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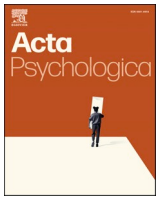

Verbal encouragement during strength and endurance assessments: The gender of the encourager can matter

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ABSTRACT

Research supports using verbal encouragement (VE) to improve performance in strength and endurance exercises. However, there is still a gap in understanding how the gender of the coach or teacher affects the efficacy of VE. This study examines whether the teacher's gender influences performance in strength and endurance assessments among male and female student-athletes. In a crossover randomized controlled design, 16 male and 16 female student-athletes (mean age 20.9 ± 0.9 years) completed one-repetition maximum (1RM) tests in Squat, Deadlift, and Bench press, as well as 8-min time trials (8MTT), under normal conditions and with VE—first from a male teacher and then from a female teacher. A counterbalancing procedure over eight weeks controlled for confounding factors related to exposure order (without and with VE), test order (1RM and 8MTT), and time of day (morning and afternoon). Male student-athletes showed significant improvements nearly across all tests ($p < 0.01$ to $p < 0.001$) under VE from both male and female teachers, with no significant interaction "Condition × Teacher Gender" effect ($p > 0.05$). Female student-athletes also demonstrated significant improvements ($p < 0.05$ to $p < 0.001$), with an interaction effect favoring VE from the female teacher ($p < 0.05$ to $p < 0.01$) in all tests except the squat. In conclusion, female student-athletes demonstrated statistically significant performance improvements with female teacher VE. Male student-athletes also showed improvements, though not statistically significant, with female teacher VE. It is therefore recommended that stakeholders in athletic clubs and educational institutions take into account gender when assigning coaches/teachers to mixed-gender groups, particularly for strength and endurance training, in order to optimize the efficacy of VE. This research provides novel data supporting the increased representation of women in coaching and physical education, specifically in relation to VE efficacy.

1. Introduction

Strength and endurance are fundamental physical qualities that underpin athletic performance across a wide range of sports (Leveritt et al., 1999). Strength, defined as the ability of muscles to generate force, is crucial for movements requiring power, speed, and resistance against external forces (Chromiak & Mulvaney, 1990). Endurance, on the other hand, refers to the capacity to sustain physical activity over an extended period, involving both muscular endurance and cardiovascular efficiency (Hickson et al., 1988). Together, these qualities contribute significantly to physical performance, whether in explosive exercises such as sprinting and weightlifting or in prolonged ones such as long-distance running and cycling (Stone et al., 2006). Despite significant efforts to implement effective training programs, summative assessments may not yield optimal physical performances (Radcliffe, 2018). This underperformance is not necessarily attributable to previous inadequacies in training but can often result from unsuitable assessment environments, instant influencing factors, or missing elements during

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the assessment process (Greenleaf et al., 2001; Radcliffe, 2018). Indeed, assessment outcomes have become a significant concern for sports practitioners, as they serve as the primary indicator of the effectiveness of their training programs (Short & Short, 2004). Consequently, they are in a continuous search for optimal strategies to apply during assessments to ensure peak performance and accurately reflect the benefits of their training efforts.

One of the strategies that has proven instrumental in enhancing physical performance is verbal encouragement (VE) (Charlina et al., 2024; Midgley et al., 2018). The sports science literature is rich with evidence supporting the effectiveness of VE, whether provided by pedagogues—coaches and teachers—or even peers, in boosting performance during assessments (Jaffri & Saliba, 2021; Jung & Hallbeck, 1999; McNair et al., 1996; Neto et al., 2015; Pacholek & Zemková, 2022; Rendos et al., 2019; Selmi et al., 2023). When specifically discussing strength and endurance assessments, there is also a substantial body of evidence demonstrating the positive impact of VE. One of the most recent contributions comes from Romdhani, Sahli, Ghouili, et al. (2024), who argue that performances of student-athletes in strength exercises—particularly the squat, deadlift, and bench press exercises—as well as endurance tasks such as the 8-min time trials (8MTT), are significantly enhanced when VE is provided by the teacher, compared to conditions without any form of VE. Similarly, the findings of Pacholek [18] underscore the effectiveness of VE in enhancing maximum strength and power during bench press exercises. Pacholek, in an earlier study (Pacholek, 2023), also confirmed that VE enhances endurance performance, particularly by increasing maximum oxygen uptake and maximal heart rate, thereby improving the distance covered in the beep test. More detailed findings from Belkhiria et al. (2018) reveal that VE significantly enhances force production, specifically maximal voluntary force and maximal rate of force development, along with neuromuscular activity. These enhancements are supported by electromyographic data collected during isometric force exercises, indicating that VE boosts performance metrics coincidentally and fundamentally influences the underlying muscular activation patterns. The literature supporting the positive effects of VE on strength and endurance performance during assessments spans several decades, providing substantial evidence for its efficacy (Bickers, 1993; Bullinger et al., 2012; Campenella et al., 2000; Jung & Hallbeck, 1999, 2004; Marinho et al., 2014; McNair et al., 1996).

