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Profiles of Flow Experience Among Chinese College Basketball Players: A Latent Profile Analysis

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Abstract (Structured)

Background. Flow is an optimal psychological state that facilitates athletic performance and engagement. Prior research has mainly used variable-centered approaches to examine flow antecedents, leaving unclear whether athletes form distinct subgroups in flow patterns.

Aim. This study identified latent flow profiles among Chinese college basketball players and examined whether these profiles differ in key situational and cognitive antecedents.

Material and methods. In total, 100 college basketball players from Chongqing, Sichuan, and Beijing completed measures of flow, coach leadership and support, environmental and resource guarantee, training task design, team interaction (harmonious relationship, cooperative spirit), and skill-challenge balance. Latent profile analysis used mclust in R; *t*-tests and one-way ANOVAs compared profiles on flow and antecedent variables.

Results. Two distinct profiles were identified: a low-flow group ($n = 70$, 70%) and a high-flow group ($n = 30$, 30%). The high-flow group scored higher on all four flow items (all $p < 0.001$; Cohen's $d = 0.72$ – 1.06) and reported higher coach leadership and support, skill-challenge balance, team interaction, training task design, and environmental and resource guarantee (all $p < 0.001$; $\eta^2 = 0.30$ – 0.59).

Conclusions. College basketball players can be classified into two distinct flow profiles. Coaches should adopt differentiated interventions, particularly for low-flow athletes.

Key words: flow experience; college basketball players; latent profile analysis; skill-challenge balance; coach leadership

1. Introduction

Flow experience refers to an optimal psychological state in which individuals are fully immersed in an activity, characterized by heightened concentration, distorted sense of time, and intrinsic enjoyment (Csikszentmihalyi, 1990). Since its introduction, flow theory has been widely applied in sport psychology, with accumulating evidence demonstrating that flow experience is positively associated with athletic performance, training engagement, and psychological well-being (Swann et al., 2012; Jackman et al., 2016). Recent work has also extended the study of flow to extreme and non-competitive movement contexts (de Sampaio Barros et al., 2024). In team sports such as basketball, flow experience is particularly important because players must simultaneously coordinate individual skills with dynamic team tactics under high-pressure competitive conditions.

Existing research on flow in sport has predominantly adopted a variable-centered approach, which examines the average relationships between antecedents and flow experience across a sample. For instance, studies have shown that coach leadership, training task design, team atmosphere, and environmental support are positively correlated with athletes' flow experience (Martiny et al., 2023; Mageau & Vallerand, 2003). The skill-challenge balance has also been identified as a core antecedent of flow (Csikszentmihalyi, 1990; Fong et al., 2015). However, this approach assumes that all athletes share the same pattern of relationships, thereby overlooking the possibility that athletes may differ qualitatively in their flow experience profiles. Building on a previous variable-centered study using the same sample (Huang & Lang, 2026), which identified significant mediation effects of skill-challenge balance on flow experience, the current investigation applies latent profile analysis to reveal subgroup heterogeneity that aggregate analyses cannot capture.

Person-centered approaches, such as latent profile analysis (LPA), offer a complementary perspective by identifying subgroups of individuals who share similar patterns across multiple indicators (Bergman & Trost, 2006; Muthén & Muthén, 2000; Spurk et al., 2020). LPA has been increasingly applied in sport and exercise psychology to examine motivational profiles, burnout profiles, and engagement profiles (e.g., Martinent & Nicolas, 2017; Huang et al., 2025). However, to date, no study has used LPA to identify flow experience profiles among college basketball players.

The variable-centered antecedents of flow experience in this sample have been reported in a companion study (Huang & Lang, 2026), which showed that external situational factors were positively associated with flow experience and that perceived skill-challenge balance mediated these associations. The present study addresses a distinct, person-centered question that the

companion study could not answer: whether athletes can be classified into qualitatively different flow profiles, and how those profiles differ in the same antecedent variables.

