Original Article

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Self-reported laterality, psychological characteristics, and technical certification in karate students: descriptive longitudinal pilot study

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Abstract: *Introduction:* Self-reported laterality-related psychological characteristics are commonly applied in sport and martial arts training, yet longitudinal evidence linking them to formal indicators of technical progression is limited. This descriptive longitudinal pilot study examined changes in laterality-related and selected emotional–cognitive attributes and explored their association with achieved technical certification in karate students enrolled in a specialized security training program. *Material and Methods:* Thirty-one students (22 males, 9 females; 20–26 years) completed the same standardized self-report questionnaire at program entry (September 2021) and completion (June 2024). Outcomes included laterality score (0–40), Positive Self-Awareness and Thinking (PSAT), Emotional Resilience (ER), Emotional Potential for Sport (EPS), and achieved kyu rank. Paired t-tests and chi-square tests were applied exploratorily, with effect sizes reported and questionnaire reliability interpreted descriptively. *Results:* Group-level laterality did not change significantly over time ($t(30)=0.92$, $p=0.364$, $d=0.17$). PSAT, ER, and EPS remained stable (all $p>0.05$; trivial effect sizes). A statistically significant association was observed between gender and achieved kyu rank ($\chi^2(2)=6.99$, $p=0.030$, Cramer's $V=0.34$), indicating a medium descriptive effect within this cohort. *Conclusions:* Across three years of structured karate training, self-reported laterality-related tendencies and emotional-cognitive characteristics remained largely stable, while technical certification outcomes differed by gender. Given the small sample size and exploratory design, findings should be interpreted descriptively. The results suggest that formal technical progression may not be systematically mirrored by changes in static self-reported psychological profiles.

Keywords: karate, laterality, self-report, sport psychology, emotional regulation, kyu rank

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INTRODUCTION

Laterality-related differences in cognitive, emotional, and sensorimotor processing have long been discussed in neuroscience, sport science, and martial arts research. In applied training contexts, laterality is commonly considered in relation to attentional style, emotional regulation, and motor coordination, particularly in combat sports that require rapid decision-making and bilateral motor execution. Karate training systematically emphasizes bilateral movement patterns, structured repetition, and progressive technical evaluation, making it a relevant context for examining laterality-related psychological characteristics. This bilateral execution requires precise kinematic coordination and neuromuscular control, as demonstrated in biomechanical analyses of karate techniques [1].

Contemporary neuroscience does not support the notion of stable "left-brain" or "right-brain" individuals. Large-scale neuroimaging studies and theoretical reviews demonstrate that hemispheric asymmetries are predominantly task-dependent and network-specific, rather than global personal traits that can be reliably inferred from questionnaire-based measures or easily modified through training alone [2-5]. Consequently, laterality assessments derived from self-report or personality instruments should be interpreted cautiously, as they reflect perceived cognitive–emotional tendencies rather than objective neurobiological hemispheric dominance [6,7]. Despite these limitations, such instruments remain widely used in applied sport and martial arts settings due to their accessibility and ease of administration. In sport and performance research, laterality has most frequently been examined through handedness, perceptual asymmetries, and interactive advantages in opponent-based sports. Functional dominance and symmetry in balance and motor performance have been shown to differ from self-reported laterality tendencies, suggesting that perceived cognitive–emotional profiles may not directly reflect objective motor asymmetries [8].

Evidence suggests that laterality-related effects are highly context-dependent and vary across sport disciplines and performance demands, particularly in combat and interactive sports [9-12]. Importantly, these findings do not imply stable hemispheric dominance but rather reflect adaptive perceptual–motor strategies shaped by training demands and competitive context [13]. Martial arts training has also been associated with a range of psychological and cognitive outcomes beyond physical skill acquisition, including attentional control, emotional regulation, and self-perception. Reviews and empirical studies suggest potential psychological benefits of martial arts practice; however, findings remain heterogeneous, and underlying mechanisms are often inferred indirectly rather than directly measured [14-16]. In applied sport and educational settings, particularly within university-based or security-force training programs, access to advanced neurocognitive assessment tools is often limited. As a result, self-report and psychometric instruments are frequently used to profile psychological characteristics, including laterality-related tendencies.

