Personality and cognitive resilience in elite athletes: a HEXACO framework

La personalidad y la resiliencia cognitiva en atletas de élite: un marco HEXACO

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Abstract

Introduction: Cognitive resilience and ethical functioning are important psychological determinants of elite sport performance, influencing athletes' stress regulation, motivation, and interpersonal behavior under competitive pressure. However, evidence from long-term and culturally specific interventions remains limited.
Objective: This study examined whether a culturally adapted psychological training program based on the HEXACO model was associated with longitudinal changes in personality traits and psychosocial functioning among elite athletes in Azerbaijan.
Methodology: A total of 100 elite athletes (18–35 years) from six sport disciplines were randomly assigned to an experimental group (n = 50) or a control group (n = 50). Personality traits were assessed at baseline, 6 months, and 12 months using an Azerbaijani-adapted 60-item HEXACO-PI-R with satisfactory reliability (α = .72–.83); the intervention included 24 HEXACO-based sessions over 6 months targeting emotional regulation, motivation, team cohesion, and moral values.
Discussion: The findings suggest that long-term, culturally grounded psychological training integrated with the HEXACO framework may be associated with gradual and context-sensitive changes in personality-related tendencies among elite athletes.
Conclusions: This study provides longitudinal evidence from a post-Soviet sport context, indicating that culturally adapted HEXACO-based interventions may support resilience, ethical functioning, and psychosocial development in elite sport settings.

Keywords

Athlete wellbeing; emotional regulation; group cohesion; moral values in sport; psychosocial adaptation.

Resumen

Introducción: La resiliencia cognitiva y el funcionamiento ético son determinantes psicológicos importantes del rendimiento en el deporte de élite, ya que influyen en la regulación del estrés, la motivación y el comportamiento interpersonal de los atletas bajo presión competitiva. Sin embargo, la evidencia de intervenciones a largo plazo y culturalmente específicas sigue siendo limitada.
Objetivo: Este estudio examinó si un programa de entrenamiento psicológico culturalmente adaptado basado en el modelo HEXACO estaba asociado con cambios longitudinales en los rasgos de personalidad y el funcionamiento psicosocial entre atletas de élite en Azerbaiyán.
Metodología: Un total de 100 atletas de élite (18–35 años) de seis disciplinas deportivas fueron asignados aleatoriamente a un grupo experimental (n = 50) o a un grupo de control (n = 50). Los rasgos de personalidad se evaluaron al inicio, a los 6 meses y a los 12 meses mediante una versión azerbaiyana adaptada del HEXACO-PI-R de 60 ítems con fiabilidad satisfactoria (α = .72–.83); la intervención incluyó 24 sesiones basadas en HEXACO durante 6 meses, centradas en la regulación emocional, la motivación, la cohesión del equipo y los valores morales.
Discusión: Los resultados sugieren que un entrenamiento psicológico a largo plazo, culturalmente fundamentado e integrado con el marco HEXACO, puede asociarse con cambios graduales y sensibles al contexto en las tendencias relacionadas con la personalidad de los atletas de élite.
Conclusiones: Este estudio aporta evidencia longitudinal desde un contexto deportivo postsoviético, indicando que las intervenciones basadas en HEXACO y culturalmente adaptadas pueden apoyar la resiliencia, el funcionamiento ético y el desarrollo psicosocial en el deporte de élite.

Palabras clave

Bienestar del deportista; regulación emocional; cohesión grupal; valores morales en el deporte; adaptación psicosocial.

Introduction

Psychological processes and stable personality traits play a central role in both performance and well-being in competitive sport (Allen & Laborde, 2014; Allen al., 2013). In high-performance environments, athletes are exposed to sustained physical, cognitive, and interpersonal demands that require effective stress regulation, motivational stability, and adaptive social functioning (Woodman & Hardy, 2003; Fletcher & Sarkar, 2012). Athletes' responses to these demands are influenced not only by situational factors but also by relatively enduring dispositional characteristics. These characteristics shape emotional responses, behavioral consistency, and interpersonal behavior under competitive pressure (Gucciardi et al., 2015). In addition, motivational and social support processes have been associated with adaptive functioning in physically active populations (Brown et al., 2018; Fletcher & Sarkar, 2012; Zimmerman, 2006).

Accumulating evidence indicates that personality traits are associated with a range of sport-related outcomes, including stress tolerance, resilience, motivation, and team functioning (Brozovich-Neyra et al., 2024; Malán-Ernst et al., 2025). Traits related to emotional regulation, self-discipline, and social engagement have been linked to both individual performance and collective dynamics in competitive settings (Allen & Laborde, 2014). Personality is often conceptualized as relatively stable. However, contemporary models acknowledge that trait-related functioning may show gradual change in response to repeated experiences, structured training, and sustained self-regulatory demands (Roberts et al., 2006; Roberts et al., 2017).

