

Pedagogical behaviors, feedback, and gaze patterns in novice and expert group fitness instructors.

FRANCISCO CAMPOS¹, FERNANDO MARTINS²

^{1,2} Polytechnic University of Coimbra, Coimbra Education School, Coimbra, PORTUGAL.

^{1,2} SPRINT – Sport Physical activity and health Research & INnovation cenTer, Polytechnic University of Coimbra, Coimbra, PORTUGAL.

^{1,2} Instituto de Telecomunicações, Delegação da Covilhã, Covilhã, PORTUGAL.

² inED – Centre for Research & Innovation in Education, Polytechnic University of Coimbra, Coimbra, PORTUGAL

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Abstract:

Visual attention is a fundamental component of instructional decision-making in group fitness contexts, as it supports instructors' ongoing monitoring of participants' performance and informs pedagogical intervention during class. Although previous research has independently examined fitness instructors' pedagogical behavior, pedagogical feedback, and gaze patterns, little is known about how these dimensions interact in instructional settings. This study aimed to examine the associations between instructors' gaze patterns, pedagogical behaviors, and pedagogical feedback during Aerobics classes, while comparing novice and expert group fitness instructors. Eight instructors aged between 21 and 42 years were classified according to professional experience as novice or expert. Pedagogical behavior was assessed using the Observation System of the Fitness Instructors Behavior – Group Activities (SOCIF-AG), and pedagogical feedback was analyzed through the Fitness Instructors Feedback Observation System (SOFIF). Gaze patterns were recorded with mobile eye-tracking technology, considering fixation count and fixation duration across total and specific areas of interest. The results showed that instructors' visual attention profiles were associated with distinct patterns of pedagogical intervention. Novice instructors tended to adopt more reactive and execution-focused strategies, characterized by more localized gaze behavior and greater use of questioning and corrective forms of feedback. In contrast, expert instructors displayed broader and more strategically distributed visual attention, which was associated with demonstration, anticipatory instructional regulation, and more structured pedagogical feedback. These findings suggest that professional experience is reflected not only in observable instructional behavior, but also in how instructors visually explore, interpret, and respond to participants' performance. From an applied perspective, the study highlights the integrative role of visual perception in pedagogical regulation during Aerobics instruction and reinforces the importance of perceptual-cognitive processes in the development of teaching expertise in group fitness settings.

Key Words: visual attention; perceptual-cognitive processes; instructional decision-making; eye-tracking; pedagogical intervention; expertise.

Introduction

Understanding how visual attention and perceptual-cognitive processes support instructional decision-making is a central concern in contemporary performance analysis. The fitness industry is strongly affected by trends, reflecting both the dynamic nature of the sector and the increasing demand for quality, innovation, and professionalization. Every year, the American College of Sports Medicine, one of the most reputable organizations in the area, publishes the fitness trends for the next year (McAvoy et al., 2025; Newsome et al., 2024a, 2024b), providing an important reference for practitioners, researchers, and organizations. In Portugal, similar studies are being carried out; the certification of the fitness professional systematically emerged as one of the first trends in the Portuguese market (Franco et al., 2024; 2025; 2026), reinforcing the relevance of qualified and evidence-based professional intervention.

Beyond technical certification, however, the provision of a service with quality, which induces satisfaction to those who enjoy it, is an actual and permanent concern (Braga-Pereira et al., 2024; 2025). In this sense, instructional quality in fitness contexts should not be understood solely in terms of technical knowledge or exercise prescription, but also in relation to the instructor's ability to perceive, interpret, and respond effectively to participants' needs during the activity. This highlights the importance of perceptual-cognitive processes as a foundation for pedagogical intervention, as instructors must continuously monitor participants' performance, detect relevant cues, and make timely decisions regarding instruction, correction and feedback. Recent evidence from group fitness contexts highlights that participants' perceptions of instructors' feedback play a central role in

class effectiveness, satisfaction, and exercise adherence, reinforcing the importance of how feedback is delivered during group sessions (Ramos et al., 2026).

