TAILORED EMOTION REGULATION STRATEGIES FOR YOUNG ATHLETES: Applying the IZOF Framework

ESTRATÉGIAS DE REGULAÇÃO EMOCIONAL PERSONALIZADAS PARA JOVENS ATLETAS: Aplicando a Estrutura IZOF

Daniela Wiethaeuper[1]
Francis Lapointe[2]

Abstract
This study examined the effectiveness of idiographically tailored emotion regulation interventions in adolescent tennis players, using the Individual Zones of Optimal Functioning (IZOF) model as a conceptual and methodological framework. Four male athletes aged 13 to 16, enrolled in a sport-études programme, participated in a three-phase protocol involving baseline assessment, intervention, and post-intervention follow-up during official competitions. Emotional and physiological profiles were assessed using idiographic scaling, psychometric instruments (TAS-20, ERQ, OMSAT-3), and self-evaluation measures. Results showed that participants who achieved greater emotional alignment with their IZOF-defined optimal zones reported improved self-perceived performance. However, interindividual variability emerged, particularly among those with elevated alexithymia scores. Although statistical effects were limited, descriptive and visual analyses suggested functional links between emotional congruence and competitive outcomes. The findings support the feasibility of IZOF-based interventions in youth sport and highlight the importance of personalisation, emotional awareness, and developmental factors in designing effective psychological strategies. Methodological limitations and directions for future research are discussed.
Keywords: Emotional Regulation; Adolescent; Athletes; Sports Psychology; Alexithymia; Self-Control; Tennis; Case Reports.

Resumo
Este estudo investigou a eficácia de intervenções de regulação emocional adaptadas de forma idiográfica em tenistas adolescentes, utilizando o modelo das Zonas Individuais de Funcionamento Ótimo (IZOF) como base conceitual e metodológica. Quatro atletas do sexo masculino, com idades entre 13 e 16 anos e matriculados em um programa *sport-études*, participaram de um protocolo de três fases: avaliação de linha de base, intervenção e seguimento pós-intervenção, conduzido durante competições oficiais. Os perfis emocionais e fisiológicos foram avaliados por meio de escalonamento idiográfico, instrumentos psicométricos (TAS-20, ERQ, OMSAT-3) e medidas de autoavaliação. Os resultados mostraram que os participantes que apresentaram maior alinhamento emocional com suas zonas ótimas definidas pelo modelo IZOF relataram melhor desempenho percebido. No entanto, foi observada

[1] PhD. Université du Québec à Trois-Rivières (UQTR), Département de psychologie. https://orcid.org/0000-0002-4787-7649; daniela.wiethaeuper@uqtr.ca
[2] PhD. Université du Québec à Trois-Rivières (UQTR), Département de psychologie. https://orcid.org/0000-0002-7638-4018; francis.lapointe@uqtr.ca

variabilidade interindividual, especialmente entre aqueles com escores elevados de alexitimia. Embora os efeitos estatísticos tenham sido limitados, análises descritivas e visuais sugeriram vínculos funcionais entre a congruência emocional e os resultados competitivos. Os achados apoiam a viabilidade de intervenções baseadas no modelo IZOF no esporte juvenil e destacam a importância da personalização, da consciência emocional e de fatores desenvolvimentais no planejamento de estratégias psicológicas eficazes. As limitações metodológicas e as direções para pesquisas futuras são discutidas.
Palavras-chave: Regulação Emocional; Adolescente; Atletas; Psicologia do Esporte; Alexitimia; Autocontrole; Tênis; Estudos de Casos.

1 INTRODUCTION

1.1 Emotion Regulation in Adolescent Athletes

Emotion regulation refers to how individuals manage the emotions they experience, their timing, and expression (Gross, 2014). In sport, emotional states can enhance or impair performance, depending on their intensity, valence, and task relevance (Robazza; Pellizzari; Hanin, 2004). Athletes regulate emotions for hedonic purposes - to feel better - and instrumental purposes - to improve performance, even by maintaining unpleasant emotions (Tamir, 2009; Tamir, Mitchell; Gross, 2008).

In adolescence, these regulatory abilities are still developing (Steinberg, 2005). Emotional awareness, differentiation, and flexibility are often limited, increasing the risk of dysregulation (Zeman *et al*., 2006). Traits such as perfectionism, reduced emotional insight, and low mental toughness can further impair emotion regulation (Kowalski; Crocker, 2001; Gucciardi; Gordon, 2009).

Alexithymia - difficulty identifying and describing emotions, often linked to externally oriented thinking - is another key factor (Bagby *et al.,* 1994). Among adolescents, high alexithymia correlates with increased anxiety (Karukivi *et al.,* 2010) and limited emotional flexibility (Luminet; Bagby; Taylor, 2021).

In individual sports like tennis, where there is no immediate team support, self-regulation becomes even more critical. Yet, few studies have investigated interventions adapted to the emotional profiles of young athletes, especially using idiographic approaches such as the Individual Zones of Optimal Functioning (IZOF; Hanin, 2000).

This gap underscores the need for research that not only describes emotional functioning but also tests personalized, evidence-based strategies aimed at enhancing self-regulation and performance outcomes.

1.2 The Individual Zones of Optimal Functioning (IZOF) Model

The IZOF model, developed by Yuri Hanin (1986, 1997, 2000), provides an idiographic framework to explain how emotional and physiological states affect athletic performance. Unlike categorical or dimensional models, it proposes that optimal performance depends on each athlete's unique "optimal zone" of emotional and physiological activation (Hanin; Syrjä, 1995a, 1995b).

A key feature of the model is its bidirectional nature: emotions influence performance, and competitive outcomes shape emotional experiences (Spielberger, 2004; Pellizzari *et al*., 2011). Key factors include emotional intensity, hedonic tone, functionality (helpful or harmful), and emotional content (Ruiz; Robazza, 2021).

Empirical studies show that IZOF-based interventions improve emotional regulation (Woodcock *et al*., 2012), psychobiological state control (Bertollo *et al*., 2015), and performance outcomes (Cohen *et al*., 2006; Robazza, Pellizzari *et al.,* 2004). Techniques such as self-talk (Hardy *et al*., 2005), imagery (Weinberg, 2008), goal setting (Cotterill, 2010), and pre-performance routines are commonly used.

Recent research highlights the value of combining IZOF approaches with monitoring tools like biofeedback and broader psychological skills training, particularly in adolescent athletes (Di Fronso *et al*., 2020; Ruiz *et al.,* 2021). These strategies respect emotional individuality and help athletes develop effective, self-sustaining regulation in high-pressure settings.

