



Emotional Synchronisation and Motor Coordination in Artistic Swimming: The Role of Team Cohesion in Synchronised Performance

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Abstract

Background. Motor synchronisation is a key determinant of performance in artistic swimming; however, it is primarily analysed from a technical perspective, with limited consideration of emotional and relational processes within the team. A more comprehensive understanding of synchronised performance requires analysis of the interaction between emotional attunement, team cohesion, and collective motor coordination.

Objectives. This study aimed to analyse the relationship between emotional attunement, team cohesion, and motor synchronisation in artistic swimming, with particular attention to the effects of an educational intervention focused on relational and emotional skills.

Materials and Methods. A mixed-methods quasi-experimental design was employed. The sample consisted of 150 competitive artistic swimmers aged 17–28 years, divided into an experimental group and a control group. Participants were additionally stratified into three age subgroups (17–19, 20–23, and 24–28 years). The experimental group underwent an educational programme designed to enhance team cohesion and emotional awareness. Quantitative data were collected using the Group Environment Questionnaire (GEQ) and structured video analysis of routines, whereas qualitative data were obtained through focus groups. Independent samples t-tests and subgroup analyses were conducted. A two-way ANOVA (Group × Age group) was performed to examine the interaction between intervention and age.

Results. The experimental group demonstrated significantly higher levels of group cohesion across all GEQ dimensions compared to the control group (e.g., Group Integration–Task: $M = 7.8$ vs. 6.5 ; $t = 4.21$; $p < .01$; $d = 0.78$). Similar differences were identified for Group Integration–Social ($M = 7.6$ vs. 6.3 ; $p < .01$) and Individual Attraction dimensions ($p < .05$). The experimental group also achieved significantly higher motor synchronisation scores across all indicators, including temporal precision (87% vs. 74%), body position uniformity (85% vs. 72%), synchronisation with music (88% vs. 76%), and execution timing consistency (86% vs. 73%) ($p < .05$). These differences remained stable across all age subgroups. ANOVA revealed a significant main effect of group ($p < .01$), whereas the main effect of age and the interaction effect (Group × Age group) were non-significant ($p > .05$). Qualitative findings additionally highlighted the importance of trust, non-verbal communication, and shared emotional states in facilitating coordination.

Conclusions. Motor synchronisation in artistic swimming should be considered not only a technical skill but also a multidimensional process influenced by emotional attunement and team cohesion. Educational interventions targeting relational and emotional dynamics may substantially improve collective coordination and performance quality in team sports, independently of age-related differences.

Keywords: artistic swimming, team cohesion, motor synchronisation, emotional attunement, sports psychology, team performance.

Introduction

Artistic swimming, formerly known as synchronised swimming, is an aquatic sport that combines elements

of swimming technique, dance, gymnastics and artistic expression. This sport demands a high level of motor coordination, body control, strength, flexibility and timing from the athletes. Routines are performed in the water following a structured choreography set to music, during which the athletes must execute complex technical movements whilst maintaining aesthetic harmony and

perfect synchronisation with their teammates (Mountjoy, 2009; Vathagavorakul et al., 2020). The origins of artistic swimming date back to the early decades of the 20th century, when aquatic shows combining choreographed movements and swimming techniques began to spread across Europe and North America. Initially, the discipline had a strong demonstrative and spectacular component, often presented in theatrical settings or aquatic exhibitions. Over time, however, synchronised swimming has gradually evolved into a structured competitive sport, characterised by technical regulations and specific judging criteria (Vathagavorakul et al., 2020). Official recognition by international sports federations has contributed to its spread and the progressive definition of technical and artistic standards. Synchronised swimming became part of the Olympic programme in 1984, consolidating its status as a top-level sporting discipline. In 2017, the International Swimming Federation (now World Aquatics) officially adopted the name 'artistic swimming' to emphasise the expressive and choreographic elements that characterise this discipline (Mountjoy, 2009). Artistic swimming differs from many other sports due to its highly interdisciplinary nature, which integrates technical, artistic and performative components. The athletes must perform sequences of complex movements that include technical figures, lifts, rotations and choreographic transitions, whilst maintaining a high level of breath control and physical endurance. Furthermore, the performance requires constant temporal alignment between the athletes' movements and the musical rhythm, an element that helps to create an effect of harmony and fluidity in the choreography (Vathagavorakul et al., 2020; Mountjoy, 2009). Within this context, synchronisation is one of the fundamental elements of performance assessment. Judges evaluate not only the technical precision of the movements, but also the degree of coordination between the athletes, the harmony of the routine and the quality of artistic expression. The ability to perform simultaneous and perfectly coordinated movements is therefore a core skill in artistic swimming, particularly in team routines (Mountjoy, 2009). Traditionally, the synchronisation of movements has been analysed primarily from a technical and biomechanical perspective, focusing on aspects such as the temporal precision of movements, the alignment of body positions and the quality of technical execution. However, in recent years, the literature in the field of sport psychology has highlighted how coordination in team sports is influenced not only by motor skills, but also by psychological and relational factors (Eys et al., 2015). In particular, recent studies have emphasised the role of team cohesion, empathy between teammates and the ability to share emotional states during performance (Carron et al., 2002; Eys et al., 2015). In artistic swimming, the team dimension takes on particular significance. Athletes must develop a form of collective coordination that goes beyond the simple simultaneous execution of movements. The performance requires, in fact, a strong capacity for mutual anticipation, deep trust between teammates and constant attention to the physical and rhythmic cues coming from the group. This form of coordination implies a high level of harmony among the athletes, which is built up over time through shared training sessions, competitive experiences and relational dynamics within the team (Eccles et al., 2004; Eys et al., 2015). In this sense, synchronisation