Cross-cultural research emphasizes that the expression and social meaning of personality traits are shaped by cultural norms, values, and institutional practices (McCrae & Terracciano, 2005). In collectivist-oriented sport systems, such as those prevalent in Azerbaijan, moral conduct, respect for authority, and group loyalty represent central components of athletic identity. These values also shape athletes' socialization within sport environments. Within such contexts, interpersonal trust and ethical responsibility are socially reinforced expectations. These norms may influence how athletes internalize and regulate personality-related tendencies during both training and competition.

Accordingly, psychological assessment instruments and intervention programs developed in Western contexts cannot be assumed to function equivalently in different cultural environments without systematic adaptation.

Cross-cultural adaptation involves more than linguistic translation. It also requires the establishment of semantic, conceptual, and contextual equivalence to ensure valid interpretation of test items and intervention content (Beaton et al., 2000; Van de Vijver & Tanzer, 2004).

In applied sport psychology, culturally responsive interventions emphasize alignment between psychological training content and athletes' sociocultural values, belief systems, and motivational frameworks (Gould & Maynard, 2009; Fletcher & Sarkar, 2012). Such approaches have been shown to enhance engagement, internalization of psychological skills, and long-term effectiveness in elite sport environments (Gucciardi et al., 2015). Psychological training programs in elite sport increasingly aim to enhance emotional regulation, self-monitoring, motivation, and interpersonal competence. Short-term benefits of such interventions—particularly improvements in confidence, coping skills, and emotional control—have been documented (Gould et al., 2002; Gould & Maynard, 2009). Neurobiological research has also linked stress-related emotional vulnerability to individual differences in physiological reactivity (Sapolsky, 2004). However, empirical evidence regarding longer-term changes in personality-related functioning remains limited. Most existing studies focus on transient psychological states rather than sustained patterns of trait expression over extended periods.

This gap is particularly evident in research examining culturally adapted interventions in post-Soviet and South Caucasus sport systems. Despite the growing emphasis on culturally responsive psychological support, few studies have systematically investigated such interventions in post-Soviet and South Caucasus sport contexts. In particular, little is known about whether long-term culturally grounded psychological programs are associated with measurable changes in personality-related tendencies among elite athletes in these regions.

Accordingly, the present study examined whether a culturally adapted, HEXACO-informed psychological training program was associated with longitudinal changes in personality traits among elite Azerbaijani

athletes over a 12-month period, compared with a control condition. Addressing the scarcity of longitudinal intervention studies in post-Soviet and South Caucasus sport contexts, this research integrates independent psychometric validation with a culturally grounded training framework. Particular emphasis was placed on Emotionality and Honesty–Humility, given their relevance to emotional regulation, ethical conduct, and interpersonal trust in collectivist sport environments.

Theoretical Background

Multidimensional personality frameworks provide a useful basis for examining individual differences in sport contexts. Among these frameworks, the Big Five model (McCrae & Costa, 1987) has been widely applied in sport psychology and linked to motivation, affect regulation, coping strategies, and performance consistency (Allen & Laborde, 2014; Allen et al., 2013). Previous studies have demonstrated associations between Big Five traits and resilience, optimism, and adaptive functioning under competitive stress (Malán-Ernst et al., 2025).

However, although the Big Five framework includes domains related to interpersonal behavior, it does not explicitly represent a moral trait dimension capturing fairness, sincerity, and integrity. Ethical behavior and social responsibility are therefore indirectly reflected through combinations of Agreeableness and Conscientiousness rather than being conceptualized as a distinct dispositional tendency.

In response to cross-cultural and empirical evidence, Ashton and Lee (2007) proposed the HEXACO model, extending the traditional five-factor structure by introducing Honesty–Humility as a sixth dimension. This trait reflects sincerity, fairness, modesty, and resistance to exploitation. The HEXACO-PI-R framework (Lee & Ashton, 2004) therefore provides enhanced explanatory value in domains where moral behavior and interpersonal trust are essential.

Research consistently indicates that Honesty–Humility is associated with ethical decision-making, cooperation, rule compliance, and reduced antisocial tendencies (Lee et al., 2014; De Vries & Van Gelder, 2015; Veselka et al., 2012; Jonason & McCain, 2012). These characteristics are particularly relevant in elite sport environments characterized by intense competition, interdependence, and strong normative expectations.

Although the Big Five model remains the most widely used personality framework in sport psychology, several limitations have been identified in applied performance contexts (Allen & Laborde, 2014; Malán-Ernst et al., 2025). In particular, the absence of a distinct moral–ethical trait dimension restricts its capacity to capture integrity, fairness, and prosocial orientation, which are central to sustainable team functioning and athlete development (De Vries & Van Gelder, 2015).

By contrast, the HEXACO model incorporates Honesty–Humility as an independent dimension, allowing for more precise assessment of ethical behavior, cooperation, and interpersonal trust (Ashton & Lee, 2007; Lee et al., 2014). These characteristics are especially relevant in competitive sport environments, where moral decision-making, rule compliance, and social responsibility directly influence team climate and long-term performance outcomes.

Table 1 presents a comparative overview of the HEXACO and Big Five models with respect to their conceptual structure, cultural relevance, and applied value in elite sport settings.