Accordingly, this study addresses two research questions: (RQ1) Can college basketball players be classified into distinct latent profiles based on their flow experience? (RQ2) Do these profiles differ significantly in coach leadership and support, environmental and resource guarantee, training task design, harmonious relationship, cooperative spirit, and skill-challenge balance?

This study makes three contributions. First, it shifts the analytical lens from variable-centered to person-centered, revealing the heterogeneity of flow experience within a team sport context. Second, it provides empirical evidence on how external situational factors and cognitive appraisal differ across flow profiles, extending the situational-individual interaction framework. Third, the findings offer practical implications for coaches to design differentiated interventions targeting athletes with low flow experience.

2. Research Materials and Methods

2.1. Ethics Statement

This study was conducted in accordance with the Declaration of Helsinki (World Medical Association, 2013). Ethical review and approval were waived due to the non-interventional, survey-based nature of the research. Written informed consent was obtained from all participants prior to data collection. All data were de-identified to ensure participant confidentiality.

2.2. Participants

A total of 100 college basketball players (including general physical education students and sports-specialized students) from universities in Chongqing, Sichuan, and Beijing participated in this study. A total of 108 questionnaires were distributed and collected, of which 8 were excluded as invalid, yielding 100 valid questionnaires (valid response rate = 92.59%). The sample consisted of 57 males (57.0%) and 43 females (43.0%). In terms of training years, 36 participants (36.0%) had 1 year of training, 48 (48.0%) had 2 years, and 16 (16.0%) had 3 years. Regarding athletic level, 34 participants (34.0%) were first-class athletes, 61 (61.0%) were second-class athletes, and 5 (5.0%) had no athletic rank (Table 1).

The dataset analyzed in this study was drawn from a broader project on the antecedents of flow experience among college basketball players. The variable-centered analysis of this sample, which examined the mediating role of skill-challenge balance, has been published elsewhere (Huang & Lang, 2026). The present study extends that work by applying a person-centered approach to identify distinct flow profiles within the same sample, and reports only the person-centered analyses described below.

Table 1. Demographic Characteristics of Participants (*N* = 100)

Variable	Category	<i>n</i>	%
Gender	Male	57	57.0
	Female	43	43.0
Training Years	1 year	36	36.0
	2 years	48	48.0
	3 years	16	16.0
Athletic Level	First-class athlete	34	34.0
	Second-class athlete	61	61.0
	No athletic rank	5	5.0

2.3. Measures

The flow experience items were adapted from the Flow State Scale (Jackson & Marsh, 1996; Jackson & Eklund, 2002). The study used the Questionnaire on Influencing Factors of Flow Experience Acquisition among College Basketball Players, which included five dimensions: flow experience, coach leadership and support, environmental and resource guarantee, training task design, and team interaction (harmonious relationship and cooperative spirit). Skill-challenge balance perception was included as a cognitive appraisal variable. The questionnaire consisted of 11 items. Questionnaires were distributed both online (via the Wenjuanxing platform) and offline (face-to-face).

2.4. Reliability and Validity

Internal consistency was assessed using Cronbach's α (Cronbach, 1951). Detailed reliability and validity estimates for this instrument and sample have been reported in the companion study (Huang & Lang, 2026); in brief, the overall questionnaire demonstrated acceptable internal consistency ($\alpha = 0.792$), and the data were suitable for factor-analytic procedures (KMO = 0.909; Kaiser, 1974; Bartlett's test of sphericity: $\chi^2 = 388.75, p < 0.001$; Bartlett, 1954). Because the two items of the team interaction dimension were only weakly correlated, harmonious relationship and cooperative spirit were treated as separate variables in the analyses reported below.

2.5. Common Method Bias

Harman's single-factor test (Podsakoff et al., 2003) was used as a preliminary screening for common method bias. The first principal component explained 61.09% of the variance, exceeding the 40% threshold. This threshold should be interpreted with caution: Harman's test has been criticized as insufficiently sensitive, and its cut-off has no statistical foundation (Fuller et al., 2016; Kock et al., 2021). The result is therefore reported as a descriptive indicator rather than as evidence that common method bias is present, and it is considered further in Section 4.4.