Group fitness activities are one of the instructor fields of action, among others (e.g., personalized training), where most professionals perform (Ramos et al., 2021). These contexts are characterized by their collective nature, requiring instructors to simultaneously address the needs of multiple participants with different skill levels, motivations, and physical conditions. As such, group fitness settings place specific demands on instructors' ability to manage the class environment, maintain engagement, and ensure both effectiveness and safety throughout the session. Aerobics, the basis through which other group activities developed (Melo & Campos, 2021), continues to be practiced in several gyms and health clubs in Portugal, although sometimes with some adaptations and other denominations (Ramos et al., 2021). Due to its structured and rhythmic nature, Aerobics requires instructors to coordinate movement patterns, synchronize actions with music, and provide clear and timely instructional cues, which reinforces the importance of effective pedagogical intervention.

To evaluate the instructor intervention quality, observation systems can be used (Franco & Simões 2021). These systems provide structured frameworks that allow for the systematic analysis of instructional behavior, offering insights into how instructors organize, communicate, and regulate class activities. In Portugal, within the scope of group fitness activities (e.g., Aerobics), two validated systems are: i) Observation System of the Fitness Instructors Behavior – Group Activities [Sistema de Observação do Comportamento dos Instrutores de Fitness – Aulas de Grupo (SOCIF-AG), in Portuguese] (Franco et al., 2008; 2012); and ii) Fitness Instructors Feedback Observation System [Sistema de Observação do Feedback dos Instrutores de Fitness (SOFIF), in Portuguese] (Simões et al., 2009; 2020). SOCIF-AG was chronologically the first to be developed and evaluates the instructor behaviors in general terms (e.g., instruction, control or organization) (Franco et al., 2008; 2012). Having this instrument as a base, SOFIF was developed, specifically, to evaluate the pedagogical feedback. Pedagogical feedback is the instructor's reaction to participants' motor performance, to question, evaluate, describe or correct something (Simões et al., 2020; Campos et al., 2023b), and presents four phases: observation; interpretation/diagnosis (evaluation); decision (react or not react); and reaction (pedagogical feedback emission) (Simões et al., 2020).

Looking at the right place at the right time is particularly important, not only in the sports domain (Ghamari & Sharifi, 2021). In both competitive contexts and instructional environments, the ability to efficiently allocate visual attention allows individuals to extract relevant information from complex and dynamic situations. In competition [e.g., field-hockey (Cañal-Bruland et al., 2010), volleyball (Afonso et al., 2012), rock climbing (Grushko & Leonov, 2014), futsal (Corrêa et al., 2020), baseball (Liu et al., 2020), tennis (Rosker & Rosker, 2021), football (Buscà et al., 2022) or basketball (Marques et al., 2023)], effective visual search behavior has been associated with higher levels of performance, as it supports anticipation, decision-making, and action regulation.

Similarly, in leisure and instructional contexts, such as group fitness activities, visual attention plays a fundamental role in enabling instructors to monitor participants, detect errors, and adjust their pedagogical intervention accordingly. Recently, this theme has aroused interest in some researchers, particularly with the increasing use of eye-tracking systems (ETS) to study visual behavior in applied settings. A study developed in a group fitness activity (Aerobics), comparing fitness instructors' gaze patterns (fixations), according to their training and professional experience, using eye-tracking system (ETS) methodology (Campos et al., 2023a), represents an important step in this direction.

ETS allows the study of eye position and optical movement (Holmqvist et al., 2010), making it possible to assess where a person looks, for how long, and how often (Campos et al., 2023a). Among the different variables available, fixation behavior has been one of the most frequently analyzed, as it reflects the moments in which visual information is processed with greater resolution (Discombe & Cotterill, 2015). As described by Land (2006), fixations correspond to the intervals between saccades during which gaze is relatively stable, allowing for detailed information processing, while saccadic movements enable shifts of attention between different locations (Moran et al., 2018).