Table 1. Comparison of the HEXACO-PI-R and Big Five models in cultural and sport contexts

Aspect	HEXACO model / HEXACO-PI-R	Big Five model
Number of dimensions	Six-factor model (includes Honesty–Humility)	Five-factor model
Core theoretical focus	Includes explicit moral/ethical trait domain (Honesty–Humility: sincerity, fairness, modesty)	Lacks a dedicated moral domain; morality-related variance is distributed mainly across Agreeableness/Conscientiousness
Moral and antisocial behavior	Honesty–Humility strongly predicts fairness, integrity, and lower exploitative behavior; differentiates prosocial vs. antisocial tendencies	Ethical behavior can be indirectly predicted via combinations of traits, but no distinct integrity dimension
Emotional domain	Emotionality reflects empathy, sentimentality, fearfulness, and stress sensitivity	Neuroticism (or Emotional Stability) reflects negative affectivity; empathy is not central
Cultural relevance	Trait structure derived cross-culturally; Honesty–Humility often relevant in contexts with strong norms of fairness and social obligation	Widely applied cross-culturally; some facets may show cultural differences in interpretation
Relevance to team sport functioning	Directly addresses traits linked to trust, sincerity, cooperation, and moral climate, potentially important for team cohesion	Useful for broad personality description but less specific to moral/team-ethics mechanisms

Applied sport psychology value	Supports interventions targeting ethical functioning, interpersonal climate, and trait-related regulation	Supports interventions targeting self-regulation, coping, confidence, motivation, and performance behavior
Evidence base	Growing research base for Honesty–Humility, moral behavior, and interpersonal functioning	Extensive evidence base across sport and performance psychology

Note. Adapted and synthesized by the authors based on McCrae and Costa (1987), Lee and Ashton (2004), Ashton and Lee (2007), Jonason and McCain (2012), De Vries and Van Gelder (2015), Veselka et al. (2012), and Lee et al. (2014).

As shown in Table 1, the inclusion of Honesty–Humility represents a major theoretical and practical advantage of the HEXACO framework for research focused on ethical functioning and group-based cooperation in sport. Moreover, the explicit differentiation of Emotionality from general negative affectivity allows for a more nuanced assessment of stress sensitivity and empathic engagement.

Taken together, these features provide strong justification for selecting the HEXACO-PI-R as the primary assessment instrument in the present study. This is particularly relevant in collectivist sport systems where moral norms, interpersonal trust, and group responsibility are strongly emphasized.

The assessment of personality traits requires careful consideration of cultural meaning and response patterns. Instruments developed in Western contexts may not fully capture culturally specific interpretations of moral behavior, interpersonal norms, or emotional expression. Cultural adaptation therefore aims to ensure linguistic, semantic, and conceptual equivalence while minimizing measurement bias, in accordance with established cross-cultural adaptation guidelines (Beaton et al., 2000; Van de Vijver & Tanzer, 2004).

In Azerbaijan, social norms emphasize collective responsibility, respect for authority, and maintenance of social harmony. In sport systems grounded in collectivist values, team cohesion and interpersonal trust constitute socially expected moral standards. Under such conditions, Honesty–Humility and Emotionality may play a particularly important role in shaping ethical behavior and emotional regulation.

Accordingly, culturally grounded psychological interventions in this context were designed to align with prevailing social norms, including collective goal orientation, respect for hierarchical relationships, and shared responsibility within sport teams. Training activities emphasized group-based reflection, cooperative problem-solving, culturally meaningful narratives, and value-oriented discussions aimed at reinforcing socially endorsed patterns of behavior.

Contemporary psychological models acknowledge that trait-related functioning can be influenced by repeated behavioral reinforcement and structured self-regulation practices. Psychological training programs in elite sport target cognitive–emotional regulation, stress tolerance, motivation, and interpersonal competence (Gould et al., 2002; Gould & Maynard, 2009). When such interventions are systematically structured and culturally congruent, they may contribute to adaptive changes in emotional responsiveness, moral self-regulation, and social functioning.

Within the HEXACO framework, Emotionality reflects empathic engagement and sensitivity to stress-related experiences, whereas Honesty–Humility captures integrity-based motivation and fairness orientation (Lee et al., 2014). These dimensions may be responsive to culturally grounded psychological training aimed at strengthening group identification and ethical responsibility.

Taken together, the HEXACO-PI-R provides a theoretically appropriate framework for examining personality-related determinants of psychosocial functioning in elite athletes. This is particularly relevant in cultural contexts where morality, cooperation, and group responsibility are strongly emphasized.

Building on this rationale, the present study examined whether a culturally adapted HEXACO-based psychological training program was associated with longitudinal changes in elite athletes' personality traits compared with a control group.

H1: Athletes in the experimental group will demonstrate greater increases over time in Emotionality and Honesty–Humility compared with athletes in the control group.

H2: The experimental group will exhibit increases in Extraversion and Openness to Experience relative to the control group, reflecting enhanced social engagement and cognitive flexibility.

In addition, exploratory analyses examined whether intervention effects differed between team and individual sport contexts.

