrity of the item–factor relationships, with the exception of the third and fourth transformation of time items (see Table 2). All factor loadings were significant at $P < 0.01$. With regard to the magnitude of the factor intercorrelations, almost all were greater than 0.5, except those involving either the loss of self-consciousness or the transformation of time factors (see Table 3). These correlations were weaker than the rest. It might be that the factor responsible for the less than adequate fit of this model is the transformation of time factor, owing to the weak items involved.

****Table 2 near here****

Hierarchical model

The hierarchical model posited that a higher-order factor would explain the intercorrelations between the nine first-order factors. Such a model is assumed to be nested under the nine-factor model inasmuch as it attempts to explain the FSS responses in a more parsimonious way. A good fit for this model means that the variance in FSS responses can be statistically represented by one factor – the higher-order flow factor. The hierarchical model did not show an adequate fit to the data as two out of the four fit indices – the NNFI and the CFI – did not approach the desirable cutoff value of 0.95 (see Table 1). However, the derived index values were as expected because the higher-order model is more constrained than the nine-factor model and was expected to display lower fit indices. The present results showed that a higher-order flow factor does not adequately account for the interrelationships between the first-order FSS factors. Examination of the higher-order loadings (i.e., the relationships between the first-order factors and the higher-order factor) showed that the sense of control, clear goals, challenge-skill balance, and unambiguous feedback factors were the most closely related to the global flow factor (see Table 3). The transformation of time and loss of self-consciousness factors showed the weakest relationships to global flow. These factors displayed the largest associated disturbance terms that represent the amounts of the true (non-error) factor variance which is not accounted for by the higher-order factor. It seems that the weak correlation of these two factors with the higher order factor may be the source of the inadequate fit of this model. That is, the concept of a higher-order factor necessitates high intercorrelations among all the first-order factors. Hence, the low intercorrelations of these two first-order factors with the remaining first-order factors inhibits the use of the higher-order factor in summarizing the intercorrelations among the first order factors.

****Table 3 near here****

A χ^2 difference test to compare the nine-factor model and the hierarchical model showed that the two models differed significantly (χ^2 difference = 418, difference in $df = 27$, $P < 0.001$). The nine-factor model was statistically superior but the substantive difference between the models was small (NNFIs of 0.890 vs. 0.876; CFIs of 0.903 vs 0.885; SRMRs of 0.051 vs. 0.061; RMSEAs of 0.055 vs. 0.058).

Internal consistency estimates

Internal consistency estimates for the nine FSS subscales using Cronbach’s (1951) alpha showed that all the coefficients were greater than 0.70 with the exception of transformation of time (see Table 3).

Discussion

The present study was designed to assess the factor structure, the integrity of the item-factor loadings, and the internal consistency of the Flow State Scale (Jackson and Marsh, 1996) using responses from aerobic dance exercise participants. In contrast to the findings of Jackson and Marsh (1996), which were based largely on the responses of athletes, the present data did not provide adequate support either for the nine first-order factors model or for the hierarchical model. In addition, the single-factor model displayed an inadequate fit as expected. This contrast may be due in part to use of more rigorous cutoff criteria in the present study – a decision based upon the recent recommendations of Hu and Bentler (1999).

The present results suggest that the variance in responses to the FSS by aerobic dance exercise participants cannot be adequately represented by a single flow score. In addition, when taking into account the considerable residual variances (i.e., disturbances) in the transformation of time and loss of self-consciousness factors in the hierarchical model (i.e., that part of the factor variances which is not explained by the higher-order factor), it is clear that an adequate representation of the variance in FSS responses requires use of the nine FSS factors in data analysis rather than the higher-order factor (Jackson and Marsh, 1996). Furthermore, according to Jackson and Marsh (1996), the fact that there is a considerable amount of variance in a few first-order factors which cannot be explained by the higher-order factor means that some external criterion variables can be better explained by the first-order factors rather than the higher-order factor. Ostensibly, the effectiveness of using the higher-order factor in explaining theoretically relevant external criterion variables will be limited, as it will not adequately represent the true variance in FSS responses.