1.3 Objectives of the Present Study

Grounded in the theoretical framework presented above, this study aimed to assess the effectiveness of personalised emotion regulation interventions in adolescent tennis players, using the IZOF model as both a conceptual and methodological foundation (Hanin, 2000). The investigation focused on identifying each athlete's emotional and physiological profiles linked to optimal performance, evaluating the effects of individualised strategies on the intensity of emotional and

physiological states, emotion regulation skills, and self-perceived performance. Additionally, the study explored whether proximity to the optimal functioning zone - both before and during competition - was associated with enhanced outcomes.

Finally, the potential moderating role of alexithymia in the relationship between intervention results and regulation efficacy was examined. Through these objectives, the research sought to offer an idiographic and developmentally sensitive contribution to applied sport psychology. The following section outlines the participants and methodological procedures adopted.

2 METHOD

2.1 Participants

Four adolescent male tennis players aged between 13 and 16 took part in the study. All were enrolled in a *sport-études* programme in the Mauricie region of Québec, Canada, combining academic education with high-performance tennis training. Each participant had between five and eight years of competitive experience (M = 6.25 years) and trained regularly. Informed assent and parental consent were obtained in accordance with ethical guidelines for research involving minors.

Baseline assessments were conducted to characterise emotional and physiological predispositions relevant to the study's aims. The Toronto Alexithymia Scale (TAS-20; Bagby; Parker; Taylor, 1994) was administered, with results indicating that three participants scored in the elevated range for alexithymia, while one scored in the low range. These results are summarised in Table 1.

Table 1 - Participant Characteristics

Participant	Age	Training (hrs/week)	Competitive Experience (years)	TAS-20 Score	Alexithymia Category
1	14	12	5	64	High
2	16	15	8	67	High
3	13	10	5	69	High
4	15	13	7	50	Low

Note. TAS-20 = Toronto Alexithymia Scale (Bagby; Parker; Taylor, 1994). All participants were enrolled in a sport-études program combining academic education and intensive tennis training. Alexithymia categories follow standard cutoffs: scores ≥ 61 = High, 52–60 = Borderline, ≤ 51 = Low. Data refer to pre-intervention assessment.

Source: Prepared by the authors, 2025

2.2 Research Design

A multiple single-case (A–B) design was used to examine the effects of personalised emotion regulation interventions on emotional intensity, physiological states, emotion regulation skills, and performance in adolescent tennis players. Phase A consisted of a baseline period, during which emotional and physiological states were assessed without intervention, while Phase B involved the application of individualised strategies based on each athlete's specific emotional and physiological profile. This design was selected for its ability to accommodate individual variability and provide idiographic insight into psychological processes, particularly relevant in applied sport psychology settings where personal emotional responses are critical (Barker; McCarthy; Jones; Moran, 2011).

A recent systematic review reinforced the relevance of this approach for tracking nuanced psychological and performance adaptations in athletes over time (Barker; McCarthy; Jones; Moran, 2013). Emotional and physiological assessments were conducted before and after competitions in both phases, enabling detailed within-subject comparisons. Interventions were selected and applied individually, based on each athlete's emotional profile, physiological indicators, and mental skills assessment, in line with the idiographic principles of the IZOF framework.

2.3 Measures

Five instruments were used to assess emotional, physiological, and psychological variables. First, the French version of the Idiographic Scaling (Hanin, 2000; Lapointe, 2019) identified emotional and physiological states linked to both optimal and suboptimal performances. Participants selected up to five descriptors from a list of 71 emotional and 45 physiological terms, rating each on a modified Borg CR-10 scale (0 = “nothing at all” to 11 = “as intense as possible”) (Borg, 1998). The French adaptation followed rigorous translation and back-translation procedures (Lapointe, 2019).

Second, the Toronto Alexithymia Scale (TAS-20; Bagby; Parker; Taylor, 1994), adapted to Québec French by Lapointe and Wiethaeuper (2021), assessed difficulties in identifying and describing feelings. The instrument includes 20 items across three dimensions, rated on a 5-point Likert scale. The French version confirmed the original three-factor structure ($\chi^2(156) = 229.46$, $p < .001$; $\chi^2/df = 1.47$; SRMR = .06; RMSEA = .05; TLI = .91; CFI = .93), with good internal consistency ($\alpha = .83$ total; subscales ranging from .51 to .84).

Third, mental skills were evaluated using the Ottawa Mental Skills Assessment Tool (OMSAT-3; Durand-Bush; Salmela; Green-Demers, 2001). This tool includes 12 subscales across three domains - Basic (e.g., goal setting, commitment), Psychosomatic (e.g., relaxation, fear control), and Cognitive (e.g., concentration, imagery) - rated on a 7-point Likert scale. Psychometric indicators for the French version were satisfactory ($\chi^2(1014) = 1839.63$, $p < .001$; RMSEA = .05; GFI = .81; CFI = .87; TLI = .88), with alpha values from .68 to .88 and an average of .78.

Fourth, the Emotion Regulation Questionnaire (ERQ; Gross; John, 2003), validated in French by Christophe, Antoine, Leroy, and Delelis (2009), was used to assess two strategies: Cognitive Reappraisal and Expressive Suppression. It comprises 10 items rated on a 7-point Likert scale. The two-factor structure was supported ($\chi^2(35) = 189.97$, $p < .001$; CFI = .90; NNFI = .87; SRMR = .07), with internal consistency of $\alpha = .76$ and .72, respectively. Lastly, subjective performance was assessed through an ad hoc self-report scale developed for this study (Lapointe; Wiethaeuper, 2019). Athletes were asked to rate their performance within 24 hours after each match on an 11-point Likert scale, ranging from 1 (“worst performance”) to 11 (“best performance”), offering a personal indicator of perceived performance quality.

2.4 Procedure

The study followed a structured three-phase protocol over a six-week period, including a baseline assessment, an intervention phase, and a post-intervention follow-up. Each participant played three official tennis matches, ensuring ecologically valid data collection. In the baseline phase (first match), no intervention was applied. Athletes completed the Emotion and Performance Self-Rating Scales and the Physiological Self-Assessment Checklist before and during the match, as well as the Subjective Performance Evaluation immediately after, to establish emotional and physiological profiles under real competition conditions.

In the second phase (intervention), each athlete received a personalised regulation strategy plan derived from their IZOF profile (Hanin, 2000; Ruiz; Robazza, 2021). Strategies were selected in collaboration with each participant and included imagery, self-talk, breathing regulation, and short pre-performance routines (Vealey; Greenleaf, 2010). These were implemented before and during the second match, with the same assessments repeated to evaluate immediate effects.