2.6. Data Analysis Strategy

Data were analyzed using R (version 4.6.1). The analysis proceeded in four steps: (1) Descriptive statistics and correlation analysis; (2) Latent profile analysis (LPA) using the mclust package (Scrucca et al., 2016) with the four flow items as indicators, determining the optimal number of profiles based on BIC, ICL, and profile sample size (Nylund et al., 2007; each profile at least 5% of the total sample); (3) Profile difference tests using independent samples *t*-tests for flow items and one-way ANOVAs for antecedent variables (significance level $p < 0.05$); (4) Visualization of the profile line chart. Given the modest sample size, we also took into account simulation evidence that LPA can recover the correct number of classes at comparable sample sizes when profiles are well separated (Tein et al., 2013).

3. Research Results

3.1. Descriptive Statistics and Correlation Analysis

Descriptive statistics are presented in Table 2. The means of all variables ranged from 1.75 to 1.86, with standard deviations ranging from 0.55 to 0.72. Bivariate associations among the study variables are reported in Supplementary Table S1; consistent with the companion study (Huang & Lang, 2026), flow experience was positively associated with all antecedent variables, most strongly with coach leadership.

Table 2. Descriptive Statistics of Study Variables ($N = 100$)

Variable	<i>M</i>	<i>SD</i>
Flow experience	1.86	0.55
Coach leadership	1.85	0.60
Skill-challenge balance	1.76	0.65
Harmonious relationship	1.80	0.71
Cooperative spirit	1.75	0.67
Training task design	1.82	0.72
Environmental and resource guarantee	1.80	0.58

3.2. Latent Profile Analysis Results

LPA was conducted with the four flow items as indicators. The model with two profiles was identified as optimal based on BIC, ICL, and profile sample size (Table 3). The BIC value was -773.85, the ICL value was -779.04, and Entropy was 0.893, indicating high classification accuracy. Profile 1 ($n = 70$, 70%) was labeled the low-flow group, and Profile 2 ($n = 30$, 30%) was labeled the high-flow group. The mean scores of the two profiles are presented in Table 4.

Table 3. Comparison of Latent Profile Model Fit Indices

No. of Profiles	Best Model	BIC	ICL	Entropy	Smallest Profile %
1	EII,1	-876.45	---	---	---
2	EII,2	-773.85	-779.04	0.893	30%
3	VEV,3	-779.34	---	---	---
4	EEV,4	-902.95	---	---	---

Table 4. Mean Comparison of Flow Items Between the Two Flow Profiles

Variable	Low-flow Group ($n = 70$)	High-flow Group ($n = 30$)
Flow item 1	1.63	2.63
Flow item 2	1.56	2.70
Flow item 3	1.59	2.57
Flow item 4	1.43	2.43

3.3. Differences in Flow Indicators Between Profiles

Independent samples t -tests showed that the high-flow group scored significantly higher than the low-flow group on all four flow items (all $p < 0.001$; Table 5). Cohen's d (Cohen, 1988) ranged from 0.72 to 1.06, indicating medium-to-large effect sizes.

Table 5. Independent Samples t -Test Results for Flow Items Between Profiles

Item	Low-flow Group M	High-flow Group M	t	p	Cohen's d
Flow item 1	1.63	2.63	-9.089	< 0.001	1.063
Flow item 2	1.56	2.70	-10.988	< 0.001	0.995
Flow item 3	1.59	2.57	-8.092	< 0.001	0.979
Flow item 4	1.43	2.43	-8.279	< 0.001	0.719

3.4. Differences in Antecedent Variables Between Profiles

One-way ANOVAs showed that the high-flow group scored significantly higher than the low-flow group on all six antecedent variables (all $p < 0.001$; Table 6). The effect sizes (η^2) ranged from 0.296 to 0.587, indicating large effects.