in artistic swimming can be interpreted not only as a motor phenomenon, but also as the result of a process of interpersonal coordination involving cognitive, emotional and relational dimensions. The athletes' ability to perceive the group's rhythm, anticipate their teammates' movements and adapt to variations in performance is a fundamental skill for the success of the routine (Eccles & Tenenbaum, 2004). The emotional dimension also plays a central role in the practice of this discipline. During competition, athletes must manage high levels of emotional arousal, competitive pressure and concentration, whilst maintaining a strong sense of connection with their teammates. Sharing emotions, mutual support and trust within the group can help strengthen team cohesion and facilitate the coordination of movements during the performance (Carron et al., 2002).

The main objective of this study was to analyse the relationship between emotional attunement among athletes and the precision of motor synchronisation in artistic swimming performances. In particular, the study aimed to examine how relational dynamics and emotional processes within the group may influence the quality of coordination and collective performance during the execution of routines. Previous research in sport psychology suggests that coordination in team sports depends not only on technical and motor skills but also on interpersonal, cognitive, and emotional processes that facilitate mutual anticipation and synchronisation of actions among team members (Eccles & Tenenbaum, 2004; Eys et al., 2015).

Within this framework, the present study focused on the role of group cohesion, mutual trust, empathy among athletes, and emotional harmony as potential mechanisms underlying effective collective coordination in artistic swimming. Several studies have demonstrated that high levels of cohesion and trust within sports teams are associated with improved communication, cooperation, and collective performance effectiveness (Carron et al., 2002; Eys et al., 2015).

Accordingly, the objectives of the study were:

- to assess the level of group cohesion in artistic swimming teams;
- to analyse the precision of motor synchronisation through video analysis of routines;
- to explore emotional management strategies adopted by athletes during performance;
- to examine the role of mutual trust and relational harmony in the process of team coordination.

Based on the literature on group cohesion and coordination in sports teams, the following hypotheses were formulated:

H1. A higher level of group cohesion is associated with greater precision in motor synchronisation during the execution of routines (Carron et al., 2002; Eys et al., 2015).

H2. Teams characterised by greater emotional harmony among athletes demonstrate higher levels of coordination and fluidity of movement (Eccles & Tenenbaum, 2004; Cooke et al., 2000).

H3. Mutual trust and the perception of support among teammates promote better emotional regulation during performance (Carron et al., 2002).

H4. Athletes who perceive a high degree of emotional connection with the group report a greater ability to anticipate teammates' movements and maintain synchronisation

during the routine (Eccles & Tenenbaum, 2004; Eys et al., 2015).

Materials and Methods

Study Design

The study employed a mixed-methods quasi-experimental design combining quantitative and qualitative approaches. The research involved an experimental group and a control group and aimed to examine the effects of an educational intervention focused on emotional attunement and team cohesion in artistic swimming. Quantitative methods were used to assess group cohesion and motor synchronisation, whereas qualitative methods explored athletes' perceptions of emotional and relational dynamics within the team context.

Participants

The sample was selected using a non-probability convenience sampling procedure due to the accessibility of the sporting environment and the possibility of continuous observation during training activities. The study was conducted at a swimming school located in the Naples metropolitan area with a competitive artistic swimming section.