The third phase (post-intervention) assessed retention and autonomous use of the strategies without further guidance. Athletes were encouraged to apply their techniques independently, and emotional, physiological, and performance variables were re-evaluated using the same instruments. All sessions were supervised by a trained sport psychology researcher. Between phases, participants received brief individualised feedback on emotional profiles and strategy use. Adjustments to interventions were based on performance and feedback, promoting engagement and ensuring protocol fidelity. The procedure was designed to combine methodological control with ecological validity, reflecting the personal and dynamic nature of adolescent competitive sport (Hardy; Gammage; Hall, 2001; Hanin, 2000).

2.5 Intervention Design

The intervention phase was grounded in an idiographic framework based on the Individual Zones of Optimal Functioning (IZOF) model (Hanin, 2000), which emphasises the emotional and psychophysiological uniqueness of each athlete. Following the baseline assessment, participants took part in a semi-structured interview to identify the emotions, physiological states, and behaviours linked to both

their best and worst performances. This mapping informed the creation of a personalised intervention plan aligned with each athlete's IZOF profile.

Intervention strategies were selected collaboratively between the researcher and the athlete to ensure personal relevance and adherence to best practices in sport psychology. Three main techniques were implemented. First, **self-talk** involved the development of brief, individualised verbal cues to boost motivation, sustain focus, or regulate emotional responses during competition (Hardy; Gammage; Hall, 2001).

Second, **imagery** exercises required athletes to mentally rehearse optimal performance scenarios that incorporated both motor actions and the associated emotional states, aiming to enhance regulation and performance stability (Weinberg, 2008). Third, **pre-performance routines** consisted of structured, individual sequences of cognitive and behavioural strategies designed to increase emotional consistency and readiness before matches (Cotterill, 2010).

Each athlete received a one-on-one orientation session on the day prior to the intervention match, allowing them to clarify and rehearse the strategies. During the match, they applied the selected techniques independently, with the researcher offering support only when explicitly requested. The intervention was designed to balance methodological rigour with ecological validity by integrating individual emotional profiling and empirically supported regulation strategies. This approach aimed to promote autonomy, strengthen emotional self-regulation, and support the development of optimal performance in real competitive settings.

2.6 Data Analysis

Given the idiographic and exploratory nature of the study, a mixed-method analytical approach was adopted in line with the personalised framework of the Individual Zones of Optimal Functioning (IZOF) model (Hanin, 2000). For each participant, visual analyses of individual graphs were conducted to track changes in emotional intensity, perceived physiological activation, and self-rated performance across the three phases - baseline, intervention, and post-intervention. This method allowed the identification of intra-individual trends, immediate intervention effects, and retention of emotional regulation strategies over time (Kazdin, 2019; Kinugasa; Cerin; Hooper, 2004).

To complement visual inspection, non-parametric statistical analyses were used given the small sample size and ordinal nature of the data. Wilcoxon signed-rank tests compared emotional, physiological, and performance scores between the baseline and intervention phases. Spearman's rank-order correlations explored the associations between the proximity to each athlete's optimal emotional zone - both pre- and intra-competition - and self-perceived performance ratings. Descriptive analyses of alexithymia scores were also conducted to contextualise emotional awareness profiles and examine their potential moderating effects on intervention responsiveness.

In addition, a cross-case qualitative synthesis identified emerging patterns in emotional self-regulation, adherence to intervention strategies, and subjective match experiences. This multimethod approach was designed to ensure both methodological rigour and ecological validity while remaining aligned with the idiographic nature of the study. Across the four participants, substantial variability was observed in the intensity of emotional and physiological states between baseline and intervention. Visual analyses, consistent with idiographic principles (Kazdin, 2019), revealed that while some athletes moved closer to their individually defined optimal emotional zones (Hanin, 2000), others remained outside those ranges despite applying the regulatory strategies.

3 RESULTS

3.1 Identification of Emotional and Physiological Profiles Related to Performance Outcomes

To address the first objective, each athlete's emotional and physiological profiles were identified in relation to their best and worst competitive performances, based on the Idiographic Scaling procedure and the emotional and physiological assessment tools used in the study. Descriptive analyses indicated that, before competition, optimal performances were most often associated with feelings of confidence, calmness, and enthusiasm. Favourable physiological states included sensations of physical energy, regular breathing, and slight muscular tension.

During competition, athletes linked their best performances to emotions such as concentration, perseverance, and serenity, accompanied by physiological sensations of effective motor coordination and a strong sense of physical control. In contrast,

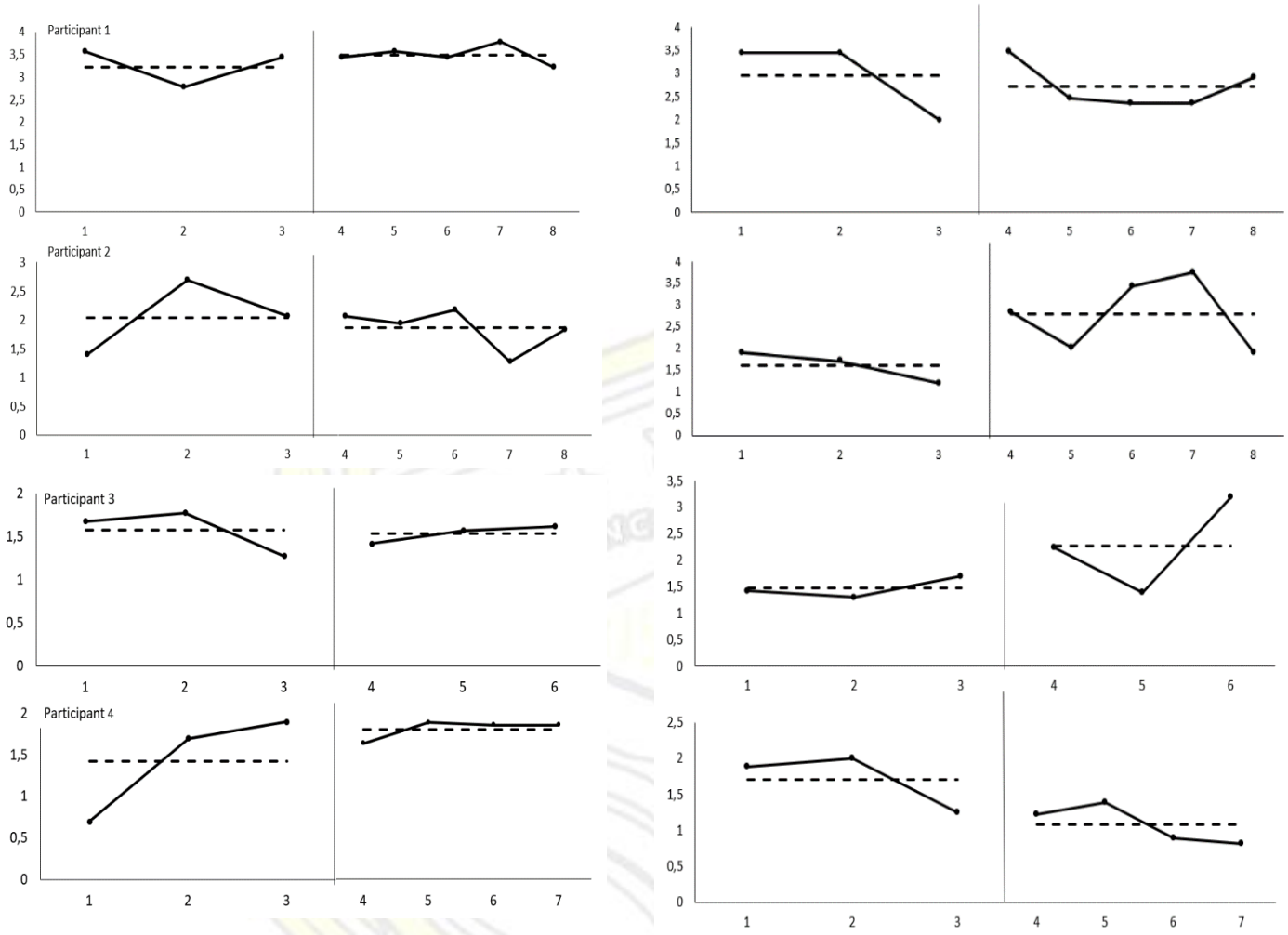
suboptimal performances were generally linked to anxiety, irritation, and mental confusion, as well as physiological markers like fatigue, excessive muscular tension, and irregular breathing. These individualised profiles, derived from pre- and intra-competition assessments, served as the basis for designing the personalised intervention strategies in line with the principles of the IZOF model (Hanin, 2000).