Table 6. One-Way ANOVA Results for Antecedent Variables Between Profiles

Variable	Low-flow Group M	High-flow Group M	F	p	η^2
Coach leadership	1.55	2.55	139.50	< 0.001	0.587
Skill-challenge balance	1.53	2.30	41.18	< 0.001	0.296
Harmonious relationship	1.49	2.53	83.80	< 0.001	0.461
Cooperative spirit	1.49	2.37	56.13	< 0.001	0.364
Training task design	1.54	2.47	53.48	< 0.001	0.353
Environmental and resource guarantee	1.52	2.45	115.30	< 0.001	0.541

3.5. Profile Line Chart

The line chart (Figure 1) shows that the high-flow group scored consistently higher than the low-flow group across all four flow items, with the two lines running parallel, further confirming the discriminant validity of the two profiles.

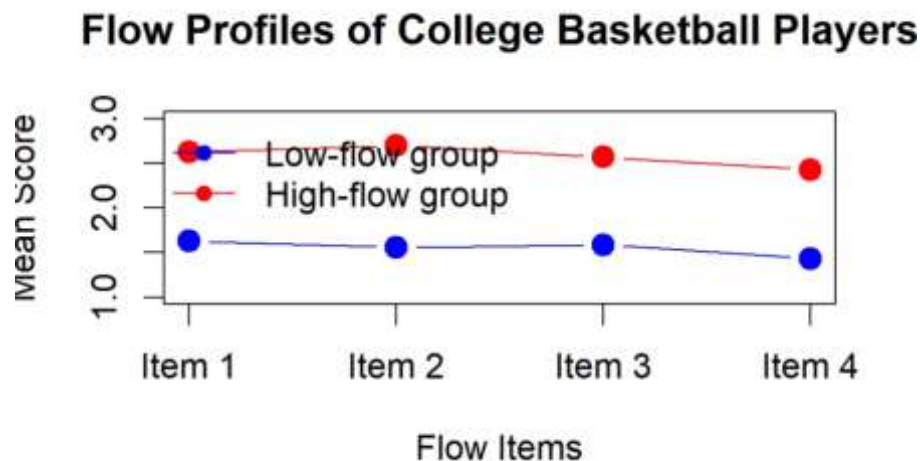


Figure 1. Line Chart of the Two Flow Profiles

4. Discussion

4.1. Identification of Two Flow Profiles and Its Theoretical Significance

The first core finding of this study is that Chinese college basketball players are not a homogeneous group but can be clearly classified into two flow experience profiles: a low-flow group ($n = 70$) and a high-flow group ($n = 30$). This finding supports the applicability of the person-centered perspective in sport flow research and echoes Bergman and Trost's (2006) methodological proposition that individuals differ qualitatively across psychological indicators. Notably, 70% of the athletes were classified into the low-flow group, suggesting that most college basketball players do not experience sufficient flow during training or competition. This proportion indicates that flow is not a universal phenomenon but a relatively "scarce" optimal state. This finding is consistent with Csikszentmihalyi's (1990) classic theory that flow is an ideal state requiring specific conditions rather than an automatic occurrence. From a methodological perspective, this study is the first to apply LPA to flow research among college basketball players, extending the application boundary of flow theory in team sports. Previous studies using a variable-centered approach could only answer "which factors are related to flow," whereas this study identifies subgroups and further answers "which athletes are more likely to enter flow."

4.2. Differences in External Situational Factors Between Profiles

The second core finding is that the high-flow group scored significantly higher than the low-flow group on five external situational variables: coach leadership ($F = 139.50$), harmonious relationship ($F = 83.80$), cooperative spirit ($F = 56.13$), training task design ($F = 53.48$), and environmental and resource guarantee ($F = 115.30$), all $p < 0.001$. This result is highly consistent with Martiny et al.'s (2023) systematic review of flow in team athletes: external environmental factors influence flow experience through their impact on athletes' cognitive appraisal. It also aligns with the motivational model of the coach-athlete relationship, in which coaches shape athletes' perceptions and evaluations of the sport environment (Mageau & Vallerand, 2003; Liu et al., 2025), and with evidence that the coach-created climate is associated

with athletes' challenge and threat appraisals (Aydın & Sarı, 2021).