The strength of the associations of the transformation of time and loss of self-consciousness with the remaining flow components concurs with findings by Jackson and Marsh (1996) and previous research based on athletes' experiences (Jackson, 1992; Jackson and Roberts, 1992). The low association between the transformation of time factor and the remaining flow components may be attributed to the relatively low internal consistency displayed by the transformation of time items, something which is also evident from the low factor loadings displayed by the third and fourth factor items. Therefore, future empirical study is required to improve the psychometric integrity of this subscale. However, a second plausible explanation is that as the workout was conducted synchronously with music, the rhythmic elements of the music may have regulated the participants’ sense of time (see Karageorghis and Terry, 1997; Karageorghis, Terry, and Lane, 1999). Hence, flow can be attained while exercising synchronously without a distorted sense of time as conceptualised in the context of flow theory. A similar type of experience was also reported by elite-level athletes interviewed on their perceptions of flow state during performance in their sport (Jackson, 1996). A number of athletes reported that the time dimension was inappropriate to their task demands. For example, some swimmers used their stroke tempo to obtain feedback about their performance; hence, they were fully aware of the time factor. A final plausible explanation is that performing synchronously with the music may enhance flow, particularly if the participants enjoyed the music (see Karageorghis & Terry, 1999a; Rhodes, David, and Combs, 1988). There is evidence to suggest that music improves the stylistic elements of movement (Chen, 1985; Spilthoorn, 1986), increases alpha brain wave activity (Burk, 1989; Wales, 1986) and enhances mood state (Karageorghis and Terry, 1997, 1999b) all of which are precursors of both flow and successful performance (Catley and Duda, 1997; Collins, Powell, and Davies, 1991; Jackson, 1992; Jackson, 1995). Further, anxiety related to keeping time may decrease flow. This can be explained through Csikszentmihalyi’s (1990) model of flow, which illustrates how in situations where challenge is high and skills are low, anxiety ensues. Attempts to maintain movements in time to music may result in worry related to (a) keeping time, (b) the exertion level that is being externally determined by the tempo of the music and (c) following the choreography of the aerobics instructor while possibly being evaluated by members of the exercise group.

The moderate associations observed between the loss of self-consciousness and the other FSS factors may suggest that it is difficult for a number of the exercise participants to experience loss of self-consciousness because they may be concerned with social evaluation (Csikszentmihalyi, 1997). Self-consciousness is more likely to intensify when individuals are engaging in a group activity as their body is in view of onlookers as well as other members of the group. This means that the correlation between loss of self-consciousness and the remaining factors may vary systematically according to the degree to which exercise participants may display the characteristic of public self-consciousness to a greater or lesser extent. This dimension was also not relevant to the flow experience of some of the elite-level athletes interviewed by Jackson (1996). This may be explained by the distinction made by Csikszentmihalyi (1990) between “being aware of self” and “being self-conscious” or self-evaluative. That is, when experiencing flow, one is very likely to be aware of self, but concurrently, not self-evaluative. Overall, the present results display a similarity with those of Jackson (1996) regarding the degree to which all the flow elements should be in operation for flow to be experienced. It seems that not all flow elements are experienced to the same degree when referring to participation in physical activity where timing is important for optimal performance and body awareness is heightened when compared to non-physical activity settings.

With respect to the adequacy of the item-factor loadings, the present results showed that all the FSS items relate to their intended factor to a considerable extent. However, this is not the case with the third and fourth transformation of time items that displayed low factor loadings and contributed to the low internal consistency coefficient of the subscale.

A shortcoming of the present study which should be taken into account when interpreting the findings is the lack of information about sample characteristics, such as whether the classes differed in intensity or duration, and possible differences among participants regarding the level of their experience in aerobic dance classes. However, it is argued that this information is not absolutely necessary considering the purpose of the present study. This is because the aim of the study was not to assess the levels of flow experienced by the exercise participants while examining potential moderating variables. Rather, the purpose was to examine the convergent and discriminant validity of the FSS items.

In conclusion, it was found that the nine-factor and the hierarchical models did not represent adequately the FSS responses of aerobic dance exercise participants. Satisfactory internal consistency indices have been demonstrated for all the subscales except the transformation of time. This may compromise the effectiveness of the subscale in assessing the intended construct. The present results suggest that future empirical work should seek to improve the transformation of time subscale and to re-examine the improved FSS factor structure in exercise.