1.1. Theoretical foundations of verbal encouragement

The impact of VE on strength and endurance performances can be understood through several theoretical frameworks. According to the "self-determination theory" (SDT), intrinsic motivation is crucial for achieving optimal performance (Deci & Ryan, 2013). Within this context, VE enhances intrinsic motivation by fostering a sense of competence and autonomy among athletes (McNair et al., 1996). Positive words from teachers/coaches, or peers elevate individuals' feelings of capability and motivate them to exert greater effort, ultimately improving their performance in strength and endurance tasks (Romdhani, Sahli, Trabelsi, et al., 2024). Building on this foundation, the "social cognitive theory" (SCT) further elucidates the mechanisms by which VE influences performance (Bandura, 1986). This theory emphasizes the role of social influence in shaping behavior. Here, VE functions as a form of social reinforcement that enhances self-efficacy—an individual's belief in their ability to succeed in specific situations (Tuckman & Sexton, 1991). When athletes experience increased self-efficacy through VE, they are more likely to engage in sustained effort and persistence, leading to improved performance in assessments. Incorporating these concepts, the "cognitive evaluation theory" (CET), a subset of SDT, explores how external factors such as VE can impact intrinsic motivation (Deci & Ryan, 2000). The CET suggests that individuals who perceive VE as supportive and affirming are more likely to enhance their intrinsic motivation (Wong, 2015). The effectiveness of VE is contingent upon its delivery—specifically, its sincerity and relevance—thereby significantly affecting performance outcomes (Daniels, 1993). Considering the broader implications of these theories, the "expectancy theory" (ET) offers another perspective, positing that individuals' expectations regarding their performance can profoundly influence actual outcomes (Vroom et al., 2015). VE has the potential to alter athletes' expectations, instilling in them the belief that they can perform at a higher level (Wong, 2015). This perception shift is likely to enhance their motivation and effort, leading to improved strength and endurance performance during assessments.

While VE has been widely documented to enhance performance, it is important to acknowledge its potential limitations. For instance, excessive VE might inadvertently increase the pressure on some athletes to perform, leading to heightened performance anxiety (Midgley et al., 2018). Moreover, an overemphasis on quantitative performance metrics driven by constant encouragement could detract from the development of intrinsic motivation and holistic athletic growth (Sullivan, 2019). These considerations highlight the need for a balanced application of VE, ensuring that its motivational benefits do not come at the cost of athlete well-being.

Research has now moved beyond simply demonstrating the effectiveness of VE on strength and endurance performances. It has reached a stage focused on optimizing this effectiveness. In the present study, the gender of the encourager is examined. This focus arises from theoretical perspectives suggesting that the gender of the pedagogue can significantly influence outcomes, depending on the specific context and the individuals involved. One relevant theory is the "social role theory" (Eagly & Wood, 2012), which argues that individuals develop expectations about behaviors based on socially constructed roles, including gender roles. Applied to the context of this study, this theory might explain that students could perceive VE differently depending on the teacher's gender. For instance, traditional gender roles could lead individuals to view females as more nurturing and supportive (Flaherty & Richman, 1989), which might elicit a more positive response to their VE. Another theoretical foundation guiding this study is the "gender schema theory" (Bem, 1981), which posits that cultural definitions of gender are internalized, shaping the perceptions and behaviors of people. Viewed through the lens of this research, this theory might suggest that individuals may interpret and respond to VE differently based on their gendered expectations of the encourager. For instance, it is hypothesized that VE from a male teacher/coach may be perceived as more authoritative, which could elicit a stronger response in contexts emphasizing discipline or achievement. Male teachers and coaches are often characterized as exhibiting more dominant behaviors and assertive communication styles due to a combination of socialization patterns, cultural expectations, and gender norms (Fasting & Pfister, 2000; Pratt & Eitzen, 1989; Zamir, 2021). It is also hypothesized that VE from a female teacher/coach may be interpreted as emotionally supportive, resulting in a distinct motivational response that aligns with traditional gender expectations. This hypothesis stems from societal norms and gender roles associating femininity with nurturing, empathy, and emotional expressiveness (Fischer & Manstead, 2000; Mestre et al., 2009). Female pedagogues often embody characteristics that are traditionally viewed as supportive and caring (Flaherty & Richman, 1989), which could influence how their VE is received by individuals engaged in assessments.