In this context, previous findings suggest that instructors with higher levels of training and professional experience tend to present fewer fixations, both in number and duration, indicating more efficient and selective visual search strategies (Campos et al., 2023a). From a perceptual-cognitive perspective, these differences may reflect a greater ability to identify relevant cues, ignore less informative stimuli, and anticipate participants' needs. However, while these results provide important insights into instructors' visual behavior, they do not clarify how such gaze patterns are functionally related to pedagogical behavior and feedback during instructional practice. Therefore, further research is needed to understand how visual attention contributes not only to observation, but also to decision-making and pedagogical regulation in group fitness contexts.

Although pedagogical behavior and pedagogical feedback of fitness instructors have been previously characterized, and gaze patterns have recently been analyzed using ETS technology, these dimensions have been mostly studied separately. From a contemporary perspective grounded in ecological dynamics and perceptual-cognitive approaches, this separation may limit the understanding of how instructional behavior emerges in real-world contexts. Instructional intervention in group fitness settings is inherently dynamic and context-dependent, requiring continuous interaction between perception, decision-making, and action. Therefore, analyzing these

components in isolation may overlook the mechanisms through which instructors integrate visual information to regulate their pedagogical behavior and feedback.

To date, there is a lack of integrative research examining how instructors' gaze patterns are associated with their pedagogical behavior and feedback during a fitness class. This gap is particularly relevant in group contexts, where instructors must rapidly interpret participants' performance and make ongoing decisions regarding instruction, correction, and communication. Understanding this relationship is essential to clarify the perceptual-decision mechanisms underlying pedagogical intervention, as well as to provide a more comprehensive perspective on instructional expertise in applied settings.

Considering that the fitness instructor's professional experience is a variable directly related to the technical intervention quality (Braga-Pereira et al., 2025; Ramos et al., 2021; Campos et al., 2023a; Franco et al., 2020), the main objectives of this research are to examine the association between gaze patterns and (i) pedagogical behavior and (ii) pedagogical feedback in Aerobics instructors, comparing novice and expert professionals. By adopting this integrative approach, the present study aims to contribute to a better understanding of how visual perception supports instructional decision-making in group fitness contexts. The accomplishment of this study will provide relevant insights into how Aerobics fitness instructors with different levels of professional experience observe their classes and whether statistically significant associations exist between their gaze patterns, pedagogical behaviors, and feedback processes.

Material & methods

Participants

Considering the two objectives, eight Aerobics fitness instructors participated in this study, aged between 21 and 42 years ($\bar{x} \pm SD = 28.75 \pm 7.91$), divided in two groups, according to their professional experience:

- Group 1 (G1): Novice Instructors (NoI), recently graduated (less than a year) in a Sports Science Bachelor's degree ($n = 4$; 2 f, $22.00 \pm .81$ years old).
- Group 2 (G2): Expertise Instructors (ExI) ($n = 4$; 2 f, 35.50 ± 4.50 years old), with relevant experience (more than 10 years) as group fitness instructor (13.75 ± 4.50 years).

Given the exploratory nature of the study and the use of ETS technology under real conditions, a small but well-defined sample was adopted, allowing for an in-depth analysis of instructors' pedagogical patterns.

After definition of the profile of each group, based on professional experience, Aerobics fitness instructors were invited to participate, being informed about the aim, task and protocol: warm-up phase; approximate duration of three to six minutes; music with 130 to 140 beats per minute (BPM); total pyramid or pairs pyramid as choreographic methodologies; spatial organization (instructor and participants) previously defined (Campos et al., 2023a); beginner class (20 participants). The procedures and settings aimed to ensure comparable conditions across the different sessions and instructors under analysis.