4.3. The Role of Skill-Challenge Balance in Profile Differentiation

The third core finding is that skill-challenge balance perception differed significantly between the two profiles ($F = 41.18, p < 0.001$), with the low-flow group scoring 1.53 and the high-flow group scoring 2.30. This finding directly validates the core proposition of Csikszentmihalyi's (1990) flow theory: when athletes perceive that task challenges match their skills and both are at a high level, they are most likely to enter flow. More importantly, skill-challenge balance played the role of "cognitive appraisal" in this study, connecting external situational factors with flow experience, which is highly consistent with the "external situation → cognitive appraisal → flow experience" theoretical model examined in this study. These findings complement those of Huang and Lang (2026), who demonstrated through mediation analysis using the same dataset that skill-challenge balance mediates the relationship between situational antecedents and flow using a variable-centered approach. The present person-centered analysis further reveals that such relationships vary meaningfully across athlete subgroups.

4.4. Practical Implications and Limitations

Practical Implications.

The findings have three implications for college basketball coaches. First, coaches should identify athletes in the low-flow group and implement targeted psychological interventions, given that 70% of the sample belonged to this group. Second, coaches should dynamically adjust task difficulty to maintain a perceived skill-challenge balance, as this cognitive appraisal was the strongest differentiator between profiles. Third, building a positive team atmosphere through team-building activities and open communication channels may further facilitate flow experience among players.

Limitations.

Several limitations of this study should be acknowledged when interpreting the findings. First, the relatively small sample size ($N = 100$), with only 30 participants in the high-flow group, may limit the statistical power and stability of the LPA solution. Simulation evidence suggests that LPA can recover the correct number of classes at sample sizes comparable to the present one when profiles are well separated (Tein et al., 2013), and the solution was additionally supported by a high Entropy value (0.893). Nevertheless, future studies should replicate these findings with larger and more diverse samples to confirm the robustness of the two-profile structure. Second, common method bias represents a potential concern. Harman's single-factor test revealed that the first principal component accounted for 61.09% of the total variance, exceeding the commonly recommended 40% threshold. This threshold should be interpreted with caution, since Harman's test is widely regarded as insufficiently sensitive and its cut-off lacks a statistical foundation (Fuller et al., 2016; Kock et al., 2021); it was therefore used here as a preliminary screening only. Inflated correlations among variables due to common method variance cannot be fully ruled out. Future research should consider adopting multi-source data collection or time-lagged designs to mitigate this issue. Third, some scales in this study demonstrated suboptimal internal consistency. In particular, the environmental and resource guarantee subscale yielded a Cronbach's α of 0.57, falling below the conventional threshold of

0.60. Although the inter-item correlation was statistically significant, the low α value may reflect the limited number of items rather than poor construct validity. Future studies should consider expanding the item pool for this dimension. Fourth, several constructs were operationalized using single items, which precludes the assessment of reliability and may not fully capture the complexity of the underlying constructs. Future research should employ multi-item validated scales for all variables. Fifth, the cross-sectional design of this study prevents causal inferences. Although the theoretical model examined in this study suggests that external situational factors and skill-challenge balance predict flow experience profiles, the directionality of these relationships cannot be confirmed from the current data. Longitudinal and experimental designs are needed in future research to establish causal pathways.

5. Conclusion

This study adopted a person-centered perspective and used latent profile analysis to examine the subgroup types of flow experience among Chinese college basketball players. The main conclusions are as follows: (1) Flow experience among college basketball players exhibits significant group heterogeneity, with two profiles identified: a low-flow group ($n = 70$, 70%) and a high-flow group ($n = 30$, 30%); (2) Different flow profiles differ significantly in external situational factors, with the high-flow group scoring significantly higher on coach leadership, harmonious relationship, cooperative spirit, training task design, and environmental and resource guarantee (all $p < 0.001$); (3) Skill-challenge balance perception differs significantly between the two profiles ($F = 41.18$, $p < 0.001$), supporting the "external situation $\rightarrow$ cognitive appraisal $\rightarrow$ flow experience" theoretical framework; (4) The findings have clear practical value for coaches to implement differentiated psychological interventions. Future research should expand the sample size, adopt longitudinal or experimental designs, and combine multi-source data to further verify the stability of flow profiles and their causal mechanisms.