All these propositions remain hypotheses, necessitating empirical investigation to establish their validity. While theoretical frameworks provide valuable insights into the potential influence of the encourager's gender VE and subsequent performance outcomes, they lack robust evidence derived from on-field research. This study primarily aims to investigate whether the gender of the teacher providing VE affects student-athlete performance during strength and endurance assessments. The central questions guiding this research are: If a male student-athlete receives VE from both a male and a female teacher during strength and endurance assessments, would the outcomes be affected by the teacher's gender? Similarly, if the student-athlete receiving VE is

female, would her performance outcomes be affected by the teacher's gender? If any differences exist in how student-athletes respond to VE based on the gender of the teacher, and if one gender significantly favors VE from a specific teacher gender, important implications arise.

2. Methods

2.1. Participants

The selection process implemented to fulfill the objectives of this study resulted in the inclusion of 32 student-athletes enrolled at the High Institute of Sport and Physical Education of Kef, University of Jendouba, Tunisia, with an average age of 20.9 ± 0.9 years. The sample comprised 16 males and 16 females. The student-athletes volunteered to participate in response to an advertisement for the study. To ensure equal representation, the inclusion of female participants was capped at 16, matching the number of male volunteers who responded. The male participants had an average body mass of 71.3 ± 7.8 kg, a body height of 178.8 ± 11.1 cm, and a body mass index (BMI) of 22.3 ± 2.1 kg/m^2. On the other hand, the female participants had an average body mass of 59.5 ± 9.1 kg, a body height of 164.7 ± 7.8 cm, and a BMI of 21.9 ± 2.4 kg/m^2. All participants were undergraduate students in sports science, with at least two years of structured training experience as part of their academic curriculum. Their background included regular exposure to both strength and endurance exercises, including 1RM assessments, maximizing familiarity with the study procedures. However, none of the participants were specialized athletes in powerlifting, CrossFit, weightlifting, or endurance sports, minimizing potential biases linked to advanced training specialization.

Initially, 41 student-athletes expressed a willingness to volunteer; however, this number was narrowed to 32 due to forced and unforced exclusions. First, the following criteria were applied: (a) the participant must not be actively engaged in sports that provide a competitive advantage in the specific assessments conducted in this study. This includes sports that are highly specialized in strength or anaerobic performance (e.g., weightlifting, sprinting) as well as those focused on aerobic endurance (e.g., marathon running), to ensure a relatively homogeneous baseline in performance capabilities; (b) the participant must be in good health at the time of the study, without any illnesses or injuries that could adversely affect their performance across test sessions; and (c) the participant must possess a normal body mass index (BMI = 18.5 to 24.9 kg/m^2) in accordance with established guidelines (WHO, 2000), ensuring that body composition does not skew performance outcomes. Then, the eligible participant pool comprised 18 males and 16 females. To achieve balanced gender representation, two male students were randomly excluded from the study before its commencement. Fortunately, there were no recorded dropouts during the study.

2.2. Legal and ethical considerations

Before the study commenced, all necessary legal authorizations were obtained from relevant stakeholders, including the director of the High Institute of Sports and Physical Education of Kef (study site) and the teachers involved. The project of the study was reviewed and approved by the research ethics committee at the High Institute of Sports and Physical Education of Kef (Approval Code: 0084–2023) on June 16, 2023. This research strictly adheres to the ethical guidelines for research practices in sports science as established by Guelmami et al. (2024). All participating student-athletes received an informed consent letter, including details about the administrators, the study procedure, and potential risks. Participation was allowed only after students signed the consent letter, thereby confirming their agreement.