3.2 Effects of the Personalized Intervention on Emotional, Physiological, and Performance Variables

To address the second objective, the effects of the personalised intervention strategies on athletes' emotional states, physiological states, and self-perceived performance were evaluated through visual inspection and non-parametric statistical analyses. Visual analyses showed that, after the intervention, athletes tended to align more closely with their individually defined optimal emotional and physiological zones.

These trends were particularly evident in the reduction of harmful emotional states and the enhancement of perceived physical readiness during competition. Improvements were observed both in emotional quality and in physiological indicators such as breathing, muscle tension, and energy levels. These changes are illustrated in **Figures 1 and 2**, which present differences in pre- and intra-competition emotional and physiological states between the baseline and intervention phases. The values represent group means, comparing the intensities of helpful and harmful states across conditions.

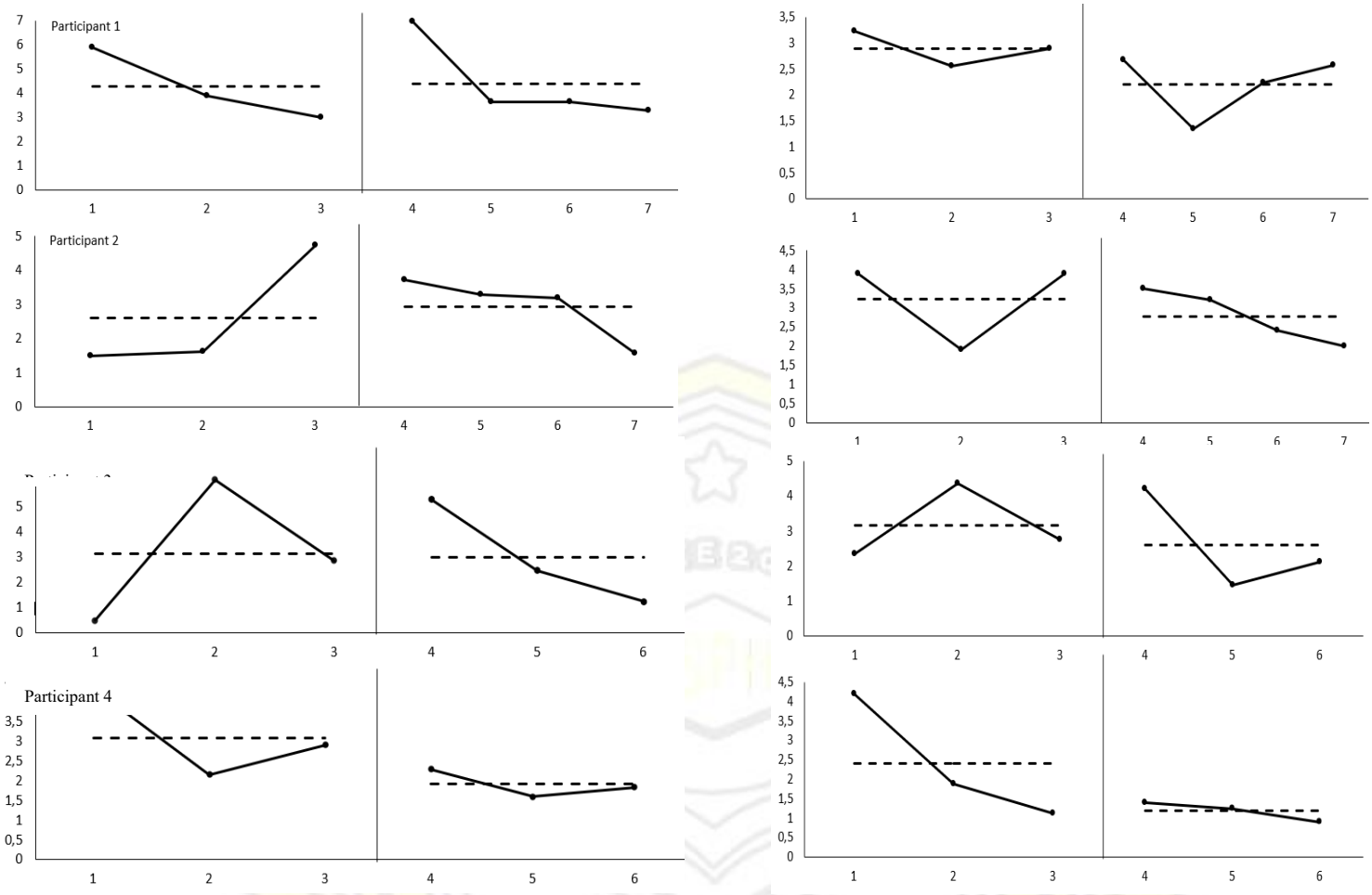
Figure 1 - Changes in Pre-Competition Emotional and Physiological States Between Baseline and Intervention Phases



Note. Changes in participants' reported intensities of helping and harmful emotional and physiological states before competition, comparing baseline and intervention phases. Values represent group means.