Instruments

To analyze the Aerobics fitness instructor pedagogical behavior SOCIF-AG was used. This observation system presents six dimensions and 33 categories (Franco et al., 2008; 2012):

- Instruction: Information with Exercise (Ins-IE); Information without Exercise (Ins-I); De-monstration with Information (Ins-DI); Demonstration without Information (Ins-D); Correction with Exercise (Ins-CE); Correction without Exercise (Ins-C); Positive Evaluation with Exercise (Ins-PEE); Positive Evaluation without Exercise (Ins-PE); Negative Evaluation with Exercise (Ins-NEE); Negative Evaluation without Exercise (Ins-NE); Questioning with Exercise (Ins-QE); Questioning without Exercise (Ins-Q).
- Interaction: Positive Affectivity with Exercise (Int-PAE); Positive Affectivity without Exercise (Int-PA); Negative Affectivity with Exercise (Int-NAE); Negative Affectivity without Exercise (Int-NA); Pressure with Exercise (Int-PE); Pressure without Exercise (Int-P); Conversations with Participants with Exercise (Int-CPE); Conversations with Participants without Exercise (Int-CP); Conversations with Others with Exercise (Int-COE); Conversations with Others without Exercise (Int-CO).
- Activity: Participative Physical Exercise (A-PPE); Independent Physical Exercise (A-IPE).
- Control: Observation with Exercise (C-OE); Observation without Exercise (C-O); Attention to the Verbal Interventions of the Participants with Exercise (C-AVIP); Attention to the Verbal Interventions of the Participants without Exercise (C-AVIP); Attention to the Verbal Interventions of Others with Exercise (C-AVIOE); Attention to the Verbal Interventions of Others without Exercise (C-AVIO).
- Organization: Management with Exercise (O-ME); Management without Exercise (O-M).
- Other Behaviors.

On the other hand, to analyze the instructors' pedagogical feedback, was used SOFIF. Together, SOCIF-AG and SOFIF allow the characterization of both general pedagogical instructors behaviors and their specific pedagogical responses to participants' motor performance. This observation system presents 11 dimensions and 45 categories (Simões et al., 2009; 2020). In this study, like in Campos et al. (2023a), only the dimensions and categories effectively observed during the warm-up phase were analyzed (four dimensions and 26 categories), ensuring methodological relevance and avoiding artificial inflation of zero-frequency categories:

- Purpose: Positive Evaluative (P-PE); Negative Evaluative (P-NE); Positive Prescriptive (P-PP); Negative Prescriptive (P-NP); Correct Model Descriptive (P-CMD); Error Descriptive (P-ED); Neutral Descriptive (P-ND); Interrogative (P-I).
- Content: Exercise Name (C-EN); Breathing (C-B); Muscle Action (C-MA); Spatial Orientation (C-SO); Rhythm (C-R); Body Segment Positioning (C-BSP); Mixed (C-M); No Content (C-NC).
- Form: Verbal (F-Ve); Visual (F-Vi); Kinesthetic (F-K); Mixed Verbal-Visual (F-MVeVi); Mixed Verbal-Kinesthetic (F-MVeK); Mixed Visual-Kinesthetic (F-MViK); Mixed Verbal-Visual-Kinesthetic (F-MVeViK).
- Direction: Individual (D-I); Group (D-G); Class (D-C).

To capture, record, map and access eye movements, and analyze the gaze patterns of the Aerobics fitness instructors, the TOBII PRO 3 eye-tracking glasses (ETG) were used (Danderyd, Sweden), and all data was coded and analyzed with TOBII PRO LAB software.

The eye-tracking data were used to characterize instructor visual attention allocation during pedagogical decision-making. Specifically, the fixation count and fixation duration were selected due to their relevance for understanding how instructors visually monitor, interpret, and respond to participants' performance. Together, the three instruments used enable a multilevel analysis of instructors' pedagogical intervention, from visual perception (eye-tracking), to pedagogical behavior (SOCIF-AG), and feedback (SOFIF), allowing an integrative analysis of perceptual-pedagogical relations in Aerobics fitness instruction.

Procedures

All sessions were recorded, later visualized in Windows Media Player. Video recordings were used to allow repeated and detailed observation of instructors' pedagogical behavior and feedback, ensuring accuracy and consistency in the coding process. Instructor behavior (SOCIF-AG) and pedagogical feedback (SOFIF) was registered in Microsoft Excel, from the moment they are positioned for the beginning of the class. In SOCIF-AG, the time registered of different behaviors (duration) was converted to percentage values, considering the total time of each class. In SOFIF, a frequency register of the different feedback was made, and their respective relation per unit of time (minute), equally considering the total time of each class. All eye-tracking, behavioral and pedagogical feedback data were synchronized at the session level, allowing the integration of gaze patterns with observed pedagogical behaviors and feedback.