2.3. Study design

This study employed a crossover randomized controlled design. Male and female student-athletes were treated separately at different times but received the same exposures and followed identical procedures. The male participants (n = 16) were randomly assigned into two equal groups, as were the female participants (n = 16), to implement a counterbalancing procedure, as outlined in Table 1. This resulted in two groups for each gender: Group 1 Males, Group 2 Males, Group 1 Females, and Group 2 Females. This counterbalancing aimed to control for potential confounding variables related to the order of exposure to conditions (with or without VE) and the order of tests administered during each testing session (1RM or 8MTT). The time of day was also controlled to align with circadian rhythm influences on physical performance (see Table 1). To ensure that the same male and female teachers worked with both male and female student-athletes, conducting the experiments simultaneously was impossible. Thus, it was randomly determined that male student-athletes would complete their sessions during the first two weeks, followed by female student-athletes in the subsequent two weeks, serving as a washout period for the males, and so on (see Table 1). It was randomly assigned that both male and female student-athletes would first be exposed to a female teacher, followed by a male teacher after a 2-week washout period (see Table 1). Furthermore, the washout period between strength and endurance assessments each week ranged from 72 to 96 h, in accordance with the recommendations of Bouchiba et al. (2022) regarding recovery from neuromuscular fatigue.

During the washout period, participants were instructed to refrain from any high-intensity and overloading strength and endurance activity, including heavy resistance training, prolonged cardiovascular exercises, or any form of physical exertion that could induce significant muscle fatigue or soreness. This precaution was emphasized to ensure that participants began each testing session in a fully recovered state, thereby minimizing any residual fatigue that could potentially influence performance outcomes and to minimize biased enhancement in performance in the upcoming testing.

2.4. Study procedures

2.4.1. Familiarization

To ensure participants were well-prepared and confident in the testing procedures, separate familiarization sessions were conducted for male and female student-athletes, each held one week before the main experiment. During these sessions, participants were given sufficient time to practice with the instruments and equipment that will be used during the study while male and female teachers provided VE. Correct execution of each test was demonstrated through video modeling, and participants received thorough instructions to ensure they fully understood the proper techniques and procedures. Anthropometric measurements, such as height and weight, were recorded at the beginning of each familiarization session.

During familiarization sessions, we employed an estimation procedure to determine the initial weight for the one-repetition maximum (1RM) in the squat, deadlift, and bench press tasks for each participant. This procedure required participants to perform a series of submaximal lifts with gradually increasing loads. Based on their performance and feedback, an appropriate starting weight was estimated to allow participants to safely and effectively progress toward their actual 1RM during experimental sessions. This aimed to challenge participants while minimizing injury risk and fatigue. Having an initial estimate of each participant's strength capabilities helped avoid unnecessary attempts with non-challenging weights, thereby optimizing time during experimental sessions.

2.4.2. Exposures

Overall, the study spanned four experimental weeks, during which

Table 1
Counterbalancing procedure for male and female participants: detailed explanation.

Teacher	Students	Washout	Week	Session	Group	Condition		Time of day		Tests	
						Without VE	With VE	9:00 a.m.	2:00 p.m.	1RM	8MTT
			1	1	1	×		×		×	
				(Mon.)	2		×		×		×
				2	1	×		×			×
				(Thurs.)	2		×		×	×	
F	M		2	3	1		×		×		×
				(Mon.)	2	×		×		×	
				4	1		×		×	×	
				(Thurs.)	2	×		×			×
			3	5	1	×		×		×	
				(Mon.)	2		×		×		×
				6	1	×		×			×
F	F	M		(Thurs.)	2		×		×	×	
			4	7	1		×		×		×
				(Mon.)	2	×		×		×	
				8	1		×		×	×	
				(Thurs.)	2	×		×			×
			5	9	1	×		×		×	
				(Mon.)	2		×		×		×
				10	1	×		×			×
M	M	F		(Thurs.)	2		×		×	×	
			6	11	1		×		×		×
				(Mon.)	2	×		×		×	
				12	1		×		×	×	
				(Thurs.)	2	×		×			×
			7	13	1	×		×		×	
				(Mon.)	2		×		×		×
				14	1	×		×			×
M	F			(Thurs.)	2		×		×	×	
			8	15	1		×		×		×
				(Mon.)	2	×		×		×	
				16	1		×		×	×	
				(Thurs.)	2	×		×			×

Mond., Monday; Thurs., Thursday; VE, Verbal Encouragement; 1RM, One-Rep Maximum Assessments; 8MTT, 8-min Time Trials; M, Male(s); F, Female(s).

male and female student-athletes participated in 16 testing sessions—eight per gender—either without VE or with VE from a male or female teacher, as outlined in Table 1. The sessions took place in the gym of the High Institute of Sport and Physical Education of Kef during October, November, and December. The ambient temperature in the gym ranged from 10 to 21 degrees Celsius, the sessions took place in the gym of the High Institute of Sport and Physical Education of Kef during October, November, and December. The ambient temperature in the gym ranged from 10 to 21 degrees Celsius, depending on the month and time of day. To mitigate potential effects of this variation, warm-up durations were adjusted on colder days, and testing sessions were scheduled to balance morning and afternoon conditions. Furthermore, the crossover design ensured that any temperature-related variability was evenly distributed across both the control and intervention conditions.