Source: Prepared by the authors, 2025

Figure 2 - Changes in Intra-Competition Emotional and Physiological States Between Baseline and Intervention Phases



Note. Changes in participants' reported intensities of helping and harmful emotional and physiological states during competition, comparing baseline and intervention phases. Values represent group means.Wilcoxon signed-rank tests were conducted to statistically compare pre- and intra-competition emotional and physiological states across the baseline and intervention phases. Significant improvements were observed for: Helping pre-competition emotions ($z = -1.92$, $p < .05$); Harmful intra-competition physiological states ($z = 2.10$, $p < .01$); All intra-competition physiological states combined ($z = 2.52$, $p < .05$); The detailed statistics are presented in Table 2.

Source: Prepared by the authors, 2025

Table 2 - Difference in average intensity of emotions and physiological states between baseline and interventions

Categories	Baseline M (SD)	Intervention M (SD)	*z-value*	*p*
Pre-competition Emotions				
Helping	5,4 (2,5)	4,7 (1,7)	-1,92	*
Harmful	1,4 (1,2)	1,6 (1,0)	-0,77	n.s.
All	3,5 (2,8)	3,2 (2,1)	-1,29	n.s.
Intra-Competition Physiological States				
Helping	4,4 (1,9)	4,5 (1,4)	-0,05	n.s.
Harmful	1,7 (2,3)	2,3 (1,8)	-1,30	n.s.
All	3 (2,5)	3,3 (1,9)	-1,15	n.s.
Intra-Competition Emotions				
Helping	4,6 (1,8)	3,9 (1,1)	-1,49	n.s.
Harmful	3,6 (1,5)	2,9 (1,3)	-0,92	n.s.
All	4,1 (1,7)	3,4 (1,3)	-1,85	n.s.
Intra-Competition Physiological States				
Helping	5,0 (1,9)	4,3 (1,1)	-1,50	n.s.
Harmful	3,2 (2,8)	2,2 (1,8)	-2,10	*
All	4,1	3,2	-2,52	**

Note. Baseline M represent means and standard deviations. Intervention M represent means and standard deviations Negative *z*-values indicate decreases in intensity from baseline to intervention phases. Wilcoxon signed-rank tests were used. *p ≤ 0,05. ** p ≤ 0,01

Source: Prepared by the authors, 2025

Regarding **self-perceived performance**, although visual trends suggested improvements for three out of four participants during the intervention phase, Wilcoxon tests did not indicate a statistically significant overall difference (z = -1.60, p > .05). Individual variability was evident, as highlighted in Table 3.

Table 3 - Individual Results for Emotion Regulation Strategies and Self-Perceived Performance Across Baseline and Intervention Phases

	Baseline Phase	Intervention Phase
Participant 1		
Expressive Suppression	9	9
Cognitive Reappraisal	15	25
Self-Perceived Performance	7,3	5,5
Participant 2		
Expressive Suppression	16	14
Cognitive Reappraisal	27	26
Self-Perceived Performance	6,7	5,5
Participant 3		
Expressive Suppression	15	--[a]
Cognitive Reappraisal	29	--[a]
Self-Perceived Performance	4,0	4,0
Participant 4		
Expressive Suppression	13	14
Cognitive Reappraisal	28	26
Self-Perceived Performance	6,3	6,0

Note. Expressive Suppression and Cognitive Reappraisal scores were obtained from the Emotion Regulation Questionnaire (ERQ). Self-Perceived Performance scores represent athletes' subjective ratings after competition. [a] = Missing data.

Source: Prepared by the authors, 2025

Spearman's rank-order correlations were also calculated to examine the association between proximity to each athlete's optimal functioning zone and their self-perceived performance ratings. These analyses indicated positive relationships, suggesting that the closer athletes remained to their optimal emotional profiles during competition, the better they rated their own performances. Detailed correlation coefficients are shown in Table 4.

Table 4 - Spearman's Rank-Order Correlations Between Emotional Zone Proximity and Self-Perceived Performance

Pre-Competition Emotions			Pre-Competition Physiological States			Intra-Competition Emotions			Intra-Competition Physiological States		
Har	Hel	All	Har	Hel	All	Har	Hel	All	Har	Hel	All
0,15	0,04	0,27	0,02	**-0,37**	**-0,29**	**-0,30**	**-0,81***	**-0,58**	**-0,30**	**-0,34**	**-0,37**
0,11	**-0,62**	**-0,26**	**-0,28**	**-0,30**	**-0,16**	**-0,64**	**-0,78***	**-0,61**	0,36	**-0,82***	**-0,52**
0,70	**-0,19**	0,40	0,15	0,46	0,15	**-0,76**	**-0,82***	**-0,94****	**-0,70**	**-0,21**	**0,70**
0,75	**-0,03**	0,81*	**-0,49**	0,14	**-0,23**	**-0,12**	0,06	**-0,12**	**-0,37**	**-0,71**	**-0,67**

Note. Spearman's rank-order correlations between proximity to athletes' individualized optimal emotional and physiological zones and their self-perceived performance ratings. Correlations in the expected direction (positive correlations for helping states and negative correlations for harmful states) are shown in bold. Har = Harmful; Hel = Helping; "All" refers to the combination of harmful and helping emotions or physiological states. P1 = Participant 1; P2 = Participant 2; P3 = Participant 3; P4 = Participant 4. $p \leq .05$ (*); $p < .01$ (**).

Source: Prepared by the authors, 2025

In summary, the combined visual and quantitative analyses provided evidence supporting the positive impact of personalized intervention strategies on the emotional and physiological regulation of young athletes, while effects on perceived performance showed individual variability. Overall, the results partially support the second objective by demonstrating significant improvements in certain emotional and physiological states, while changes in emotion regulation skills and self-perceived performance were more variable and did not reach statistical significance.

3.3 Self-Perceived Performance

Self-perceived performance ratings, collected after each match using a 10-point Likert scale, showed small but meaningful improvements for two of the four participants during the intervention phase. Participant 1 reported a three-point increase in self-rated performance compared to baseline, which coincided with greater emotional alignment with his IZOF-defined optimal zone. Participant 4 also reported modest improvement and expressed feeling “more prepared and focused” as a result of applying the intervention strategies.

In contrast, Participant 2 reported no change in perceived performance, reflecting difficulties engaging with the techniques. Participant 3, despite reporting increased emotional awareness, showed a slight decline in self-assessed performance, suggesting that subjective evaluations may also be shaped by contextual or technical aspects of the match.