For the gaze patterns analysis, and also before collecting data, individual calibration of the ETG was made before the start of the proposed task. Fixations are the variable under analysis, in terms of count [fixations per minute (f/m)] and duration [seconds per minute of class (s/m)]. For a more accurate analysis, results were presented in total (T) perspective, regardless of the location of the fixation, and stratified by area of interest (AOI). One main AOI was defined – the participants – and, in them, three sub AOI: head (H); upper body (UB); lower body (LB).

The standardized procedures aimed to minimize contextual variability and to ensure that observed differences were primarily related to instructors' perceptual and pedagogical characteristics.

Statistical analysis

The eight warm-up classes under analysis present an average duration of 320.50 seconds. The Pearson correlation test is used, after validation of its assumption of normality, to examine the association between gaze patterns (fixations number and duration) of Aerobics instructors with their pedagogical behavior (SOCIF-AG) and feedback (SOFIF) (Campos et al., 2023b, 2023c). For samples below 30, the assumption of normality was verified using Shapiro-Wilk test (Marôco, 2018). Despite the sample size, parametric correlation was considered appropriate based on the distributional characteristics of the data. When normality was not verified, symmetry analysis was resorted to the condition: skewness / standard error skewness ≤ 1.96 (Field, 2019).

The following correlation scale was adopted (Glass & Hopkins, 1996) to classify correlation intensity: trivial ($r < .10$); small ($.10 \leq r < .30$); moderate ($.30 \leq r < .50$); large ($.50 \leq r < .70$); very large ($.70 \leq r < .90$); nearly perfect ($r \geq .90$). Accordingly, greater emphasis was placed on the magnitude and direction of the associations than on strict inferential generalization.

Statistical analysis is performed using IBM Statistical Package for the Social Sciences (SPSS), V29, for a significant level of 5% ($p < .05$). Given the exploratory nature of the study and sample size, correlation analyses were interpreted as indicators of association patterns rather than as stable population estimates.

Results

Aerobics fitness instructor's pedagogical behavior

Of the 33 categories and six dimensions of SOCIF-AG, only 10 categories from three dimensions were coded during the analyzed period.

In novice instructors, very large positive correlations were observed between fixation count on the lower body area of interest and the frequency of Ins-QE behaviors ($r = .99$; $p = .009$). Very large negative correlations were observed between fixation duration on the head area of interest and the frequency of Ins-IE behaviors ($r = -.97$; $p = .026$) (Table 1).

Table 1. Correlation of the gaze patterns (fixations) with pedagogical behaviors (G1 – NoI).

	AOI	Instruction					Interaction			Control	
		Ins-IE	Ins-I	Ins-DI	Ins-PEE	Ins-QE	Int-PAE	Int-PA	Int-PE	C-OE	C-O
DURATION COUNT (f/m)	T	.80	.31	-.12	-.19	.91	-.24	.53	-.73	-.57	.05
	H	-.33	.91	.78	.82	-.23	-.01	.78	.68	-.09	-.68
	UB	.56	.53	-.01	-.04	.72	-.42	.69	-.44	-.40	-.01
	LB	.94	.14	-.14	-.23	.99*	.01	.38	-.88	-.70	.02
DURATION COUNT (s/m)	T	.87	.53	.40	.31	.89	.37	.71	-.57	-.94	-.51
	H	-.97*	-.29	-.15	-.04	-.77	-.29	-.51	.78	.89	.27
	UB	.45	.83	.41	.38	.60	-.16	.93	-.16	-.54	-.41
	LB	.57	-.69	-.39	-.46	.41	.47	-.55	-.72	-.33	.25

*significant for $p < .05$

In expert instructors, very large positive correlations were observed between fixation count on the total area of interest and the frequency of Ins-DI behaviors ($r = .97$; $p = .030$), as well as on the head area of interest and Int-PA behaviors ($r = .96$; $p = .034$).