Declarations

Disclosure: During the preparation of this manuscript, the authors used Claude (Anthropic) to improve the language and readability of the text. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Related Publications: Part of the data analyzed in this article was previously reported in a companion study examining the variable-centered antecedents of flow experience (Huang & Lang, 2026). The present article addresses distinct person-centered research questions using different analytical procedures and does not duplicate that work.

Supplementary Materials: Supplementary Table S1 (Pearson correlation matrix among study variables) is provided as supplementary material.

Author Contributions: Huang Xiaoqing: Conceptualization, Methodology, Formal Analysis, Writing – Original Draft. Lang Jun: Supervision, Writing – Review & Editing.

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Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki. Ethical review and approval were waived due to the non-interventional, survey-based nature of the research.

Informed Consent Statement: Written informed consent was obtained from all participants prior to data collection.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to participants' privacy and the terms of informed consent.

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Conflicts of Interest: The authors declare no conflicts of interest.

References

- Aydın, M., & Sarı, İ. (2021). The relationship between coach-created motivational climate and athletes' challenge and threat perceptions. *Quality in Sport*, 7(2), 24-37. <https://doi.org/10.12775/qs.2021.008>
- Bartlett, M. S. (1954). A note on the multiplying factors for various χ^2 approximations. *Journal of the Royal Statistical Society: Series B*, 16(2), 296-298. <https://doi.org/10.1111/j.2517-6161.1954.tb00174.x>
- Bergman, L. R., & Trost, K. (2006). The person-oriented versus the variable-oriented approach: Are they complementary, opposites, or exploring different worlds? *Merrill-Palmer Quarterly*, 52(3), 601-632. <https://doi.org/10.1353/mpq.2006.0023>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16(3), 297-334. <https://doi.org/10.1007/BF02310555>
- Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. Harper & Row.
- de Sampaio Barros, M. F., Stefano Filho, C. A., Menezes, L. T. de, Araújo-Moreira, F. M., Trevelin, L. C., Pimentel Maia, R., Radel, R., & Castellano, G. (2024). Psycho-physio-neurological correlates of qualitative attention, emotion and flow experiences in a close-to-real-life extreme sports situation: Low- and high-altitude slackline walking. *PeerJ*, 12, e17743. <https://doi.org/10.7717/peerj.17743>
- Fong, C. J., Zaleski, D. J., & Leach, J. K. (2015). The challenge-skill balance and antecedents of flow: A meta-analytic investigation. *The Journal of Positive Psychology*, 10(5), 425-446. <https://doi.org/10.1080/17439760.2014.967799>
- Fuller, C. M., Simmering, M. J., Atinc, G., Atinc, Y., & Babin, B. J. (2016). Common methods variance detection in business research. *Journal of Business Research*, 69(8), 3192-3198. <https://doi.org/10.1016/j.jbusres.2015.12.008>
- Huang, H., Sha, X., Zhong, C., Ma, N., & Shui, Y. (2025). Association of football athlete engagement profiles with adolescent mental health: A latent profile analysis. *BMC Public Health*, 25(1), 2045. <https://doi.org/10.1186/s12889-025-23239-5>
- Huang, X., & Lang, J. (2026). Understanding flow experience among college basketball players: The mediating role of perceived skill-challenge balance. *Frontiers in Humanities and Social Sciences*, 6(7), 51-61. <https://doi.org/10.54691/e6mt6j95>
- Jackman, P. C., Swann, C., & Crust, L. (2016). Exploring athletes' perceptions of the relationship between mental toughness and dispositional flow in sport. *Psychology of*