Method

The Method section is organized as follows: Participants, Measures, Cultural adaptation and validation, Intervention program, Procedure, Observer ratings, and Data analysis.

Study Design

A longitudinal, three-wave randomized controlled trial was conducted over a 12-month period, with assessments at baseline (T1), 6 months (T2), and 12 months (T3). The psychological training program was implemented during the first 6 months of the study, followed by a 6-month follow-up period without active intervention. Accordingly, T2 reflected immediate post-intervention effects, whereas T3 assessed the stability and maintenance of changes over time.

Participants were randomly assigned to the experimental or control group using a computerized random number generator. Randomization was conducted after baseline assessment to ensure comparable groups prior to intervention.

The study aimed to examine whether a culturally adapted, HEXACO-informed psychological training program was associated with longitudinal changes in personality traits compared with a control condition.

Participants

A total of 100 elite athletes (50 men, 50 women; age range 18–35 years) participated in the intervention trial. Participants were recruited from six national sport disciplines through cooperation with sport federations and training centers.

This age range was selected because personality traits are considered relatively stable in early adulthood, while remaining amenable to intervention-related modification (Roberts, Walton, & Viechtbauer, 2006; Roberts et al., 2017). In addition, several HEXACO-PI-R items presuppose adult life experience (e.g., attitudes toward ethical dilemmas), which may be difficult to interpret reliably in younger respondents.

Eligibility criteria included: (a) active participation in national-level training programs, (b) age between 18 and 35 years, (c) absence of diagnosed psychiatric disorders, and (d) no prior participation in structured psychological training programs during the previous year.

After baseline assessment, participants were randomly allocated to the experimental group (n = 50) or the control group (n = 50). No significant baseline differences were observed between groups in age, gender distribution, sport type, or personality trait scores. The sample size was considered adequate for detecting medium effect sizes in repeated-measures designs, in accordance with statistical power recommendations for behavioural research (Cohen, 1988; Faul et al., 2009).

Validation Sample

An independent validation sample consisted of 250 elite athletes (N = 250; 132 men, 118 women; age range 18–35 years) recruited from national sport federations and training centers. This sample did not participate in the intervention trial and was used exclusively for psychometric analyses.

Separation of the validation and intervention samples ensured independence of instrument development and outcome evaluation.

Instrument

Personality traits were assessed using the 60-item HEXACO Personality Inventory–Revised (HEXACO-PI-R; Lee & Ashton, 2004), which measures six dimensions: Honesty–Humility, Emotionality, Extraversion, Agreeableness, Conscientiousness, and Openness to Experience.

Each dimension is represented by 10 items. Items were rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Example items include “I feel anxious when facing uncertainty”

(Emotionality) and "I avoid manipulating others for personal gain" (Honesty–Humility). Mean scores were computed for each factor, with higher values indicating greater expression of the corresponding trait.

Cultural Adaptation and Psychometric Validation

The Azerbaijani version of the HEXACO-PI-R was developed following established cross-cultural adaptation guidelines. Two bilingual experts independently translated the original English items into Azerbaijani. After reconciliation by an expert panel, a backward translation was conducted by an independent translator blind to the original instrument. Semantic, conceptual, and cultural equivalence were evaluated by sport psychologists and linguists. A pilot study (N = 50; 25 men and 25 women; age range: 18–35 years) was conducted to assess item clarity, comprehensibility, and cultural relevance. Based on participant feedback and expert review, minor wording refinements were introduced while preserving the original construct meanings. This process ensured linguistic accuracy and cultural appropriateness of the adapted instrument for use in Azerbaijani sport contexts.

Psychometric Validation

Psychometric validation was conducted using data from an independent validation sample (N = 250) that did not participate in the intervention trial. Confirmatory factor analysis (CFA) was performed in AMOS 26.0 using maximum likelihood estimation to examine the six-factor structure of the adapted HEXACO-PI-R. The use of CFA was justified a priori by the theoretically established six-factor structure of the HEXACO model.

The six-factor model demonstrated acceptable to good fit to the data: $\chi^2(894) = 2156.42$, $\chi^2/df = 2.41$, CFI = .92, TLI = .91, RMSEA = .058. These indices meet commonly accepted criteria for adequate model fit, indicating that the hypothesized HEXACO factor structure was satisfactorily replicated in the Azerbaijani sample. The validation sample size exceeded commonly recommended thresholds for confirmatory factor analysis (at least five participants per estimated parameter), supporting the stability and reliability of the factor solution.

Measurement invariance across time points was not formally tested due to sample size limitations and insufficient statistical power for multi-group structural equation modeling. Test–retest reliability was therefore not estimated separately and is addressed as a limitation of the present study.

Internal consistency reliability was satisfactory across all subscales, with Cronbach's alpha coefficients ranging from .72 to .83, indicating acceptable to good internal consistency and supporting the reliability of the adapted instrument (see Table 2).