Statistical analysis using the Wilcoxon signed-rank test revealed no significant differences in performance ratings between the baseline and intervention phases across the sample ($p > .05$). Nonetheless, idiographic profiles highlight the value of individualised assessment approaches (Hanin, 2000), as subtle yet relevant changes emerged at the individual level. Athletes who more closely approached their IZOF profiles tended to report improved performance, reinforcing the potential of personalised emotional regulation strategies in youth sport (Ruiz; Robazza, 2021). Although global statistical effects were not observed, individual trajectories emphasised the role of tailored interventions in supporting perceived performance in adolescent athletes.

3.4 Proximity to Optimal Zones

An analysis of the proximity between athletes’ reported emotional and physiological states and their individual IZOF profiles was carried out for both pre-competition and in-competition phases, with the aim of exploring whether greater alignment with the optimal zone would predict enhanced self-perceived performance. During the intervention phase, Participants 1 and 4 showed clear convergence with their IZOF-defined profiles, both before and during matches. Participant 1 exhibited strong emotional and physiological alignment with his optimal zone, corresponding with

notable improvement in subjective performance ratings. Participant 4 also demonstrated partial emotional convergence and reported more favourable evaluations of his match performance.

In contrast, Participants 2 and 3 displayed limited or inconsistent proximity to their IZOF zones. Participant 2 remained outside his optimal emotional and physiological range, which aligned with unchanged performance ratings. Although Participant 3 reported increased emotional self-awareness, physiological fluctuations and irregular proximity to his optimal zone were noted, which may have influenced his perceived performance.

Spearman's rank-order correlations revealed a positive but non-significant association between proximity to the optimal zone and self-perceived performance ($p > .05$). Nonetheless, visual and descriptive patterns indicated that athletes who more closely matched their IZOF profiles tended to report more adaptive and satisfying competitive outcomes. These findings reinforce the importance of idiographic emotional profiling (Hanin, 2000), suggesting that proximity to an athlete's IZOF-defined optimal zone may serve as a meaningful - though not exclusively statistical - indicator of perceived performance. In dynamic and complex sport environments, emotional calibration on a personal level may therefore represent a valuable focus for psychological interventions.

3.5 Alexithymia and Emotion Regulation

Alexithymia scores revealed marked variability across participants. Three out of four athletes scored in the elevated or borderline ranges on the TAS-20, indicating significant difficulty in identifying and describing emotional experiences. Participant 2, who consistently reported low self-perceived performance and limited emotional alignment with his IZOF profile, recorded the highest alexithymia score.

In contrast, Participant 1 - who demonstrated strong convergence with his optimal emotional and physiological zones, as well as improved perceived performance - showed the lowest alexithymia level among the group. Participant 3 reported increased emotional awareness during the intervention but continued to struggle with labelling emotional states, which was reflected in a moderately elevated TAS-20 score.

No statistically significant association was found between alexithymia levels and changes in emotion regulation or perceived performance ($p > .05$). However, descriptive patterns suggest that higher alexithymia may hinder the effective use of self-regulatory strategies, particularly those requiring introspective skills such as cognitive reappraisal and imagery. These findings align with previous research indicating that alexithymia can obstruct emotional clarity and flexibility in emotion regulation processes (Luminet; Bagby; Taylor, 2021). Within the adolescent sport context, elevated alexithymia may reduce the impact of IZOF-based interventions unless additional emotional literacy support is provided.

Table 5 presents a summary of emotional, physiological, and performance measures by participant and phase. Figures 3 and 4 offer visual representations that complement the descriptive findings.

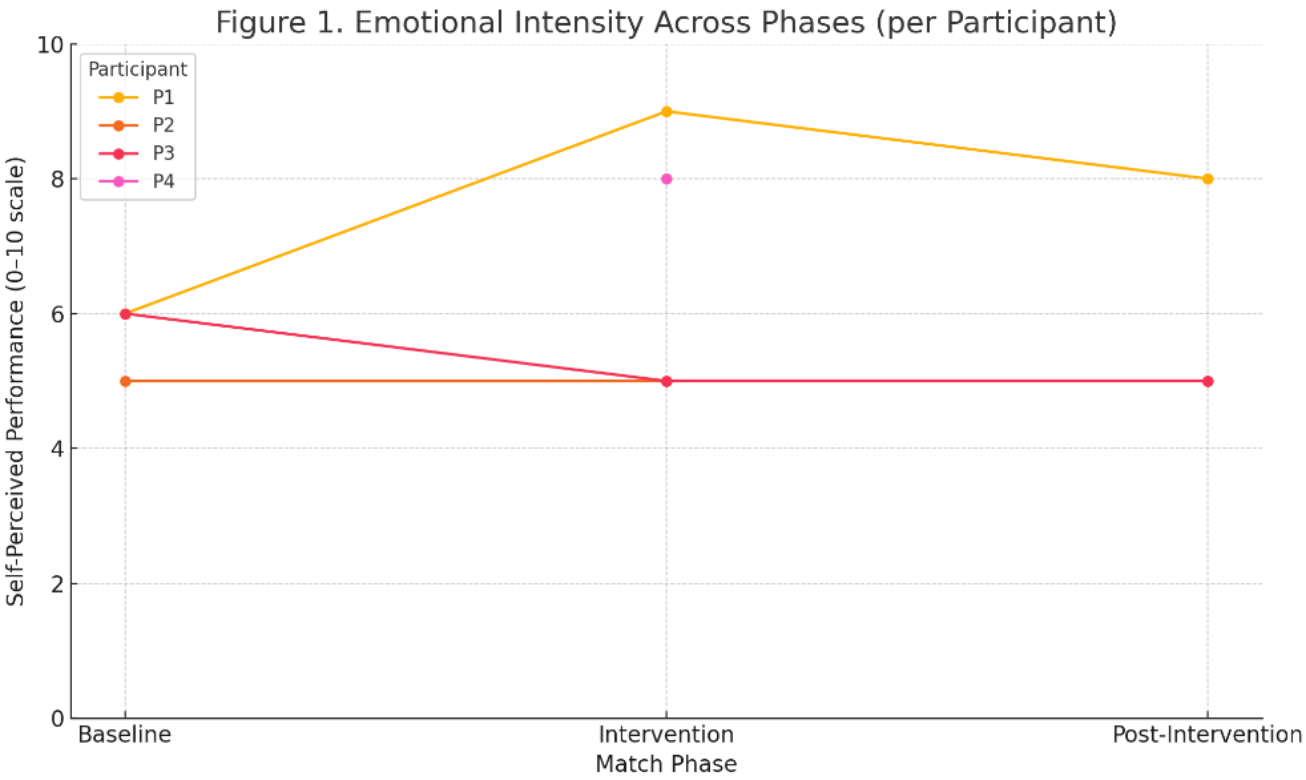
Table 5 - Summary of Emotional, Physiological, and Performance Measures by Participant and Phase