The sample consisted of 150 competitive artistic swimmers aged 17–28 years who regularly participated in training sessions and official competitions. Participants were additionally stratified into three age subgroups:

- 17–19 years (late adolescence);
- 20–23 years (emerging adulthood);
- 24–28 years (young adulthood).

Participants were included according to the following criteria:

- regular participation in official artistic swimming competitions;
- a minimum of two years of experience in the discipline;
- participation in team routines;
- provision of written informed consent prior to participation.

Educational intervention

The educational intervention was implemented only in the experimental group during the competitive season, whereas the control group continued the standard technical and physical training programme provided by the swimming school.

The intervention aimed to develop emotional awareness, mutual trust, relational harmony, and team cohesion through integrated educational activities conducted alongside regular training sessions. The programme included:

- team-building activities;
- cooperative coordination exercises;
- group trust-building exercises;
- guided emotional reflection sessions;
- non-verbal communication and synchronisation exercises;
- competition simulations followed by group discussions.

Specific activities involved synchronised movements without verbal communication, pair coordination exercises, rhythm adaptation tasks, and guided reflection on emotional states experienced during performance and competition.

The control group continued routine technical training focused on:

- swimming technique and body control;
- technical figures and choreographic transitions;
- synchronisation exercises through routine repetition;
- coordination with music;
- physical conditioning for strength, endurance, and flexibility.

Instruments

Group cohesion assessment

Group cohesion was assessed using the Group Environment Questionnaire (GEQ) developed by Carron et al. (1985). The questionnaire includes 18 items organised into four dimensions:

- Group Integration – Task;
- Group Integration – Social;
- Individual Attractions to the Group – Task;
- Individual Attractions to the Group – Social.

Responses were provided using a 9-point Likert scale ranging from 1 (strongly disagree) to 9 (strongly agree). The questionnaire was administered individually under conditions ensuring anonymity and confidentiality.

Motor synchronisation assessment

Motor synchronisation was assessed through structured video analysis of routines recorded during training sessions and competition simulations using high-definition cameras positioned at poolside.

The analysis included the following indicators:

- temporal precision of movements;
- body position uniformity;
- synchronisation with musical rhythm;
- execution timing consistency.

Each indicator was evaluated using a structured observational scoring system to obtain a composite synchronisation index.

Qualitative data Collection

Qualitative data were collected through semi-structured focus groups conducted with the athletes. Focus groups explored:

- emotional experiences during performance;
- perception of group harmony;
- non-verbal communication;
- mutual trust within the team;
- emotional regulation strategies during competition.

Each session lasted approximately 45–60 minutes and was audio-recorded and transcribed for analysis.

Statistical Analysis

Descriptive statistics were calculated for all study variables and are presented as means and standard deviations

(M ± SD). Independent samples t-tests were used to compare the experimental and control groups across all dimensions of group cohesion and motor synchronisation.

To examine the potential influence of age, subgroup analyses were conducted across the predefined age categories (17–19, 20–23, and 24–28 years). In addition, a two-way analysis of variance (ANOVA) (Group × Age group) was performed to assess:

- the main effect of the intervention;
- the main effect of age;
- the interaction effect between intervention and age.

Effect sizes were calculated using Cohen's d. Statistical significance was set at $p < .05$.

Qualitative data obtained from focus groups were analysed using thematic analysis according to Braun and Clarke (2006).

Results

Quantitative results

The analysis of the quantitative data was conducted with the aim of comparing the results obtained by the experimental group and the control group in relation to levels of group cohesion and the precision of motor synchronisation during the performance of artistic swimming routines. In an initial phase, descriptive statistics were calculated for the variables under study, including the mean (M), standard deviation (SD) and distribution of scores obtained in the Group Environment Questionnaire (GEQ) and in the scores derived from video analysis of the performances. This preliminary phase provided a general overview of the characteristics of the two groups and identified any differences in levels of team cohesion and motor coordination. Subsequently, a comparison was made between the experimental group and the control group to verify the presence of statistically significant differences between the two groups. In particular, the analysis took into account the mean scores for the four dimensions of the Group Environment Questionnaire — task-oriented group integration, socially oriented group integration, individual attraction to the group in relation to the task, and individual attraction to the group in relation to the social dimension — as well as the scores relating to the precision of motor synchronisation obtained through the observation grid used for the video analysis of the routines. To assess the differences between the two groups, an independent samples t-test was used, a statistical procedure

frequently employed in quasi-experimental studies in sports science to compare the means of different groups and verify the possible effect of an educational or training intervention.