A standardized warm-up, including dynamic stretching, cardiovascular exercises, and mobility drills, was conducted before each session to enhance blood flow, flexibility, and muscle activation, ensuring physical readiness for testing. The warm-up lasted 10 to 15 min, with colder days necessitating longer durations to reduce the risk of injury. A standardized warm-up was performed before each session. For strength tests (1RM), it included 5 min of moderate cycling, dynamic stretching, and two sets of submaximal lifts at 50–70 % of estimated 1RM. For endurance tests (8MTT), it consisted of 5 min of jogging, dynamic stretching, and bodyweight exercises. Warm-up durations were adjusted based on ambient temperature, with extended aerobic and mobility drills on colder days (10–15 °C) to ensure optimal muscle activation. Following the warm-up, participants engaged in strength assessments, including 1RM tests for squat, bench press, and deadlift, or endurance assessment in the form of the 8MTT, depending on the specific objectives of the session (see Table 1).

Both the male and female teachers provided VE to participants in the Tunisian dialect throughout each test. They maintained a distance of half to one meter from the student-athletes while they performed the different exercises (see the example in Fig. 1). The standardized expressions included phrases such as “Well done!”, “Keep going”, “You can do it”, and “Don't give up” (interpretive translation). Standardized VE expressions were provided only during the execution of each test, not before. Each participant received multiple encouragements per attempt in strength tests (1RM) and continuously throughout the endurance test (8MTT) to maintain consistency. The frequency and delivery of VE were identical across strength and endurance assessments. Teachers also personalized encouragement by addressing each student by name (e.g., “You can do it, Amin” or “Don't give up, Mariem”) once per testing task, using a loud, energetic, and enthusiastic tone to ensure clarity and motivation.

The same male (28 years old) and female (29 years old) teachers provided VE to both male and female participants to maintain consistency in delivery. Both teachers were certified physical education teachers with expertise in strength and endurance training. The teachers were chosen specifically because they were familiar to the student-athletes, which was intended to enhance receptivity to the VE.

2.5. Data collection

2.5.1. One-Rep maximum (1RM) assessments

During each strength testing session, participants completed two sets of the one-repetition maximum (1RM) tests for squat, deadlift, and bench press. The exercise order followed the recommendations of Simao et al. (2012). Prioritizing exercises involving larger muscle groups before those targeting smaller ones (e.g., bench press before pec-deck fly or squat before leg extension). This sequence was designed to prevent