Participant	Match Phase	EI	PS	ERQ-R	ERQ-S	Perf	IZP
1	Bas	H	H	4.0	3.2	6	Low
1	Int	M	M	4.7	3.1	9	High
1	PI	M	M	4.6	3.2	8	High
2	All	H	H	3.2	4.0	5	Low
3	All	Fluc	Fluc	4.5	3.8	5.5	Medium
4	Int	M	M	4.6	3.3	8	Medium–High

Note. Match Phase: Bas = Baseline match (pre-intervention); Int = Intervention match; PI = Post-Intervention match; All = Aggregated measure across matches. EI = Emotional Intensity; athlete-reported emotional activation, categorised as High (H), Moderate (M), or Fluctuating (Fluc). PS = Physiological State; self-reported arousal indicators (e.g., breathing control, muscular tension). ERQ-R = Emotion Regulation Questionnaire – Reappraisal; ERQ-S = Emotion Regulation Questionnaire – Suppression (Gross; John, 2003); subscale scores range from 1 (low) to 7 (high). Perf = Self-perceived performance, rated on a 0–10 Likert scale immediately after each match. IZP = IZOF Proximity; qualitative judgement of emotional and physiological alignment with each participant's optimal zone.

Source: Prepared by the authors, 2025

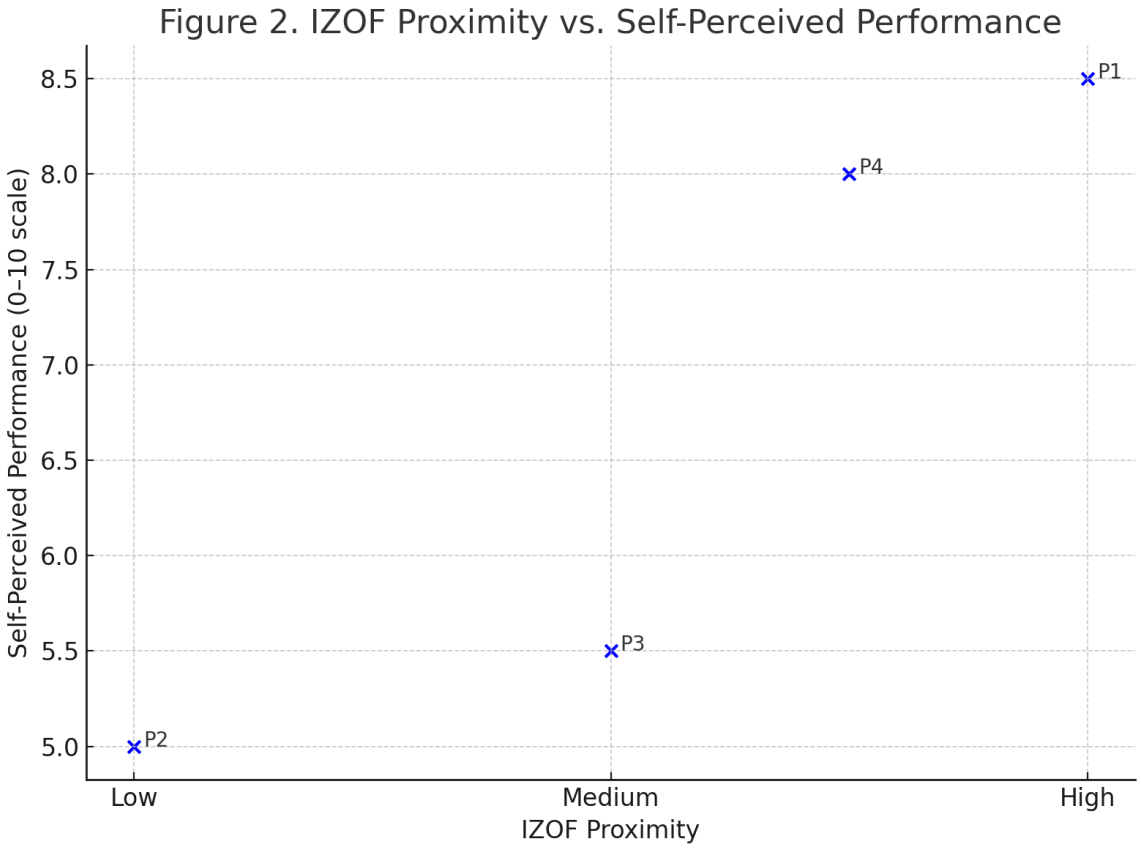
Figure 3 - Illustrates the trajectory of self-perceived performance across the three matches



Note. Participant 1 shows a clear increase during the intervention phase, with Participant 4 also exhibiting an upward trend. Conversely, Participants 2 and 3 display either stable or slightly declining self-ratings, mirroring their lower emotional alignment and engagement with intervention strategies.

Source: Prepared by the authors, 2025

Figure 4 - Depicts the relationship between proximity to the IZOF-defined optimal zone and self-rated performance



Note. Although statistical significance was not achieved, the figure suggests a positive trend: greater emotional and physiological alignment appears visually associated with higher self-perceived performance. This observation reinforces the relevance of emotional calibration as a practical focus for psychological interventions aimed at young athletes.

Source: Prepared by the authors, 2025

4 DISCUSSION

4.1 Summary and Interpretation of Findings

This study aimed to evaluate the effectiveness of idiographically tailored emotion regulation interventions in adolescent tennis players, using the IZOF model as both conceptual and methodological grounding. The results provide partial support for the model's applicability to youth sport and reveal the developmental complexity involved in self-regulatory processes during adolescence. The most promising outcomes were observed in participants who showed alignment between their emotional and physiological states and their IZOF-defined optimal zones.

These athletes also reported improvements in self-perceived performance, suggesting a functional link between emotional congruence and more adaptive competitive experiences. This pattern is consistent with findings by Hanin (2000) and Robazza *et al*. (2004), who proposed that optimal performance is facilitated when athletes function within their individually defined emotional ranges. Ruiz, Raglin, and Hanin (2017) likewise emphasised the importance of emotional profiling in enhancing performance outcomes.

However, substantial variability was observed across participants. Not all athletes responded equally to the intervention. For some, emotional intensity remained dysregulated or failed to align with their IZOF profiles, even after the intervention. These findings are in line with the work of Woodcock *et al.* (2012), who suggested that the effectiveness of IZOF-based strategies may depend on an athlete's baseline level of emotional awareness and introspective ability. The absence of meaningful change in expressive suppression scores also suggests that certain regulatory mechanisms may be less responsive to short-term intervention, particularly in adolescence, a developmental stage marked by ongoing emotional maturation (Gross; John, 2003).