Descriptive and inferential statistics for group cohesion variables are presented in Table 1, allowing a structured and reproducible comparison between the experimental and control groups across all GEQ dimensions.

As shown in Table 1, the experimental group reported significantly higher levels of group cohesion across all GEQ dimensions compared to the control group. The differences were statistically significant and associated with medium-to-large effect sizes, indicating a consistent and substantial impact of the educational intervention on both task-related and social aspects of cohesion. Significant differences between the two groups also emerged regarding the precision of motor synchronisation, assessed through the analysis of routines recorded during training sessions and competition simulations. Descriptive and inferential statistics for motor synchronisation variables are presented in Table 2, allowing a clear and reproducible comparison between the experimental and control groups across all performance indicators.

As shown in Table 2, the experimental group achieved higher levels of motor synchronisation across all indicators analysed, including temporal precision, uniformity of body positions, synchronisation with the musical rhythm and execution timing consistency. These differences were statistically significant and supported by consistent effect sizes, confirming the positive impact of the intervention on collective coordination performance.

To further examine the internal validity of the findings, additional analyses were conducted across the predefined age subgroups (17–19, 20–23, 24–28 years). Across all age categories, the experimental group consistently reported higher levels of group cohesion compared to the control group on all GEQ dimensions. The pattern of results was stable across subgroups, with mean differences comparable to those observed in the overall sample.

Similarly, for motor synchronisation indicators, the experimental group outperformed the control group within each age subgroup. Improvements were observed in temporal precision, body position uniformity, synchronisation with music, and execution timing consistency across all age ranges.

However, some minor variations emerged. Athletes in the younger subgroup (17–19 years) showed slightly larger differences in social cohesion dimensions, suggesting a stronger impact of the intervention on relational dynamics at earlier developmental stages. In contrast, athletes in the

Table 1. Comparison between experimental and control group on GEQ dimensions

Variable	Group	Mean (M)	SD	t-value	p-value	Effect size (Cohen's d)
Group Integration – Task	Experimental	7.8	0.9	4.21	< .01	0.78
	Control	6.5	1.1			
Group Integration – Social	Experimental	7.6	1.0	3.87	< .01	0.72
	Control	6.3	1.2			
Individual Attraction – Task	Experimental	7.9	0.8	3.95	< .01	0.75
	Control	6.7	1.0			
Individual Attraction – Social	Experimental	7.4	1.1	3.52	< .05	0.65
	Control	6.2	1.3			

Table 2. Comparison between experimental and control group on motor synchronisation indicators

Variable	Group	Mean (%)	SD	p-value	Effect size (Cohen's d)
Temporal precision	Experimental	87	5	< .05	0.80
	Control	74	6		
Body position uniformity	Experimental	85	6	< .05	0.78
	Control	72	7		
Synchronisation with music	Experimental	88	5	< .05	0.82
	Control	76	6		
Execution timing consistency	Experimental	86	6	< .05	0.79
	Control	73	7		

Table 3. Comparison between experimental and control group across age subgroups

Variable	Age group	Experimental (M ± SD)	Control (M ± SD)	p-value
Group Integration – Task	17–19	7.9 ± 0.8	6.4 ± 1.1	< .01
	20–23	7.8 ± 0.9	6.5 ± 1.0	< .01
	24–28	7.7 ± 1.0	6.6 ± 1.1	< .05
Group Integration – Social	17–19	7.7 ± 0.9	6.2 ± 1.2	< .01
	20–23	7.6 ± 1.0	6.3 ± 1.1	< .01
	24–28	7.5 ± 1.1	6.4 ± 1.2	< .05
Temporal precision (%)	17–19	86 ± 6	73 ± 7	< .05
	20–23	87 ± 5	74 ± 6	< .05
	24–28	88 ± 4	75 ± 5	< .05
Synchronisation with music (%)	17–19	87 ± 6	75 ± 7	< .05
	20–23	88 ± 5	76 ± 6	< .05
	24–28	89 ± 4	77 ± 5	< .05

older subgroup (24–28 years) demonstrated more stable performance in motor synchronisation indicators, with lower variability in execution timing.

The two-way ANOVA (Group × Age group) revealed a significant main effect of group ($p < .01$), confirming the overall effectiveness of the educational intervention. The main effect of age was not statistically significant ($p > .05$), indicating that age alone did not account for the observed differences. Importantly, the interaction effect between group and age was not statistically significant ($p > .05$), suggesting that the impact of the intervention was consistent across age groups and not dependent on the age structure of the sample.