Table 2. Internal Consistency Reliability of the Azerbaijani HEXACO-PI-R

Subscale	Items	Cronbach's α
Honesty–Humility	10	.81
Emotionality	10	.78
Extraversion	10	.83
Agreeableness	10	.75
Conscientiousness	10	.80
Openness to Experience	10	.77

Note. α ≥ .70 = acceptable; α ≥ .80 = good.

Convergent validity was examined using a multimethod approach. Moderate to strong positive correlations were observed between self-reported HEXACO traits and independent observer ratings of corresponding domains ($r = .61–.73$, $p < .01$), indicating satisfactory convergence.

Criterion-related validity could not be formally examined due to the absence of standardized Azerbaijani benchmarks, and is addressed as a limitation.

Inter-factor correlations derived from the CFA are presented in (Table 3) and were moderate in magnitude ($|r| \leq .42$), supporting discriminant validity.

Table 3. Latent Factor Correlations from Confirmatory Factor Analysis

	HH	E	X	A	C	O
Honesty–Humility	1	−.18	.12	.42	.29	.24
Emotionality		1	−.31	−.34	−.22	−.08
Extraversion			1	.26	.33	.28
Agreeableness				1	.38	.21
Conscientiousness					1	.35
Openness to Experience						1

Note. HH = Honesty–Humility; E = Emotionality; X = Extraversion; A = Agreeableness; C = Conscientiousness; O = Openness to Experience

Inter-factor correlations were moderate in magnitude ($|r| \leq .42$), suggesting that the six dimensions were related yet empirically distinguishable, thereby supporting the discriminant validity of the adapted scale.

Intervention Program

The psychological training program consisted of four integrated modules:

(1) Stress resilience and emotional regulation

(2) Team cohesion and interpersonal competence

(3) Self-development and self-regulation

(4) Cultural identity and moral functioning

The program comprised 24 group-based sessions delivered over a 6-month period (one session per week, approximately 90 minutes per session) by certified sport psychologists.

Each module was implemented through a standardized intervention protocol specifying session objectives, core activities, and learning outcomes. In addition to the core sessions, periodic support meetings and feedback discussions were organized to enhance participant engagement and program adherence.

Procedure

The intervention was implemented in federation facilities under standardized conditions and followed a manualized protocol. The program was designed as a form of culturally adapted training and incorporated culturally grounded motivational strategies, ensuring alignment with athletes' sociocultural context, shared moral values, and collective goal orientation

Sessions were based on evidence-based approaches in applied sport psychology and cognitive-behavioral intervention. The program incorporated mindfulness-based stress reduction, cognitive restructuring, self-talk modification, emotion management training, guided relaxation, reflective journaling, role-playing exercises, and structured group discussions.

Each session emphasized experiential learning through cooperative problem-solving tasks, simulated competitive scenarios, and feedback-based reflection. Participants were encouraged to apply acquired strategies during regular training and competition.

Training materials included structured manuals, worksheets, reflective diaries, and multimedia resources. Intervention fidelity was monitored through facilitator checklists and periodic supervision meetings to ensure consistency across groups.

In addition to group sessions, periodic feedback meetings and individual consultations were conducted to support skill consolidation and participant motivation.

Observer Ratings

Three independent observers with formal training in sport psychology participated in behavioral assessment. Prior to data collection, observers completed a standardized training program, including calibration sessions and joint rating exercises, to ensure consistent interpretation of behavioral criteria.

A structured behavioral observation protocol aligned with the six HEXACO domains was developed based on established sport psychology assessment frameworks and pilot-tested before the main study.

Observers rated athletes' behaviors during training sessions and competitive events using a 5-point Likert scale covering emotional regulation, cooperation, ethical conduct, self-discipline, and social engagement.

Inter-rater reliability was evaluated using Cohen's kappa coefficient. Agreement between observers was high at both assessment points ($\kappa = .85$ at T2; $\kappa = .83$ at T3), indicating strong consistency and supporting the reliability of observational data.

Observer ratings demonstrated significant correlations with self-report HEXACO scores ($r = .61–.73$, $p < .01$), providing additional evidence of convergent validity.

Qualitative methods

Semi-structured interviews, focus groups, and behavioral observations were conducted to contextualize intervention implementation and participant experiences. These qualitative data were used for descriptive triangulation and were not subjected to separate statistical analysis.

Data Analysis

Statistical analyses were conducted using SPSS version 28.0. Baseline equivalence between groups was examined using independent-samples t-tests.

Intervention effects were analyzed using 2 (Group: experimental vs. control) × 3 (Time: baseline, 6 months, 12 months) repeated-measures ANOVA, with Group × Time interactions serving as the primary indicators of differential change.

Assumptions of normality and homogeneity of variance were evaluated using Kolmogorov–Smirnov and Levene's tests. Mauchly's test of sphericity was examined, and Greenhouse–Geisser corrections were applied when necessary. Effect sizes were reported as Cohen's d and partial eta squared (ηp^2). Results are presented as means ± standard deviations, 95% confidence intervals, p-values, and effect sizes.

No substantial missing data were observed.

Exploratory moderation analyses were conducted using mixed-design ANOVA to examine whether sport type (team vs. individual) moderated intervention-related changes.