Alexithymia appeared to be a particularly influential factor in explaining individual differences. Athletes with higher TAS-20 scores experienced greater difficulty in identifying and verbalising emotional states, and consequently seemed to benefit less from the intervention. These observations are consistent with those of Luminet, Bagby, and Taylor (2021), who found that alexithymic tendencies can hinder emotional clarity and restrict access to adaptive regulation strategies in performance contexts.

Overall, the findings support the use of IZOF-based interventions as a flexible and individualised approach to fostering emotion regulation in adolescent sport. At the same time, they underscore the importance of accounting for dispositional factors - such as alexithymia, motivational engagement, and developmental maturity - when designing psychological support for young athletes. These elements may function as moderators that shape how adolescents internalise and benefit from intervention content.

4.2 Practical Implications

The findings of this study yield meaningful implications for sport psychologists, coaches, and educators working with adolescent athletes. Most notably, the results emphasise the need to tailor psychological interventions to each athlete's unique emotional and physiological profile. The IZOF framework offers a structured yet flexible model for identifying individualised patterns and guiding corresponding intervention strategies (Hanin, 2000; Robazza; Pellizzari; Hanin, 2004).

Practitioners are encouraged to initiate the intervention process through comprehensive emotional profiling, incorporating assessments of emotional self-awareness and stress reactivity. Tools such as pre-performance routines, self-rating scales, and guided imagery - techniques widely supported in the sport psychology literature (Vealey; Greenleaf, 2010; Latinja; Hatzigeorgiadis, 2021) - can be adapted to reflect each athlete's optimal zone of functioning. Involving athletes actively in this collaborative and exploratory process also fosters self-reflection, autonomy, and sustained engagement, which are particularly crucial during adolescence.

At the same time, the variability in intervention outcomes underscores the relevance of developmental and dispositional factors. Brief interventions may not suffice for adolescents with underdeveloped emotional competencies or elevated alexithymia. These athletes may benefit from longer-term programmes that incorporate emotional literacy development, self-monitoring techniques, and progressive skills training (Luminet; Bagby; Taylor, 2021; Rui; Robazza, 2021). The role of coaches and support staff is also essential. Their reinforcement of emotional and mental skills during training and competition can enhance the sustainability and ecological validity of interventions. An integrated psychosocial environment - where emotional and

psychological preparation is normalised alongside physical training - may support not only performance optimisation but also athlete wellbeing (Ruiz; Raglin; Hanin, 2017).

Overall, these results support the inclusion of evidence-based emotion regulation strategies within broader athlete development frameworks, particularly in individual sports such as tennis, where self-regulation is both a prerequisite for and a consequence of high performance.

4.3 Methodological Considerations and Limitations

Several methodological considerations must be taken into account when interpreting the findings of this study. First, the small sample size - though appropriate for the idiographic and single-case approach adopted - limits the generalisability of results. The study aimed not at producing statistically generalisable findings but at exploring individual emotional trajectories in depth. Nevertheless, future research with larger and more diverse samples is needed to determine whether the patterns observed here can be replicated across broader populations of adolescent athletes.

Second, the use of self-report measures, while aligned with the IZOF model's emphasis on subjective experience, introduces potential bias, particularly in a developmental period marked by maturing introspective abilities. Although instruments such as the TAS-20 and ERQ are validated for adolescent populations (Gross; John, 2003; Luminet; Bagby; Taylor, 2021), the accuracy of self-assessed emotional and physiological states may be influenced by cognitive development, social desirability, or competitive stress.

Third, the duration and intensity of the intervention may have been insufficient for all participants to fully internalise the emotion regulation strategies introduced. While short-term interventions can trigger change, they may fall short of promoting sustained skill development, particularly among athletes with high levels of alexithymia or limited previous exposure to psychological training. A longer intervention period combined with structured follow-up may be necessary to produce deeper and more lasting effects.

An additional limitation concerns the absence of objective physiological data. Although athletes completed a self-assessment checklist for physiological states, the inclusion of biometric measures - such as heart rate variability or galvanic skin

response - could have provided a more rigorous assessment of arousal and enhanced the validity of estimates concerning proximity to IZOF zones.

Finally, contextual variables such as opponent skill level, match difficulty, and external pressures were not controlled and likely influenced both emotional responses and perceived performance. Future studies should integrate contextual performance indicators to better understand how emotion regulation interacts with the complex, dynamic nature of competitive sport.

Despite these limitations, the study provides valuable insights into the feasibility, complexity, and potential impact of IZOF-based interventions in adolescent athletes. It also identifies key areas where methodological refinement can contribute to the advancement of applied sport psychology research.

4.4 Future Directions

Building on the findings of this study, several directions for future research warrant attention. First, there is a need for studies involving larger and more diverse samples of adolescent athletes. Expanding participant characteristics across dimensions such as age, gender, competition level, and cultural background may clarify the generalisability and limitations of idiographic interventions based on the IZOF model (Robazza; Ruiz, 2018; Ekkekakis, 2013).

Second, longitudinal research designs should be prioritised to evaluate the sustainability of emotion regulation improvements over time. Tracking changes in emotional stability, regulatory development, and competitive outcomes across multiple matches or an entire sport season may yield critical insights into the long-term efficacy of IZOF-based interventions (Gross, 2014; Tenenbaum; Eklund, 2007). Such designs also allow for the observation of developmental trajectories and the consolidation of emotional competencies throughout adolescence.

Third, incorporating objective psychophysiological indicators would improve the robustness of future studies. Biometric data such as heart rate variability, skin conductance, and cortisol levels could enhance the precision of IZOF proximity assessments and deepen our understanding of the psychophysiological mechanisms underlying performance (Laborde; Mosley; Thayer, 2017).

Furthermore, the effectiveness of blended intervention models merits exploration. Combining individualised emotional profiling with psychoeducational

workshops, mobile apps for mood tracking, and the active involvement of coaches and support staff may promote greater accessibility, adherence, and ecological validity (Sullivan; Black; Feltz, 2021; Latinjak; Hatzigeorgiadis, 2021). The integration of technology, without compromising the idiographic essence of IZOF principles, could expand the practical reach of emotion regulation strategies across various sport contexts.

Altogether, these future directions call for integrated, longitudinal, and multidisciplinary approaches. Advancing research along these lines will not only strengthen the theoretical foundation of emotion regulation in sport but also enhance its applied value for young athletes pursuing excellence in competitive environments.

5 CONCLUSION

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