As shown in Table 3, the differences between the experimental and control groups remained consistent across all age subgroups, confirming the stability of the intervention effect across different age ranges.

Overall, the results show a consistent pattern across all variables and age groups, with the experimental group outperforming the control group in both cohesion and motor synchronisation, indicating a structured and robust effect of the educational intervention rather than isolated or age-dependent differences.

Qualitative results

The analysis of the qualitative data was carried out through a thematic analysis of the focus group transcripts,

with the aim of exploring the athletes' perceptions of the emotional, relational and communicative dynamics that characterise team performance in artistic swimming. The analysis identified several recurring themes in the participants' narratives, particularly regarding the harmony between athletes, the management of emotions during performance, non-verbal communication and the role of mutual trust in team coordination. During the focus groups, a number of guiding questions were used to stimulate reflection and discussion among the participants. Among the main questions posed to the athletes were:

- “How would you describe the level of harmony with your teammates whilst performing the routines?”
- “What emotions do you experience whilst performing a routine in competition or during a performance simulation?”
- “How do you communicate with your teammates during the routine, even without speaking?”
- “How important do you consider mutual trust to be for maintaining synchronisation during the performance?”

With regard to the perception of harmony among the athletes, significant differences emerged between the experimental group and the control group. The athletes in the experimental group, who had taken part in the educational programme aimed at developing group cohesion, described a strong sense of connection and mutual coordination whilst

performing the routines. Several participants emphasised how the collaboration and mutual understanding developed during the intervention had fostered greater fluidity in their movements and a better perception of the collective rhythm. One of the athletes stated: "During the routine, I almost automatically feel my teammates' movements, as if we were all moving to the same rhythm." Another participant noted: "When we're in the water, we don't need to keep looking at each other, because we already know what the other will do." In contrast, the athletes in the control group described coordination based primarily on technical training and the repetition of choreographic sequences. Some participants emphasised that synchronisation depends above all on individual attention and memory of the choreography. One of the athletes stated: "I try to focus a lot on the beat of the music and on what I have to do, trying to stay in sync with the others." Another observed: "If someone makes a mistake or moves too early, it becomes difficult to regain synchronisation." Another theme that emerged from the focus groups concerns the management of emotions during the performance of routines, particularly in competitive contexts. The athletes in the experimental group demonstrated greater awareness of their own emotions and of the strategies used to manage anxiety and the pressure of competition. Some participants highlighted how comparing themselves with their teammates and the reflective activities carried out during the educational intervention helped to develop greater confidence. One of the athletes said: "Before the competition I always feel a bit tense, but knowing that my teammates are as focused as I am helps me stay calm." Another participant said: "When we're in the water I try to focus on the group, not just on myself. This helps me not to get overwhelmed by anxiety." In the control group, however, the athletes described a more individual approach to managing their emotions. Some participants highlighted how the pressure of the competition can affect concentration and the precision of movements.

One of the athletes said: "During the competition, I'm sometimes afraid of making a mistake and this makes me lose my rhythm a bit." Another added: "When I'm very nervous, I find it harder to stay in sync with the others." A further theme that emerged from the analysis concerns the role of non-verbal communication in coordination between the athletes. Participants in the experimental group highlighted the importance of body signals, eye contact and the perception of their teammates' movements in maintaining synchronisation during the routine. One of the athletes explained: "Even without speaking, we can tell when to speed up or slow down just by looking at each other." Another participant said: "During some moves, I can really feel the others' movements and I adapt automatically." In the control group, however, the athletes relied more on the music and counting the beats as their main reference for maintaining coordination. One participant stated: "I try to follow the rhythm of the music above all to stay in time." Finally, a recurring theme that emerged from the discussions concerns the role of mutual trust within the team. The athletes in the experimental group emphasised how trust in their teammates is a fundamental element in approaching the performance with greater confidence. One participant said: "When I know my teammates are as focused and alert as I am, I feel more at ease during the routine." Another

stated: "Trust within the group is essential, especially during the most difficult parts of the choreography." In the control group, however, trust within the group was mentioned less frequently and was often linked primarily to the technical competence of teammates.

Discussion

The aim of this study was to analyse the relationship between emotional attunement among female athletes and the precision of motor synchronisation in artistic swimming performances, taking into account the role of relational dynamics and team cohesion in collective coordination processes. In this perspective, sport has increasingly been recognised as a complex educational environment in which motor, cognitive and relational dimensions interact, contributing to both performance and personal development (Di Palma et al., 2025; Mazzeo et al., 2016).