All statistical tests were two-tailed with $\alpha = .05$.

Ethical Considerations

The study was approved by an institutional research ethics committee. All participants provided written informed consent and were assured of confidentiality, voluntary participation, and the right to withdraw at any time.

Results

Results are presented as means ± standard deviations (M ± SD). HEXACO-PI-R personality traits were assessed at three time points: baseline (T1), midpoint (T2; 6 months), and post-intervention (T3; 12 months). Primary intervention effects were examined using a 2 (Group: experimental vs. control) × 3 (Time: T1, T2, T3) repeated-measures ANOVA, with Group × Time interactions serving as the main indicators of differential change between groups. Effect sizes are reported as partial eta squared (ηp^2).

Pre–post (T1 vs. T3) within-group comparisons were also conducted, and Cohen's d values are reported for descriptive purposes.

Assumptions of normality and homogeneity of variance were evaluated using Kolmogorov–Smirnov and Levene's tests and were generally satisfied.

Mean scores across the three assessment waves for each HEXACO dimension are presented in Table 4. At baseline, the experimental and control groups demonstrated comparable levels across all personality traits. Across subsequent waves, the experimental group showed modest increases in Emotionality, Honesty–Humility, Conscientiousness, Extraversion, and Openness to Experience, whereas the control group exhibited smaller and less consistent changes. Agreeableness remained relatively stable in both

groups. Considerable inter-individual variability was observed, particularly for Emotionality and Extraversion, indicating heterogeneous response patterns to the intervention.

Table 4. Means and Standard Deviations of HEXACO Traits Across Three Waves (T1, T2, T3)

Trait	Exp. T1 (M ± SD)	Exp. T2 (M ± SD)	Exp. T3 (M ± SD)	Ctrl. T1 (M ± SD)	Ctrl. T2 (M ± SD)	Ctrl. T3 (M ± SD)
Emotionality	28.3 ± 3.4	30.1 ± 4.2	31.2 ± 4.5	30.7 ± 4.9	31.4 ± 5.6	32.1 ± 6.2
Honesty–Humility	33.4 ± 5.9	34.9 ± 6.1	36.0 ± 6.2	35.8 ± 6.9	35.2 ± 6.8	34.7 ± 6.7
Conscientiousness	32.8 ± 7.4	34.1 ± 7.5	35.1 ± 7.6	35.8 ± 9.1	36.4 ± 8.9	37.2 ± 8.6
Agreeableness	34.3 ± 6.4	34.5 ± 6.0	34.8 ± 5.6	32.4 ± 8.3	33.4 ± 8.1	34.5 ± 8.2
Extraversion	34.3 ± 6.4	35.9 ± 6.2	37.2 ± 6.0	35.2 ± 4.7	35.2 ± 4.8	35.2 ± 4.7
Openness to Experience	34.7 ± 7.7	36.2 ± 6.8	37.1 ± 6.4	34.4 ± 8.7	36.1 ± 8.4	38.8 ± 8.1

Repeated-measures ANOVA results are summarized in Table 5. Significant main effects of Time were observed for Emotionality, Honesty–Humility, Conscientiousness, Extraversion, and Openness to Experience ($p = .002–.030$). No significant main effect of Time was found for Agreeableness ($p > .05$).

Significant Group × Time interactions were observed for Emotionality, Honesty–Humility, Conscientiousness, Extraversion, and Openness ($p = .006–.035$), indicating differential change trajectories between groups. Effect sizes were in the small-to-moderate range ($\eta p^2 = .07–.12$).

Table 5. Repeated-Measures ANOVA Results

Trait	F(Time)	p (Time)	F(Group × Time)	p (G×T)	ηp^2
Emotionality	12.4	.002	8.7	.006	.12
Honesty–Humility	7.8	.018	6.2	.024	.09
Conscientiousness	6.5	.025	5.4	.031	.08
Agreeableness	1.1	> .05	0.9	> .05	.01
Extraversion	10.1	.004	7.3	.009	.11
Openness to Experience	5.8	.030	4.9	.035	.07

Within-group pre–post comparisons for the experimental group are presented in Table 6. Statistically significant increases were observed for Emotionality, Honesty–Humility, Conscientiousness, Extraversion, and Openness ($p = .003–.030$). Agreeableness did not show a significant change.

Effect sizes were small to moderate in magnitude ($d = 0.35–0.75$) and should be interpreted cautiously in the context of repeated-measures designs.

Table 6. Pre–Post Comparisons in the Experimental Group (T1–T3)

Trait	T1 (M ± SD)	T3 (M ± SD)	d	95% CI (T3)	p
Emotionality	28.3 ± 3.4	31.2 ± 4.5	0.75	30.1–32.3	.003
Honesty–Humility	33.4 ± 5.9	36.0 ± 6.2	0.45	34.7–37.3	.018
Conscientiousness	32.8 ± 7.4	35.1 ± 7.6	0.35	33.3–36.9	.025
Agreeableness	34.3 ± 6.4	34.8 ± 5.6	0.07	33.8–35.7	>.05
Extraversion	34.3 ± 6.4	37.2 ± 6.0	0.50	35.6–38.8	.009
Openness to Experience	34.7 ± 7.7	37.1 ± 6.4	0.36	35.2–38.9	.030

In the control group (Table 7), no statistically significant pre–post changes were observed across HEXACO traits (all $p > .05$), indicating relative stability over the study period.