While these tools may offer practical insights for training evaluation and pedagogical decision-making, their interpretative scope is inherently descriptive and must be clearly distinguished from claims about neurobiological mechanisms [17,18]. In karate training, which emphasizes bilateral execution of techniques and coordinated movement patterns, laterality-related tendencies may therefore be more meaningfully expressed at the level of perceived attentional style, emotional regulation, and self-evaluated cognitive control rather than as indicators of true hemispheric dominance.

Despite growing interest in combat sport psychology, empirical studies that combine self-reported laterality-related characteristics, emotional–cognitive attributes, and formal indicators of training progression, such as technical certification, remain limited, particularly for longitudinal designs conducted in applied training contexts. Therefore, the aim of the present descriptive longitudinal pilot study was to descriptively examine longitudinal changes in self-reported laterality-related characteristics and selected emotional-cognitive attributes, and to explore their association with achieved technical certification (kyu rank) in karate students enrolled in a specialized security forces training program.

MATERIAL AND METHODS

Study Design

The study employed a descriptive longitudinal pilot design with repeated measurements. Data were collected at two time points: at entry into the study program (September 2021) and upon completion of the program (June 2024). The design aimed to describe longitudinal patterns and associations among self-reported laterality-related characteristics, selected emotional-cognitive attributes, and technical certification outcomes. The study was not designed to test causal effects of karate training or to infer neurobiological hemispheric dominance.

Participants

A total of 31 students (22 males, 9 females; aged 20–26 years) enrolled in a three-year bachelor's degree program in Special Physical Training for Security Forces participated in the study. All participants were actively engaged in mandatory karate training as part of the curriculum throughout the study period. Inclusion criteria comprised continuous enrollment in the program, completion of both baseline and follow-up assessments, and participation in standard karate training activities. Students who discontinued their studies or failed to complete either assessment were excluded from the analysis. No exclusion criteria related to handedness or prior karate experience were applied, to reflect the applied training context. The cohort size was determined by program enrollment and could not be expanded for research purposes.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Prešov University (Approval ID: ECUP032025PO; 14 February 2025). Written informed consent was obtained from all participants.

Measures

Self-Reported Laterality and Psychological Characteristics

Laterality-related characteristics and selected emotional–cognitive attributes were assessed using the Gurský Comprehensive Personality Evaluation Test, a psychometric battery commonly applied in sport psychology settings. In the present study, laterality was assessed indirectly via self-report and reflects perceived cognitive–emotional tendencies rather than objective hemispheric dominance. The laterality scale ranges from 0 to 40, with lower scores indicating a tendency toward analytically oriented, detail-focused processing, higher scores indicating more holistic and intuitive processing, and intermediate scores reflecting mixed profiles. These categories were used for descriptive purposes only. In addition to laterality, the

questionnaire includes subscales assessing Positive Self-Awareness and Thinking (PSAT), Emotional Resilience (ER), and Emotional Potential for Sport (EPS). These dimensions capture self-perceived emotional regulation, optimism, and psychological readiness in sport-related contexts. Internal consistency of questionnaire subscales at baseline (2021) was evaluated using Cronbach's alpha (N=31). Positive Self-Awareness and Thinking demonstrated acceptable reliability (α=0.726). Emotional Potential for Sport showed low reliability (α=0.415), and Emotional Resilience demonstrated very low internal consistency (α=0.194). Given that each subscale consisted of two items (k=2), alpha coefficients are interpreted cautiously and reported for descriptive transparency only. Due to the very low internal consistency of ER and EPS, these subscales were not interpreted as robust psychological constructs and their results are presented strictly descriptively.