Table 2. Correlation of the gaze patterns (fixations) with pedagogical behaviors (G2 – ExI).

	AOI	Instruction					Interaction			Control	
		Ins-IE	Ins-I	Ins-DI	Ins-PEE	Ins-QE	Int-PAE	Int-PA	Int-PE	C-OE	C-O
DURATION COUNT (f/m)	T	-.39	.75	.97*	.15	.78	-.22	.86	.91	-.80	.87
	H	-.54	.89	.54	.67	.82	-.61	.96*	.71	-.25	.76
	UB	-.11	-.03	.49	-.87	.18	.77	-.19	.08	-.55	-.11
	LB	.81	-.41	.33	.22	.12	-.45	.09	.52	-.65	-.08
DURATION COUNT (s/m)	T	-.67	.82	.88	-.14	.89	.14	.70	.66	-.63	.79
	H	-.05	-.09	.47	-.87	.14	.76	-.23	.06	-.55	-.15
	UB	-.01	.47	.30	.94	.55	-.75	.80	.68	-.21	.69
	LB	-.32	.78	.74	.62	.91	-.64	.79	.91	-.55	.94

*significant for $p < .05$ *Aerobics fitness instructor's pedagogical feedback*

Of the 45 categories and 11 dimensions of SOFIF, 16 categories from four dimensions were coded during the analyzed phase. In novice instructors, very large positive correlations were observed between fixation duration on the total area of interest and the frequency of P-CMD ($r = .95$; $p = .043$), F-Ve ($r = .95$; $p = .047$), and D-I feedback ($r = .99$; $p = .003$). Very large negative correlations were observed between fixation duration on the head area of interest and the frequency of F-Ve ($r = -.95$; $p = .048$) and D-I feedback ($r = -.95$; $p = .041$)(Table 3).

Table 3. Correlation of the gaze patterns (fixations) with pedagogical feedback (G1 – NoI).

	AOI	Purpose				Content				Form		Direction		
		P-	P-	P-	P-I	C-	C-	C-	C-R	C-	F-	F-	D-I	D-C
DURATION COUNT (f/m)	T	-.01	-.33	.82	.17	-.60	.09	.47	.18	.41	.65	-.38	.82	.09
	H	-.06	.25	.36	-.08	.70	-.45	-.26	.32	-.57	-.06	.29	.17	.52
	UB	-.23	-.05	.81	.33	-.27	-.22	.54	.46	.07	.45	-.09	.72	.42
	LB	.23	-.58	.79	-.04	-.81	.39	.30	-.11	.68	.80	-.62	.86	-.21
DURATION COUNT (s/m)	T	.56	-.75	.95*	-.45	-.59	.50	-.16	-.33	.64	.95*	-.76	.99*	-.31
	H	-.51	.77	-.87	.35	.78	-.57	.01	.34	-.76	.95*	.80	-.95*	.39
	UB	-.01	-.14	.91	.04	-.05	-.17	.18	.31	.01	.52	-.15	.79	.37
	LB	.53	-.67	-.09	-.38	-.84	.82	-.14	-.72	.86	.44	-.69	.13	-.85

*significant for $p < .05$

In expert instructors, very large positive correlations were observed between fixation count on the total area of interest and the frequency of C-BSP feedback ($r = .97$; $p = .026$), as well as between fixation count on the head area of interest and F-Ve feedback ($r = .99$; $p = .003$). Very large positive correlations were also observed between fixation duration on the total area of interest and the frequency of P-PE feedback ($r = .99$; $p = .008$), between fixation duration on the upper body area of interest and P-PP ($r = .96$; $p = .032$), C-SO ($r = .97$; $p = .024$), C-R ($r = .96$; $p = .038$), F-VeVi ($r = .95$; $p = .047$), D-I ($r = .99$; $p = .008$), and D-C feedback ($r = .96$; $p = .040$). Additionally, also very large positive correlation were observed between fixation duration on lower body area of interest and the frequency of P-I ($r = .99$; $p = .008$) and C-R feedback ($r = .95$; $p = .045$) (Table 4).