The findings from the quantitative and qualitative analyses provide valuable insights into how psychological and relational factors can influence performance quality in team sports contexts. The quantitative data showed that the experimental group, which took part in an educational programme aimed at developing emotional attunement and group cohesion, reported significantly higher levels of cohesion across the various dimensions measured by the Group Environment Questionnaire compared to the control group. In particular, the athletes in the experimental group showed higher mean scores both in the dimensions relating to task-oriented group integration and in those linked to the social dimension. This result suggests that educational activities aimed at strengthening collaboration, mutual trust and a sense of belonging to the team may contribute to improving the perception of unity and cohesion among group members. Moreover, a growing body of literature has also highlighted how structured and guided motor programmes can significantly enhance social skills, group cohesion and cooperative behaviours in both educational and sport contexts (Tafuri et al., 2026; Raiola et al., 2015). These findings are also consistent with the literature on sports psychology, which suggests that high levels of group cohesion are associated with greater collective performance effectiveness and better coordination among team members (Carron et al., 2002; Eys et al., 2015; Carron et al., 2000).

Similarly, analysis of the data on motor synchronisation revealed that the experimental group achieved higher average scores than the control group across all indicators analysed, including the temporal precision of movements, the uniformity of body positions, synchronisation with the musical rhythm, and the consistency of execution times among the athletes. These results suggest that the development of relational and emotional skills within the team may foster greater interpersonal coordination during the execution of routines. In other words, the athletes' ability to perceive themselves as part of a cohesive group and to share goals and emotional states appears to help facilitate the alignment of movements and the fluidity of collective performance.

Importantly, the stratified analysis by age groups further strengthens the interpretation of these findings. The results showed that the positive effects of the educational intervention on both group cohesion and

motor synchronisation remained consistent across all age subgroups. Although some age-related variability emerged—particularly in relation to social cohesion among younger athletes and greater stability in motor performance among older participants—these differences did not alter the overall pattern of results. From a statistical perspective, the absence of a significant interaction between group and age indicates that the effectiveness of the intervention does not depend on the age structure of the sample. This finding is particularly relevant in addressing potential concerns related to internal validity, as it supports the interpretation that the observed improvements are primarily attributable to the educational programme rather than to developmental differences among participants. In this sense, the results reinforce the idea that emotional attunement and team cohesion act as key mechanisms in facilitating motor synchronisation, independently of age-related factors, confirming the robustness and generalisability of the intervention within the analysed age range.

The qualitative findings further indicated that athletes perceive synchronisation not solely as a technical process but as a form of collective adaptation based on non-verbal communication, emotional connection, and the anticipation of teammates' movements. Emotion regulation also emerged as an important component of performance, as perceived group support and shared emotional states appeared to facilitate concentration and emotional stability during competition. These findings are consistent with previous sport psychology research highlighting the role of emotional regulation processes and psychological coping strategies in maintaining performance under competitive pressure (Lane et al., 2012; Weinberg & Gould, 2019).

The findings of the present study suggest that the relationship between team cohesion and motor synchronisation in artistic swimming should be interpreted as a dynamic and process-based phenomenon rather than a simple associative effect. From an analytical perspective, coordination can be understood as an emergent process resulting from continuous interactions among athletes, in which cognitive, perceptual and emotional components are tightly interconnected. In this framework, group cohesion does not act directly on performance, but operates as a facilitating condition that enhances the efficiency of interpersonal coordination mechanisms.

Conclusion

This study examined the relationship between emotional attunement, group cohesion, and motor synchronisation in artistic swimming performances using a mixed-methods approach that combined questionnaires, video analysis of routines, and focus groups with athletes.

The findings demonstrated that athletes involved in an educational programme focused on emotional and relational skills achieved higher levels of team cohesion and greater precision of motor synchronisation compared to the control group. The results suggest that mutual trust, emotional harmony, and relational quality within the team represent important mechanisms facilitating collective coordination processes.

The qualitative findings additionally indicated that athletes perceive synchronisation not solely as a technical process but as a form of collective adaptation based on

non-verbal communication, emotional connection, and the anticipation of teammates' movements. Emotion regulation also emerged as an important component of performance, as perceived group support and shared emotional states appeared to facilitate concentration and emotional stability during competition.

Several limitations should nevertheless be acknowledged. The study was based on convenience sampling and included athletes from a single sporting organisation, which may limit the generalisability of the findings. In addition, the quasi-experimental design relied on pre-existing teams rather than random assignment.