Technical Certification

Technical performance was operationalized using the achieved kyu rank at the end of the study period, based on standardized criteria established by the Slovak Karate Association. Kyu rank represents formal technical certification and is commonly used as an indicator of training progression in karate. Certification assessment was conducted within the regular evaluation framework of the training program.

Data Collection Procedure

All assessments were administered online via institutional email accounts. Participants completed the questionnaire independently and without time constraints. The average completion time was approximately 60 minutes. Baseline and follow-up assessments were administered using identical procedures to ensure consistency across measurement points.

Statistical Analysis

Data were analyzed using TIBCO Statistica (v.14) and Microsoft Excel. Descriptive statistics (mean, standard deviation, and range) were calculated for all variables. Normality of continuous variables was assessed using Shapiro–Wilk tests and inspection of Q-Q plots. Homogeneity of variance was evaluated using Levene's test where applicable. Given the small sample size, both parametric (paired t-tests) and non-parametric alternatives (Wilcoxon signed-rank tests) were explored, yielding comparable results; therefore, parametric statistics are reported for consistency and interpretability. Paired t-tests were used to examine within-group changes between baseline and follow-up. Associations between categorical variables were assessed using chi-square tests. Effect sizes were calculated as Cohen's d for paired comparisons and Cramer's V for chi-square analyses. An a priori power analysis was not conducted because the cohort size was fixed by the educational program. Post hoc inspection indicates that the study was powered to detect only large within-subject effects (approximately $d \geq 0.8$), reinforcing the exploratory nature of the findings. Given the limited sample size and multiple exploratory comparisons, all statistically significant findings are interpreted cautiously and considered descriptive signals rather than confirmatory evidence. Statistical significance was set at $p < 0.05$.

RESULTS

Participant Characteristics

Participants were aged 20–24 years at baseline (2021) and 22–26 years at follow-up (2024). No inferential statistics were applied to age, as the observed change reflects cohort progression rather than an experimental effect.

Internal consistency

Internal consistency at baseline indicated acceptable reliability for PSAT (α=0.726), low reliability for EPS (α=0.415), and very low reliability for ER (α=0.194). Given the two-item (k=2) structure of the subscales, these estimates are interpreted cautiously. Descriptive statistics for self-reported laterality and emotional-cognitive variables at baseline (2021) and follow-up (2024) are presented in Table 1. At both time points, most participants were classified within the lower score range, corresponding to a left-oriented laterality profile, with a smaller proportion exhibiting mixed profiles. At the group level, no statistically significant difference in laterality scores was observed between baseline and follow-up $t(30) = 0.92$, $p = 0.364$, Cohen's $d = 0.17$. Mean laterality scores showed minimal change over time. This represents a trivial effect size.

Self-Reported Laterality by Gender

Among male participants, no statistical change in laterality scores was observed between baseline and follow-up $t(21)=0.75$, $p=0.460$, $d=0.16$. Among female participants, a statistically significant within-group change was observed $t(8)=2.67$, $p = 0.028$, $d=0.89$. Given the small female subgroup (n=9) and exploratory comparisons, this finding is reported strictly as a descriptive signal and should not be interpreted inferentially.

Emotional-Cognitive Characteristics

Across the total sample, no statistically significant differences were observed between baseline and follow-up scores for Positive Self-Awareness (PSAT), Emotional Resilience (ER), or Emotional Potential for Sport (EPS) (all $p > 0.05$). PSAT: $t(30)= -0.17$, $p=0.865$, $d=0.03$; ER: $t(30)= -0.29$, $p=0.777$, $d=0.05$; EPS: $t(30)=0.16$, $p=0.869$, $d=0.03$. All effect sizes were trivial.