Table 4. Correlation of the gaze patterns (fixations) with pedagogical feedback (G2 – ExI).

	AOI	Purpose				Content				Form			Direction	
		P-PE	P-PP	P-CMD	P-I	C-EN	C-MA	C-SO	C-R	C-BSP	F-Ve	F-VeVi	D-I	D-C
DURATION COUNT (f/m)	T	.87	.46	-.67	.79	-.02	-.14	.64	.68	.97*	.69	.17	.57	.50
	H	.64	.90	-.20	.94	.59	.26	.90	.91	.83	.99*	.67	.86	.92
	UB	.44	-.69	-.80	-.32	-.75	-.22	-.51	-.46	.19	-.38	-.85	-.57	-.65
	LB	-.26	.06	.25	.21	.07	-.78	.27	.28	.01	-.18	.25	.33	.04
DURATION COUNT (s/m)	T	.99*	.22	-.89	.56	-.28	.15	.35	.40	.92	.59	-.13	.26	.28
	H	.39	-.72	-.77	-.35	-.76	-.26	-.53	-.48	.15	-.43	-.86	-.59	-.68
	UB	.15	.96*	.31	.89	.85	-.11	.97*	.96*	.51	.79	.95*	.99*	.96*
	LB	.65	.84	-.25	.99*	.47	-.06	.93	.95*	.89	.90	.63	.89	.86

*significant for $p < .05$

Discussion

This study aimed to explore the association between instructors' visual patterns, pedagogical behavior, and pedagogical feedback during Aerobics warm-up classes. Overall, the results suggest that distinct gaze patterns were associated with different pedagogical intervention profile. These associations were particularly evident when comparing novice and expert fitness instructors. The present research builds on three previous studies conducted sequentially in the context of Aerobics fitness instruction, focusing on pedagogical behaviors (Campos et al., 2023c), pedagogical feedback (Campos et al., 2023b), and gaze patterns (Campos et al., 2023a), according to instructors' training and experience.

From an integrative perspective, the present findings suggest that instructors' visual attention, pedagogical behavior, and feedback operate as interconnected components of instructional decision-making in Aerobics fitness classes. Observed associations indicate that where instructors direct their visual attention is closely related not only to how they regulate class activities, but also to how they communicate, adjust, and reinforce participants' performance. This multilevel relationship appears to reflect a perceptual-pedagogical chain in which visual information supports ongoing decisions about intervention and explanation during group fitness instruction. This interpretation is consistent with ecological dynamics perspectives, which conceptualize coaching behavior as an adaptive and context-dependent process emerging from the interaction between individual, task and environmental constraints.

Within this integrative framework, the tendency of novice instructors to direct visual attention more frequently toward participants' lower body may reflect a greater reliance on observable motor execution cues during the class monitoring (Campos et al., 2023a). This focus on lower body areas is particularly relevant in Aerobics contexts, where rhythm, coordination, and synchronization with music constitute key elements of motor performance (Campos et al., 2021).

However, privileging visual information from these areas may limit access to affective and cognitive cues, such as misunderstanding or fatigue, which are more readily perceived in the head area. In this sense, the observed gaze patterns of novice instructors could help explain the higher frequency of questioning behaviors and directive feedback, as questioning is often used to verify participants' understanding, physical state, or the need to adapt task complexity/intensity (Franco et al., 2021). Together, these patterns indicate that novice instructors may rely on a more reactive perceptual-pedagogical strategy, in which visual monitoring of motor execution supports immediate pedagogical interventions during the class. Such reactive patterns are also compatible with ecological dynamics reasoning, where expertise is viewed as the progressive attunement to relevant environmental information that enables more flexible and anticipatory instructional action.