- Sport and Exercise*, 27, 56-65. <https://doi.org/10.1016/j.psychsport.2016.07.007>
- Jackson, S. A., & Eklund, R. C. (2002). Assessing flow in physical activity: The Flow State Scale-2 and Dispositional Flow Scale-2. *Journal of Sport and Exercise Psychology*, 24(2), 133-150. <https://doi.org/10.1123/jsep.24.2.133>
- Jackson, S. A., & Marsh, H. W. (1996). Development and validation of a scale to measure optimal experience: The Flow State Scale. *Journal of Sport and Exercise Psychology*, 18(1), 17-35. <https://doi.org/10.1123/jsep.18.1.17>
- Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, 39(1), 31-36. <https://doi.org/10.1007/BF02291575>
- Kock, F., Berbekova, A., & Assaf, A. G. (2021). Understanding and managing the threat of common method bias: Detection, prevention and control. *Tourism Management*, 86, 104330. <https://doi.org/10.1016/j.tourman.2021.104330>
- Liu, R., Wang, S., & Li, J. (2025). How coach leadership behavior influences athletes' performance: The chain-mediated role of the coach-athlete relationship. *Frontiers in Psychology*, 15, 1500867. <https://doi.org/10.3389/fpsyg.2024.1500867>
- Mageau, G. A., & Vallerand, R. J. (2003). The coach-athlete relationship: A motivational model. *Journal of Sports Sciences*, 21(11), 883-904. <https://doi.org/10.1080/0264041031000140374>
- Martinent, G., & Nicolas, M. (2017). Athletes' affective profiles within competition situations: A two-wave study. *Sport, Exercise, and Performance Psychology*, 6(2), 143-157. <https://doi.org/10.1037/spy0000085>
- Martiny, L. E., Theil, L. Z., Maciel Neto, E., Dias, G., Ferreira, J. P., & Mendes, R. (2023). Effects of flow states on elite athletes in team sports: A systematic review. *Revista Foco*, 16(8), e2910. <https://doi.org/10.54751/revistafoco.v16n8-118>
- Muthén, B., & Muthén, L. K. (2000). Integrating person-centered and variable-centered analyses: Growth mixture modeling with latent trajectory classes. *Alcoholism: Clinical and Experimental Research*, 24(6), 882-891. <https://doi.org/10.1111/j.1530-0277.2000.tb02070.x>
- Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling*, 14(4), 535-569. <https://doi.org/10.1080/10705510701575396>
- Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879-903. <https://doi.org/10.1037/0021-9010.88.5.879>
- Scrucca, L., Fop, M., Murphy, T. B., & Raftery, A. E. (2016). mclust 5: Clustering, classification and density estimation using Gaussian finite mixture models. *The R Journal*, 8(1), 289-317. <https://doi.org/10.32614/RJ-2016-021>
- Spurk, D., Hirschi, A., Wang, M., Valero, D., & Kauffeld, S. (2020). Latent profile analysis: A

review and "how to" guide of its application within vocational behavior research. *Journal of Vocational Behavior*, 120, 103445. <https://doi.org/10.1016/j.jvb.2020.103445>

- Swann, C., Keegan, R. J., Piggott, D., & Crust, L. (2012). A systematic review of the experience, occurrence, and controllability of flow states in elite sport. *Psychology of Sport and Exercise*, 13(6), 807-819. <https://doi.org/10.1016/j.psychsport.2012.05.006>
- Tein, J.-Y., Coxe, S., & Cham, H. (2013). Statistical power to detect the correct number of classes in latent profile analysis. *Structural Equation Modeling: A Multidisciplinary Journal*, 20(4), 640-657. <https://doi.org/10.1080/10705511.2013.824781>
- World Medical Association. (2013). World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. *JAMA*, 310(20), 2191-2194. <https://doi.org/10.1001/jama.2013.281053>

Supplementary Materials

Table S1. Pearson Correlation Matrix Among Study Variables (N = 100)

Variable	1	2	3	4	5	6	7
1. Flow experience	1						
2. Coach leadership	0.72	1					
3. Skill-challenge balance	0.50	0.47	1				
4. Harmonious relationship	0.64	0.67	0.37	1			
5. Cooperative spirit	0.58	0.53	0.39	0.38	1		
6. Training task design	0.60	0.57	0.53	0.48	0.51	1	
7. Environmental and resource guarantee	0.69	0.63	0.46	0.53	0.46	0.53	1