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Table 1. Fit Indices for Confirmatory Factor Analyses of FSS Models (*N* = 1, 231)

Model	χ^2	*df*	*P*	χ^2 dif.	*df* dif.	NNFI	CFI	SRMR	RMSEA	90% CI RMSEA
One first-order	8346	594	0.001	___	___	0.614	0.636	0.083	0.103	0.101-.105
Nine first-order	2626	558	0.001	5720	36	0.890	0.903	0.051	0.055	0.053-.057
One higher-order	3044	585	0.001	418	27	0.876	0.885	0.061	0.058	0.056-.060

*P < .05.

Abbreviations: χ^2 = chi-square statistic; NNFI = non-normed Fit Index; CFI = comparative fit index; SRMR = standardized root mean squared residual; RMSEA = root mean squared error of approximation; 90% CI = 90% confidence interval, d.f. = degrees of freedom.

Table 2. Standardized Factor Loadings and Error Terms for the Nine-Factor FSS Measurement Model (*n* = 1, 231)

Item	Challenge		Action		Goals		Feedback		Concentr.		Control		Loss		Time		Enjoy	
	FL	E	FL	E	FL	E	FL	E	FL	E	FL	E	FL	E	FL	E	FL	E
1	0.51	0.86	0.67	0.74	0.66	0.75	0.71	0.70	0.75	0.66	0.73	0.68	0.76	0.65	0.67	0.74	0.77	0.64
2	0.77	0.63	0.75	0.66	0.74	0.67	0.74	0.67	0.52	0.85	0.74	0.67	0.60	0.80	0.74	0.68	0.67	0.74
3	0.75	0.66	0.83	0.56	0.71	0.70	0.74	0.67	0.86	0.50	0.77	0.64	0.66	0.75	0.46	0.89	0.76	0.65
4	0.73	0.68	0.81	0.59	0.66	0.75	0.78	0.63	0.85	0.53	0.77	0.63	0.80	0.60	0.39	0.92	0.77	0.63

Notes: 1. FL = Factor loading; E = error term. Challenge = Challenge-Skill Balance; Action = Action-Awareness Merging; Goals = Clear Goals; Feedback = Unambiguous Feedback; Concentr. = Total Concentration; Control = Sense of Control; Loss = Loss of Self-consciousness; Time = Transformation of Time; Enjoy = Autotelic (enjoyable) Experience.

2. All parameter estimates are in a standardized form and are statistically significant at the $P < .01$ level.

3. There are four items in each of the nine FSS subscales.

Table 3. Factor Intercorrelations Based on the Nine-factor FSS Measurement Model, Higher-order Factor Loadings, and Internal Consistency Estimates (*N* = 1, 231)

Factor	Challenge	Action	Goals	Feedback	Concentration	Control	Loss	Time	Enjoy
Challenge	(0.78)								
Action	0.64	(0.84)							
Goals	0.78	0.61	(0.78)						
Feedback	0.81	0.61	0.82	(0.82)					
Concentration	0.51	0.40	0.59	0.50	(0.82)				
Control	0.82	0.64	0.82	0.76	0.69	(0.84)			
Loss	0.33	0.36	0.42	0.36	0.39	0.48	(0.79)		
Time	0.22	0.25	0.23	0.22	0.31	0.18	0.25	(0.65)	
Enjoy	0.66	0.29	0.62	0.51	0.58	0.56	0.33	0.35	(0.83)
Higher-order Factor Loadings									
Flow	0.89	0.68	0.91	0.86	0.66	0.92	0.47	0.28	0.65
Disturbances									
	0.45	0.73	0.42	0.51	0.75	0.39	0.88	0.96	0.75

Notes: 1. Challenge = Challenge-Skill Balance; Action = Action-Awareness Merging; Goals = Clear Goals; Feedback = Unambiguous Feedback; Concentration = Total Concentration; Control = Sense of Control; Loss = Loss of Self-consciousness; Time = Transformation of Time; Enjoy = Autotelic (enjoyable) Experience.

2. All parameter estimates are in a standardized form and are statistically significant at the $P < .01$ level.

3. Internal consistency coefficients (alphas) are presented in parentheses along the top diagonal.

4. Disturbances represent the amount of true (non-error) variance not accounted for by the higher-order factor.