Expert instructors displayed higher fixation rates per minute at a global level, which were consistently associated with demonstrative instructional behaviors, namely Ins-DI. This pattern supports the idea that the demonstration, combined with verbal and/or visual explanation, constitutes a pedagogical strategy that facilitates clearer transmission of task-related information (Franco et al., 2012; Francis & Seibert, 2000). In this sense, visual attention appears to support anticipatory instructional regulation, allowing the expert instructors to simultaneously monitor participants while providing structured demonstrations. Additionally, the association between gaze directed to participants' head and interaction behaviors suggests that expert instructors may rely more strongly on face-oriented cues to assess the comprehension, effort, and engagement, thereby enabling timely pedagogical adjustments during class progression.

Regarding feedback, expert instructors tended to allocate visual attention to specific areas of interest according to the informational demand of the task. The increased fixation time in the head area was associated with feedback focused on correctness and clarification (e.g., F-Ve, D-I), suggesting that face-oriented gaze supports fine-tuning of instructional messages and reinforces precision in the pedagogical communication (Simões et al., 2009; 2020). These interpretations align with pedagogically grounded views of coach learning, highlighting the importance of intentional instructional design, reflective engagement and purposeful regulation of pedagogical behavior. Conversely, gaze directed toward upper and lower body areas appeared to support feedback related to the technical execution and spatial orientation, indicating that expert instructors flexibly adapt their visual strategies to pedagogical intent underlying the feedback provided. This adaptive use of visual attention reinforces the notion of a tightly coupled perceptual-pedagogical system in expert instructional practice.

Taken together, the findings suggest that instructional experience is associated with more differentiated and purposeful visual attention strategies, which support higher-quality pedagogical behavior and feedback. In line with pedagogically informed approaches to coach development, these findings suggest that structured learning environments may help instructors refine their ability to integrate observation, communication and feedback in meaningful ways.

Expert instructors appear to use gaze not merely as a monitoring tool, but as an active component of instructional decision-making, enabling more individualized, timely, and context-sensitive interventions (Campos et al., 2023a). In contrast to more reactive strategies observed in novice instructors, expert gaze patterns reflect a proactive pedagogical approach, in which visual information is systematically integrated to regulate demonstration, explanation, and feedback during Aerobics classes. This reinforces the relevance of visual perception as a key mechanism underpinning effective pedagogical intervention in group fitness contexts.

Conclusions

This study explored the associations between instructors' visual patterns, pedagogical behavior, and feedback during Aerobics warm-up classes, adopting an integrative perceptual-pedagogical perspective. The findings indicate that professional experience is associated with distinct ways of visually observing the class, which, in turn, relate to differentiated pedagogical intervention profile. Instructors with greater experience tend to distribute their visual attention more broadly and strategically while novice instructors show more localized and execution-focused gaze patterns, reflecting different approaches to instructional decision-making in group fitness contexts.

From an applied perspective, the results highlight that instructors' visual monitoring of participants, in terms of both gaze location and duration, is closely linked to how they regulate class activities, communicate instructions, and provide feedback. These findings reinforce the idea that visual perception constitutes a central component of the pedagogical expertise in Aerobics instruction, supporting ongoing decisions related to explanation, correction, demonstration, and motivational feedback during a class instruction.

The present study also offers relevant implications for instructor training and professional development. Rather than viewing experience as a factor that only accumulates over time, results suggest that training programs may benefit from explicitly addressing visual attention strategies and their pedagogical consequences. Incorporating perceptual-decision-making components into instructor training, both in initial and continuing development, may contribute to more effective instructional behaviors and improved quality.

Despite its contributions, this study presents some limitations. The reduced number of participants, the focus on a single activity (Aerobics), and the analysis restricted to the warm-up phase limit the generalizability of the findings. Future research should consider larger samples, different phases of the class, and comparisons across other group activities (e.g., Water Aerobics, Indoor Cycling), where the spatial constraints and instructional demands differ substantially. Such approaches may further clarify how visual attention supports the pedagogical regulation across diverse fitness contexts.

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Conflict of interest

The authors declare no conflicts of interest.

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