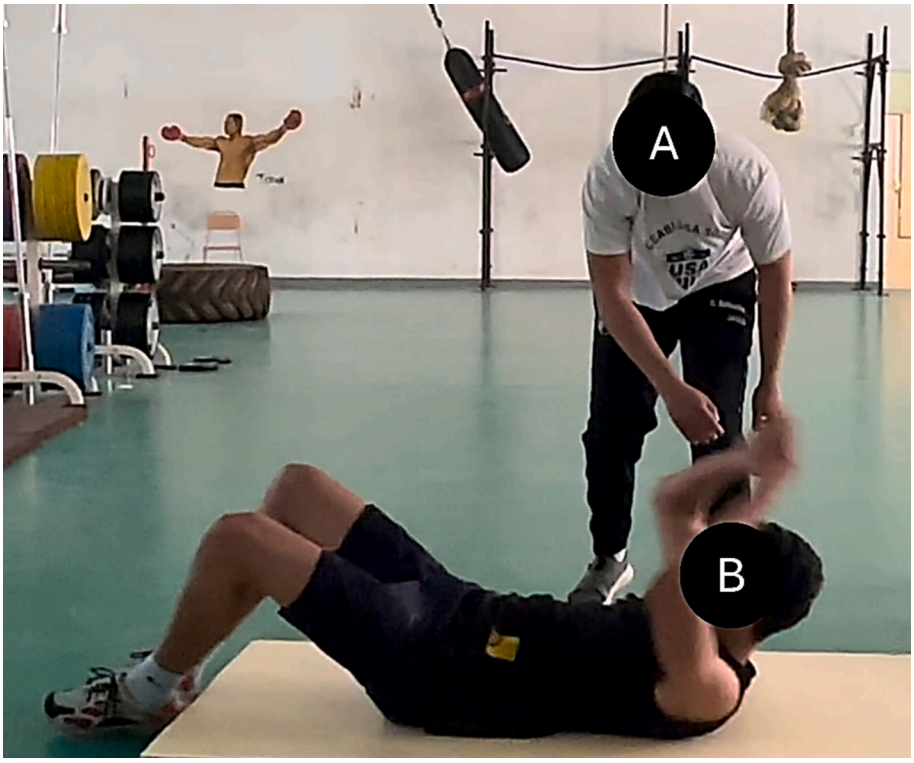

Fig. 1. Male teacher (A) providing verbal encouragement (VE) to male student-athlete (B) during sit-ups in the 8-min time trials (8MTT).

smaller muscle groups (e.g., triceps brachii, anterior deltoids) from becoming fatigued through single-joint exercises, which could impair the performance of larger muscle groups (e.g., pectoralis major) during subsequent multi-joint exercises, ultimately limiting their ability to sustain load or repetitions per set.

During the familiarization session, participants received thorough explanations and demonstrations of the proper technique for each lift. During experimental sessions, the starting weight was set at approximately 80–90 % of the estimated 1RM based on the familiarization session. Participants performed a single repetition at each weight increment. If successful, the load was increased by 2.5–5 kg for upper-body exercises (bench press) and 5–10 kg for lower-body exercises (squat, deadlift) until failure. If a participant failed to lift the initial weight, it was reduced by 2.5–5 kg for a second attempt. A maximum of five attempts was allowed per exercise in each testing session. Standardized rest intervals were applied during the strength testing, consisting of 2 min between repetitions, 3 min between exercises, and 5 min between sets (Sforzo & Touey, 1996). At the end of each session, the heaviest weight successfully lifted in each exercise was recorded for each participant.

2.5.2. 8-min Time Trials (8MTT)

During the endurance testing sessions, participants were required to complete as many rounds as possible of a set of exercises within an 8-min time frame. Each round consisted of 6 repetitions of burpees, 6 repetitions of box jumps, 6 repetitions of hand-release push-ups, and 10 repetitions of sit-ups, after which participants would start again. If participants became fatigued before the 8 min had elapsed, the number of repetitions completed at the point of cessation was recorded. Participants were not allowed to rest for >10 s before resuming their performance within the 8-min time frame. All movements adhered to the standardized range of motion outlined in the High-Intensity Functional Training (HIFT) guidelines established by CrossFit Inc. in 2017. The total number of repetitions completed within the 8-min period served as a measure of endurance capacity, providing valuable insights into their ability to sustain effort and maintain performance over an extended duration.

2.6. Data analyses

In this study, a pooled analysis was conducted separately for each gender, combining the data from both groups ([Group 1 Males + Group 2 Males] and [Group 1 Females + Group 2 Females]) across specific tests (e.g., squat test) under defined conditions (e.g., under VE) and defined teacher gender (e.g., female teacher). This pooling approach was employed irrespective of the session in which each test was performed, ensuring that every participant experienced all conditions or treatments in a balanced and systematic manner (Jones & Kenward, 2003; Senn, 2002).

Datasets for all tests were assessed for normality using the Shapiro-Wilk test and for homogeneity of variances using Levene's test, with both criteria met at $p > 0.05$. This allowed for parametric testing of the 1RM and 8MTT assessments. All statistical analyses were performed utilizing IBM SPSS Statistics (IBM Corp. 2020. *IBM SPSS Statistics for Windows, Version 27.0*. Armonk, NY: IBM Corp.).

A split-plot ANOVA was conducted to analyze the 1RM and 8MTT results, comparing normal conditions (without VE) to experimental conditions with VE (sub-plot factor) and male vs. female teachers (whole plot factor). Significant "Condition × Teacher Gender" interactions indicated different value changes (Δ) after switching to VE conditions. Effect sizes were quantified using partial eta-squared (η_p^2), categorized as small (0.01–0.059), medium (0.06–0.13), and large (≥0.14), following the guidelines of Cohen (1988). The Δ was calculated by subtracting the values collected under normal conditions from those under VE conditions. Comparisons between conditions (sub-plot factor) were conducted using paired *t*-tests, with statistical significance set at $p < 0.05$. Bonferroni adjustments were unnecessary, as single comparisons were possible throughout the analysis.