An additional limitation concerns the heterogeneity of the sample in terms of age. Participants ranged from late adolescence to young adulthood (17–28 years), potentially introducing variability in emotional regulation, interpersonal interaction, and coordination abilities. However, subgroup analyses demonstrated that the positive effects of the educational intervention remained consistent across all age categories, supporting the interpretation that the observed improvements were primarily associated with the intervention rather than developmental differences among participants.

Finally, the relatively short duration of the intervention limits conclusions regarding the long-term stability of the observed effects. Future studies should include larger and more diverse samples, longitudinal designs, and more advanced motion-analysis technologies to further investigate the mechanisms underlying collective synchronisation in team sports.

Overall, the findings suggest that motor synchronisation in artistic swimming should be understood not only as a technical skill but also as a multidimensional process shaped by emotional attunement, interpersonal trust, and team cohesion. These results support the integration of socio-emotional and relational training strategies into preparation programmes for highly coordinated team sports.

Ethics Approval

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki for research involving human participants. Ethical approval for the study protocol was obtained from the institutional ethics committee of the participating university prior to data collection. All procedures involving participants were reviewed and approved in accordance with national and institutional ethical standards.

Informed Consent

All participants provided written informed consent prior to participation in the study. Participants were informed about the objectives, procedures, voluntary nature of participation, and confidentiality of the collected data. For participants under the age of 18 years, written informed consent was additionally obtained from a parent or legal guardian.

Data Availability Statement

The datasets generated and/or analysed during the current study are available from the corresponding author upon reasonable request.

AI Transparency Statement

The authors used AI-assisted tools for language editing and text refinement only and take full responsibility for the content of the manuscript.

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Not applicable.

Conflicts of Interest

The authors declare no conflicts of interest.

References

- Mountjoy, M. (2009). Injuries and medical issues in synchronized swimming. *Clinical Sports Medicine*, 28(2), 253-264.
- Vathagavorakul, R., Gonjo, T., & Homma, M. (2020). Underwater and above-water coordination in artistic swimming performance. *Sports Biomechanics*, 19(4), 455-468.
- Eys, M.A., Evans, M.B., Martin, L.J., & Bruner, M.W. (2015). *Team cohesion and team performance in sport*. In M.R. Beauchamp & M.A. Eys (Eds.), *Group dynamics in exercise and sport psychology* (2nd ed., pp. 213-226). Routledge.
- Carron, A.V., Colman, M.M., Wheeler, J., & Stevens, D. (2002). Cohesion and performance in sport: A meta-analysis. *Journal of Sport and Exercise Psychology*, 24(2), 168-188. <https://doi.org/10.1123/jsep.24.2.168>
- Eccles, D.W., & Tenenbaum, G. (2004). Why an expert team is more than a team of experts: A cognitive conceptualization of team coordination and communication in sport. *Journal of Sport and Exercise Psychology*, 26(4), 542-560. <https://doi.org/10.1123/jsep.26.4.542>
- Cooke, N.J., Salas, E., Cannon-Bowers, J.A., & Stout, R.J. (2000). Measuring team knowledge. *Human Factors*, 42(1), 151-173. <https://doi.org/10.1518/001872000779656561>
- Carron, A.V., Widmeyer, W.N., & Brawley, L.R. (1985). The development of an instrument to assess cohesion in sport teams: The Group Environment Questionnaire. *Journal of Sport Psychology*, 7(3), 244-266. <https://doi.org/10.1123/jsp.7.3.244>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. <https://doi.org/10.1191/1478088706qp0630a>
- Di Palma, D., Tafuri, M.G., & Ogbondah, L.D. (2025). Sport as a tool for inclusion and sustainability in secondary school: A qualitative-quantitative analysis. *Rivista di Studi sulla Sostenibilità*, 10(1), 93-108. <https://doi.org/10.3280/riss2025oa19679>
- Mazzeo, F., Monda, M., Messina, G., Santamaria, S., Messina, A., Montesano, M., & Tafuri, D. (2016). Doping in Italy: An analysis of its spread in ten years. *Biology and Medicine*, 8(1), 1. <https://doi.org/10.4172/0974-8369.1000263>
- Tafuri, M.G., Gravino, G., Scala, G., Di Palma, D., & Romano, G. (2026). Effects of an instructional handball programme on motor and social skills in a secondary school: A randomized study with qualitative-quantitative design. *Journal of Human Sport and Exercise*, 21(1), 82-92. <https://doi.org/10.55860/y00gk130>
- Raiola, G., Tafuri, D., & Altavilla, G. (2015). Physical activity and its relation to body and ludic expression in childhood. *Mediterranean Journal of Social Sciences*, 6, 293-296.
- Carron, A.V., & Brawley, L.R. (2000). Cohesion: Conceptual and measurement issues. *Small Group Research*, 31(1), 89-106. <https://doi.org/10.1177/104649640003100105>
- Creswell, J.W., & Plano Clark, V.L. (2007). *Designing and conducting mixed methods research* (2nd ed.). Sage Publications.
- Lane, A.M., Beedie, C.J., Jones, M.V., Uphill, M., & Devonport, T.J. (2012). The BASES expert statement on emotion regulation in sport. *Journal of Sports Sciences*, 30(11), 1189-1195. <https://doi.org/10.1080/02640414.2012.693621>
- Weinberg, R.S., & Gould, D. (2019). *Foundations of sport and exercise psychology* (7th ed.). Human Kinetics.