Although some effect size estimates in the control group appeared moderate (e.g., $d \approx 0.50–0.70$), these changes did not reach statistical significance and are likely attributable to limited statistical power, inter-individual variability, and random fluctuation rather than systematic intervention effects.

Table 7. Pre–Post Comparisons in the Control Group (T1–T3)

Trait	T1 (M ± SD)	T3 (M ± SD)	d	95% CI (T3)	p
Emotionality	30.7 ± 4.9	32.1 ± 6.2	0.67	32.6–37.6	>.05
Honesty–Humility	35.8 ± 6.9	34.7 ± 6.7	−0.16	33.0–36.3	>.05
Conscientiousness	35.8 ± 9.1	37.2 ± 8.6	0.14	34.5–39.8	>.05
Agreeableness	32.4 ± 8.3	34.5 ± 8.2	0.25	32.5–36.5	>.05

Extraversion	35.2 ± 4.7	35.2 ± 4.7	0.00	33.5–36.8	>.05
Openness to Experience	34.4 ± 8.7	38.8 ± 8.1	0.52	36.1–41.5	>.05

Exploratory analyses indicated that sport type moderated intervention-related changes for Emotionality and Extraversion (significant Group × Time × Sport Type interactions), whereas no other traits showed significant three-way interactions. These findings suggest limited and domain-specific moderation and should be interpreted with caution.

Overall, the psychological training program was associated with modest but statistically significant improvements in several HEXACO traits over time, primarily in the experimental group. However, inter-individual variability and contextual influences (e.g., participant expectations, trainer characteristics, institutional context, and repeated exposure) should be taken into account when interpreting these findings.

Discussion

The present study examined whether a culturally adapted, HEXACO-informed psychological training program was associated with longitudinal changes in trait-related functioning among elite Azerbaijani athletes. Repeated-measures analyses indicated modest but statistically significant Group × Time interactions for Emotionality, Honesty–Humility, Conscientiousness, Extraversion, and Openness to Experience over the 12-month period, whereas Agreeableness did not show meaningful change.

Consistent with Hypothesis 1, athletes in the intervention group demonstrated small-to-moderate increases in Emotionality and Honesty–Humility compared with controls, suggesting potential benefits for emotional coping and integrity-related interpersonal functioning. However, these effects should be interpreted cautiously, as repeated exposure, trainer influence, and participant expectations may have contributed to the observed changes (e.g., Hawthorne or demand characteristics).

In support of Hypothesis 2, modest increases in Extraversion and Openness were observed in the experimental group, potentially reflecting enhanced social engagement, communication under competitive pressure, and cognitive flexibility. Conscientiousness also showed slight improvement, consistent with the intervention's emphasis on structured self-development and goal-directed behavior. No significant change in Agreeableness may reflect the relative stability of long-term team socialization and prior sport experience, which are less sensitive to medium-term interventions.

A notable contribution of this study lies in the integration of culturally relevant content. Context-specific practices emphasizing collective responsibility, respect, and shared goals may have strengthened interpersonal trust and moral self-regulation within sport teams. Observed increases in Honesty–Humility and Emotionality may partly reflect alignment with culturally reinforced behavioral norms rather than broad personality restructuring. Future research should examine these cultural processes explicitly using mixed-method approaches.

These findings are consistent with recent applied research in competitive sport contexts, which has highlighted the role of psychological resources, resilience, and emotional regulation in athletic performance and adaptation (Brozovich-Neyra et al., 2024; Malán-Ernst et al., 2025). Similar to these studies, the present results suggest that structured psychological support may contribute to improved psychosocial functioning, particularly in relation to emotional coping and interpersonal engagement.

The results also align with previous research linking emotion-related traits to stress regulation and vulnerability (Sapolsky, 2004) and the role of Honesty–Humility in ethical functioning (De Vries & Van Gelder, 2015; Lee et al., 2014). In sport psychology, Extraversion and emotional regulation are associated with resilience and effective team functioning (Allen & Laborde, 2014). Overall, the findings suggest that trait-related patterns may be moderately responsive to structured, culturally adapted interventions, although these changes likely reflect expression of traits rather than deep structural personality change.

Limitations

Several limitations of the present study should be acknowledged. First, personality assessment relied primarily on self-report measures, which are susceptible to social desirability and impression management, particularly for morally salient traits such as Honesty–Humility. Although observer ratings were included, the scope of multi-method validation remains limited, and future research should incorporate additional behavioral and physiological indicators.

Second, the absence of an active or attention-matched control group limits causal inference, as non-specific factors such as increased researcher contact, participant expectations, and contextual influences cannot be fully ruled out. Future studies should incorporate alternative active control conditions to strengthen internal validity.