Table 1. Longitudinal changes in self-reported laterality and emotional-cognitive variables

Variable	2021 Mean ± SD	2024 Mean ± SD	Cronbach's α (2021)	t (30)	p	Cohen's d
Laterality	18.58 ± 4.28	17.94 ± 3.97	—	0.92	0.364	0.17
PSAT	5.77 ± 1.23	5.81 ± 0.98	0.726	-0.17	0.865	0.03
ER	2.71 ± 0.94	2.81 ± 1.74	0.194	-0.29	0.777	0.05
EPS	3.06 ± 1.57	3.00 ± 1.95	0.415	0.16	0.869	0.03

PSAT= Positive Self-Awareness and Thinking; ER= Emotional Resilience; EPS= Emotional Potential for Sport. Cronbach's alpha values are reported for baseline assessment only (2021; N=31). Cohen's represents within-subject effect size for baseline-to-follow-up change

Table 2. Technical certification outcomes (kyu rank) by gender

Kyu rank	Males (n = 22)	Females (n = 9)	Statistics
3rd kyu	2 (9.1%)	4 (44.4%)	χ^2 (2) = 6.99
4th kyu	17 (77.3%)	4 (44.4%)	p = 0.03
5th kyu	3 (13.6%)	1 (11.1%)	V=0.34

Kyu rank represents achieved technical certification at follow-up (third year)

Technical Certification Outcomes

Technical certification outcomes at follow-up, expressed as achieved kyu rank, are summarized in Table 2. Most participants attained the expected 4th kyu level by program completion, while smaller numbers achieved higher (3rd kyu) or lower (5th kyu) certification. A chi-square test indicated a statistically significant association between gender and achieved kyu rank (χ^2 (2)= 6.99, p = 0.030, Cramer's V=0.34), corresponding to a medium descriptive effect size. Given small cell sizes, Fisher´s exact test was also conducted and yielded comparable results (two-tailed p=0.031), supporting the descriptive robustness of this association. Female participants more frequently attained the 3rd kyu level, whereas male participants most achieved the 4th kyu level. These findings describe distributional differences within the sample.

Distribution of Laterality Categories Over Time

The distribution of participants across laterality categories (left-oriented versus mixed profiles) at baseline and follow-up was examined descriptively. No participants were classified within the higher score range indicative of a right-oriented profile at either time point. McNemar tests did not indicate statistically significant shifts in category membership over time, either for the total sample or when analyzed by gender (all $p > 0.05$). Although individual-level changes were observed, these did not result in meaningful redistribution across laterality categories. These analyses further support the overall stability of laterality classifications across the study period.

DISCUSSION

The present study descriptively examined self-reported laterality-related characteristics, selected emotional–cognitive attributes, and technical certification outcomes in karate students enrolled in a specialized security forces training program. The main contribution of this study is the descriptive documentation of the stability of self-reported psychological profiles under conditions of three years of karate training, rather than testing causal relationships. The present study makes a primarily methodological and applied contribution. Methodologically, it demonstrates that static self-report measures of laterality-related and emotional-cognitive characteristics show limited sensitivity to learning-related change across three years of structured martial arts training. Applied, it highlights that formal technical progression (kyu certification) may diverge from self-perceived psychological profiles in real-world training contexts. Conceptually, the findings caution against simplified interpretations of laterality-based self-report instruments as indicators of training adaptation or performance development. Together, these results suggest that psychometric self-description alone provides an incomplete picture of skill acquisition in applied martial arts settings.

Across a three-year training period, self-reported laterality scores and emotional-cognitive characteristics remained largely stable, while a gender-related distributional difference was observed in achieved kyu rank. All findings should be interpreted within the descriptive scope of the study and the indirect nature of the assessment methods used. At the group level, no statistically significant longitudinal change was observed in self-reported laterality scores. This finding is consistent with contemporary perspectives in neuroscience and sport science indicating that hemispheric asymmetries are predominantly task- and network-specific rather than global personal traits that can be reliably captured by questionnaire-based

instruments or easily modified through training alone [2,4,5]. Because laterality in the present study was assessed indirectly via self-report, the observed stability likely reflects relatively enduring self-perceived cognitive–emotional tendencies rather than changes in neurobiological hemispheric dominance [6,7].