3. Results

3.1. Results of male student-athletes

The main results showed a significant improvement in performances of male student-athletes in the squat ($p < 0.001$), deadlift ($p < 0.001$), bench press ($p < 0.001$) tests, as well as in the 8MTT when they transition from normal conditions, without exposure to VE, to experimental conditions under a female teacher VE (see Table 2).

The shift from normal conditions without VE to experimental conditions, this time under a male teacher VE, also showed significant improvements in squat ($p < 0.01$), deadlift ($p < 0.01$), and 8MTT ($p < 0.01$). On the other hand, no significant improvement was found in bench press performances ($p > 0.05$). Further details are presented in Table 2.

The key focus of this study is on comparing the score change (Δ) observed among male participants influenced by both male and female teachers VE. Data analyses showed non-significant "Condition × Teacher Gender" interactions ($p > 0.05$) across all tests, suggesting no statistically significant difference in the impact of VE provided by a teacher of the same or opposite gender on strength and endurance performance of male student-athletes. Detailed information is provided in Table 2 and Figs. 2–5.

3.2. Results of female student-athletes

The data analyses revealed significant improvements in the squat ($p < 0.01$), deadlift ($p < 0.001$), and bench press ($p < 0.01$) tests, as well as in the 8MTT test ($p < 0.001$) when female student-athletes shifted from normal to experimental conditions where they received VE from a female teacher (see Table 2).

On the other hand, the improvements observed when shifting from

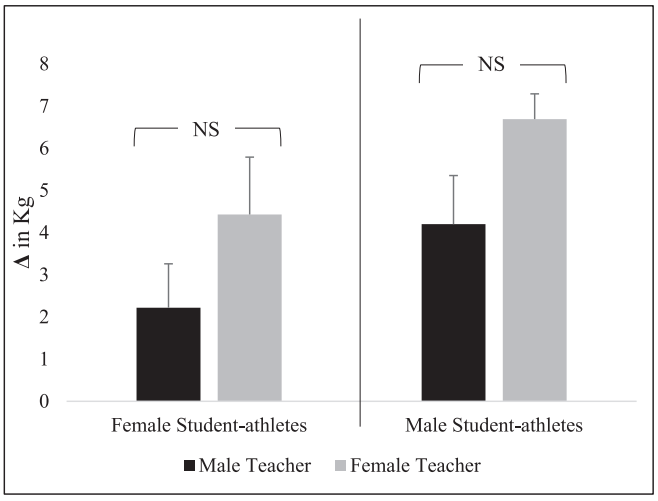

Fig. 2. Comparison of Squat test performance improvements (Δ) under male and female teacher verbal encouragement.
NS. not significant.

Table 2
Influence of gendered verbal encouragement (VE) on performance in strength and endurance tests.

Test (Unit)	Mean ± SD				Δ (WVE − NVE)		ANOVA Interaction effect			
	Male Teacher		Female Teacher		Δ Male Teacher	Δ Female Teacher	F	p	η_p^2	Power
	NVE	WVE	NVE	WVE						
Female students										
Squat (Kg)	66.78 ± 5.70	68.99 ^{NS} ± 6.29	66.03 ± 5.38	70.46** ± 7.78	2.22 ± 6.03	4.43^{NS} ± 4.69	0.95	0.35	–	–
Deadlift (Kg)	89.10 ± 12.48	92.76* ± 11.10	88.69 ± 10.66	96.26*** ± 89.70	3.06 ± 4.58	7.57* ± 7.07	4.55	0.05	0.23 (S)	0.51
Bench Press (Kg)	35.04 ± 5.01	35.95 ^{NS} ± 4.65	34.05 ± 3.99	38.27** ± 3.91	0.91 ± 2.03	4.22** ± 2.06	8.82	0.01	0.37 (S)	0.79
8MTT (Rep.)	148.88 ± 7.62	150.81* ± 6.67	147.50 ± 6.40	154.06*** ± 9.23	1.94 ± 3.51	6.56* ± 5.85	5.62	0.03	0.27 (S)	0.6
Male students										
Squat (Kg)	77.40 ± 7.08	81.60** ± 7.69	77.70 ± 6.91	84.39*** ± 7.07	4.20 ± 5.21	6.69^{NS} ± 2.67	2.9	0.09	–	–
Deadlift (Kg)	121.48 ± 13.21	126.60** ± 12.20	122.23 ± 13.34	128.96*** ± 14.26	5.13 ± 5.07	6.73^{NS} ± 5.69	0.7	0.41	–	–
Bench Press (Kg)	61.87 ± 7.18	67.10^{NS} ± 13.32	63.43 ± 6.72	71.50*** ± 4.86	5.23 ± 7.42	8.07^{NS} ± 4.79	0.74	0.4	–	–
8MTT (Rep.)	156.75 ± 10.65	162.19** ± 10.92	158.19 ± 8.34	165.19** ± 10.73	5.44 ± 6.57	7.00^{NS} ± 6.93	0.28	0.61	–	–