Third, effect sizes were generally small to moderate, suggesting that observed changes may reflect shifts in trait-related expression rather than deep structural personality change. Some differences may also be influenced by contextual compliance and social reinforcement processes.

Fourth, longer-term follow-up beyond the 12-month period is required to determine the stability and durability of the observed changes in personality-related functioning.

Fifth, psychometric validation did not include separate test–retest reliability estimates or formal longitudinal measurement invariance testing, primarily due to sample size limitations and insufficient statistical power for complex multi-group structural equation modeling. Future investigations with larger and more diverse samples are needed to address these methodological issues.

Finally, subgroup analyses by sport type were exploratory in nature and involved unequal sample sizes, which limits the generalizability of these findings. Replication studies conducted by independent research teams across different cultural and institutional settings are necessary to confirm the robustness of the present results.

Taken together, these limitations indicate that the observed effects should be interpreted cautiously and primarily as modest, context-sensitive changes in personality-related tendencies rather than robust, large-scale transformations.

Conclusions

This study represents one of the first attempts to examine longitudinal personality-related changes associated with a culturally adapted psychological training program in a post-Soviet elite sport context using a validated HEXACO framework and mixed-method design. By integrating independent psychometric validation, behavioral observation, and qualitative data with a randomized controlled intervention, the present research provides a carefully designed contribution to applied sport personality research.

The present study provides evidence that a culturally adapted, HEXACO-informed psychological training program may be associated with modest and gradual changes in personality-related functioning among elite Azerbaijani athletes. Specifically, longitudinal effects were observed for Emotionality, Honesty–Humility, Conscientiousness, Extraversion, and Openness to Experience, whereas Agreeableness remained relatively stable.

Rather than indicating large-scale personality transformation, the observed changes appear to reflect context-sensitive modifications in the expression of trait-related behaviors. These patterns are consistent with contemporary models suggesting that personality development in adulthood is shaped primarily through sustained self-regulation, social reinforcement, and repeated behavioral practice.

One important contribution of this study lies in the integration of a validated HEXACO framework with culturally grounded psychological training in a post-Soviet sport environment. By combining rigorous instrument adaptation with a longitudinal intervention design, the study adds to existing research on personality development in elite sport and underscores the relevance of moral and emotional traits for psychosocial functioning. These findings contribute to sport psychology by highlighting the potential value of culturally adapted personality-based psychological training for supporting athlete development and team functioning in elite sport contexts.

In practical terms, the findings suggest that structured psychological programs targeting emotional regulation, ethical awareness, and self-regulatory capacities may support athlete development beyond performance outcomes alone. Embedding culturally meaningful practices may further enhance engagement, interpersonal trust, and team cohesion in collectivist sport systems.

Nevertheless, the results should be interpreted in light of methodological limitations, including reliance on self-report measures, moderate effect sizes, and the absence of an active control condition. Accordingly, the findings primarily indicate gradual and context-dependent changes rather than robust personality restructuring.

Overall, this study contributes to a growing body of evidence suggesting that personality-related functioning in elite athletes may be responsive to systematically structured, empirically validated, and culturally responsive psychological interventions.

Practical Implications

Targeting Emotionality and Honesty–Humility may enhance emotional regulation, interpersonal trust, and ethical awareness in competitive sport environments.

Developing Extraversion- and Conscientiousness-related competencies may support leadership, communication, and self-regulation within teams.

Integrating culturally grounded practices can strengthen athlete engagement and group cohesion, particularly in collectivist sport systems.

Directions for Future Research

Replicate these findings using larger, multi-site samples and diverse competitive levels. Incorporate active or attention-matched control conditions and extended follow-up periods. Employ multi-method assessment approaches, including behavioral indicators, coach ratings, and performance metrics. Examine underlying mechanisms, such as stress physiology and neurocognitive regulation, to clarify how long-term psychological training influences personality-related functioning across cultural contexts.

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Conflict of Interest Statement

The authors declare no conflicts of interest. All financial or personal relationships that could be perceived as potential sources of bias have been disclosed.

Author Contribution Statement (CRediT)

Aynur Bunyatova: Conceptualization, Methodology, Investigation, Writing – Original Draft, Project Administration.

Lala Ahmadova: Data Curation, Formal Analysis, Visualization, Validation.

Arzu Suleymanova: Data Curation, Supervision, Writing – Review & Editing, Resources.

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Data Availability Statement

The datasets generated and analyzed during the current study are not publicly available due to confidentiality agreements with national sport federations. However, they are available from the corresponding author upon reasonable request.

Ethics Statement

This study was reviewed and approved by the Ethics Committee of the Azerbaijan Sports Academy (Protocol No. 03/2024, dated 20 June 2024). All procedures were conducted in accordance with the ethical standards of the 2013 Declaration of Helsinki and the institutional research guidelines of the Azerbaijan Sports Academy. All participants provided informed consent prior to participation and were assured of confidentiality, voluntary involvement, and the right to withdraw at any time without consequence.

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