A statistically significant within-group change was observed among female participants; however, given the small size of this subgroup, this result is reported strictly as descriptive. Emotional-cognitive characteristics appeared stable over time; however, interpretation of ER and EPS findings is constrained by limited internal consistency. This pattern aligns with prior evidence indicating moderate temporal stability of self-reported psychological characteristics in young adulthood, particularly in the absence of targeted psychological interventions [19]. It is also possible that standard psychometric instruments lack sufficient sensitivity to detect subtle experiential or regulatory changes associated with long-term physical training [17,18]. A statistically significant association was observed between gender and achieved kyu rank, with female participants more likely to attain higher technical certification. Previous research in combat sports has reported sex-related differences in selected biomechanical and technical performance parameters, which may reflect sport-specific adaptations rather than dispositional psychological traits [20]. This finding should not be interpreted as evidence of inherent gender differences in learning capacity or performance potential, but rather as a distributional pattern within a small applied sample. Importantly, technical certification in karate represents an integrated evaluation of technical execution, learning engagement, and performance under assessment conditions and is influenced by multiple contextual and instructional factors [21,15].

From an applied perspective, this suggests that formal certification outcomes may diverge from self-reported psychological profiles, consistent with evidence that technical progression in combat sports depends more on learning processes and training quality than on isolated dispositional traits [10]. Taken together, the findings highlight limitations of relying solely on static self-report psychometric measures to capture learning-related change in applied martial arts training. Karate emphasizes bilateral execution, coordination, and adaptability, which may reduce the relevance of laterality-based self-perceptions as indicators of training progression [12]. Instead, skill acquisition is likely driven by process-level factors such as attentional engagement, task execution, and instructional context that are not directly captured by standard questionnaires [22,23].

In terms of practical implementation, these results suggest that educators and coaches in martial arts and security-force training programs should interpret self-reported laterality and psychological profiles cautiously and avoid using them as proxies for learning effectiveness or performance potential. While such instruments may provide useful descriptive information, technical progression appears to reflect broader learning-related and contextual factors. Integrative perspectives such as the Primed Interoceptive Processing (PIP) framework may offer useful directions for future hypothesis-driven research by emphasizing process-level regulation rather than static traits; however, this framework is introduced here strictly as an interpretative perspective and was not empirically tested in the present study.

Several limitations must be acknowledged. Internal consistency was low for two subscales, particularly Emotional Resilience, which limits interpretability of related findings and reinforces the descriptive framing of the study. The study relied on self-report measures and indirect assessment of laterality, included a small and gender-imbalanced sample, and lacked a comparison group. Also, the questionnaire time (60 minutes) may have contributed to respondent fatigue, potentially affecting response quality. Furthermore, previous karate experience was not controlled for,

reflecting the applied educational setting, and may have influenced individual learning trajectories. Statistical analyses were exploratory, increasing susceptibility to Type I error [24,25]. In addition, no objective measures of attentional state, neurocognitive function, or regulatory processes were included. Future research should integrate psychometric data with objective behavioral or physiological indicators to better characterize learning-related mechanisms in martial arts training.

CONCLUSION

This descriptive longitudinal pilot study examined self-reported laterality-related characteristics, selected emotional-cognitive attributes, and technical certification outcomes in karate students undergoing specialized security forces training. Across a three-year period, self-reported laterality and emotional-cognitive characteristics remained largely stable, suggesting that these questionnaire-based profiles reflect relatively enduring self-perceived tendencies rather than training-induced change. A gender-related distributional difference was observed in achieved kyu rank; however, this finding should be interpreted cautiously and does not imply causal or trait-based explanations. Overall, formal technical progression was not accompanied by systematic changes in self-reported psychological characteristics. These results indicate that skill development and certification outcomes in applied martial arts training may depend more on learning-related and contextual factors than on static psychometric profiles. Future research should integrate self-report assessments with objective behavioral, physiological, or performance-based measures to better characterize learning-related mechanisms in martial arts and applied training contexts.

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Ethical approval: The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Prešov University (Approval ID: ECUP032025PO; 14 February 2025). Written informed consent was obtained from all participants.

Data availability: The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

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