Емоційна синхронізація та моторна координація в артистичному плаванні: роль згуртованості команди в синхронному виступі

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

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Обґрунтування. Моторна синхронізація є ключовим визначальним фактором успішності виступу в артистичному плаванні; однак вона аналізується переважно з технічної точки зору, при цьому емоційним та реляційним процесам у команді приділяється обмежена увага. Більш цілісне розуміння синхронного виступу потребує аналізу взаємодії між емоційним налаштуванням, згуртованістю команди та колективною моторною координацією.

Мета дослідження. Це дослідження мало на меті проаналізувати взаємозв'язок між емоційним налаштуванням, згуртованістю команди та моторною синхронізацією в артистичному плаванні, акцентуючи увагу на вплив навчальної інтервенції, спрямованої на розвиток реляційних та емоційних навичок.

Матеріали і методи. У дослідженні застосовано квазіекспериментальний дизайн із використанням змішаних методів. Вибірку склали 150 спортсменок змагального рівня з артистичного плавання віком 17–28 років, яких було розподілено на експериментальну та контрольну групи. Учасниць додатково стратифікували за трьома віковими підгрупами (17–19, 20–23 та 24–28 років). Експериментальна група пройшла навчальну програму, спрямовану на підвищення згуртованості команди та емоційної усвідомленості. Збір кількісних даних проведено за допомогою опитувальника групового середовища (GEQ) та структурованого відеоаналізу програм, тоді як якісні дані були отримані через фокус-групи. Було застосовано t-критерій для незалежних вибірок та проведено аналіз у підгрупах. Для вивчення взаємодії між інтервенцією та віком виконано двофакторний дисперсійний аналіз (Група × Вікова група).

Результати. Експериментальна група продемонструвала статистично значуще вищі рівні групової згуртованості за всіма вимірами опитувальника GEQ порівняно з контрольною групою (наприклад, інтеграція групи — завдання: $M = 7,8$ проти $6,5$; $t = 4,21$; $p < .01$; $d = 0,78$). Подібні відмінності були виявлені за вимірами «інтеграція групи — соціальна» ($M = 7,6$ проти $6,3$; $p < .01$) та «індивідуальна привабливість» ($p < .05$). Експериментальна група також досягла статистично значуще вищих показників моторної синхронізації за всіма індикаторами, включаючи часову точність (87% проти 74%), одноманітність положення тіла (85% проти 72%), синхронність із музикою (88% проти 76%) та стабільність часу виконання (86% проти 73%) ($p < .05$). Зазначені відмінності залишалися стабільними в усіх вікових підгрупах. Дисперсійний аналіз виявив значущий головний ефект чинника групи ($p < .01$), тоді як головний ефект віку та ефект взаємодії (Група × Вікова група) були статистично незначущими ($p > .05$). Результати якісного аналізу додатково підкреслили важливість довіри, невербальної комунікації та спільних емоційних станів для полегшення координації.

Висновки. Моторну синхронізацію в артистичному плаванні слід розглядати не лише як технічну навичку, але й як багатовимірний процес, на який впливають емоційне налаштування та згуртованість команди. Навчальні інтервенції, спрямовані на реляційну та емоційну динаміку, можуть суттєво покращити колективну координацію та якість виступу в командних видах спорту незалежно від вікових відмінностей.

Ключові слова: артистичне плавання, згуртованість команди, моторна синхронізація, емоційне налаштування, спортивна психологія, командна результативність.

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