SD. standard deviation; WVE. with verbal encouragement; NVE. no verbal encouragement; 8MTT. 8-min time trials test; Rep. repetition; NS. difference is not statistically significant; (S). small effect size.
Note: Significant differences between Δ were identified based on the results of interaction effect (2 conditions [NVE vs. WVE] × 2 genders [Female vs. Male Teacher]) presented in the ANOVA column.
* significant difference at $p < 0.05$.
** significant difference at $p < 0.01$.
*** significant difference at $p < 0.001$.

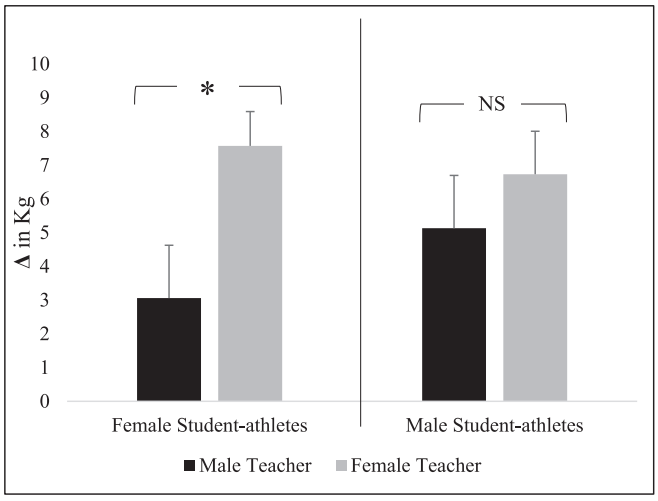

Fig. 3. Comparison of Deadlift test performance improvements (Δ) under male and female teacher verbal encouragement.
NS. not significant; * significant difference at $p < 0.05$.

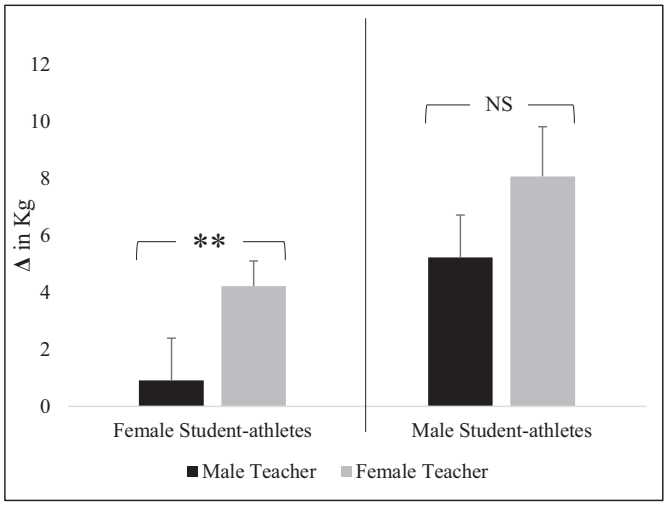

Fig. 4. Comparison of Bench Press test performance improvements (Δ) under male and female teacher verbal encouragement.
NS. not significant; ** significant difference at $p < 0.01$.

normal to experimental conditions where female student-athletes received VE from a male teacher were only significant for the deadlift and 8MTT tests, showing minimal significance levels ($p < 0.05$). Further details are presented in Table 2.

Most importantly, the main results revealed that the score changes (Δ) achieved by female student-athletes under the VE of a female teacher, compared to those under the VE of a male teacher, showed significant differences in favor of the same-gender teacher for most tests, particularly the deadlift ($p < 0.05$), bench press ($p < 0.01$), and 8MTT ($p < 0.05$) tests. Although the effect size estimates were small to moderate ($\eta_p^2 < 0.06$) for most tests, these results suggest more pronounced effects in female student-athletes when the VE came from a female teacher. Detailed information is provided in Table 2 and Figs. 2–5.

4. Discussion

4.1. Interpretation of findings

The first research question of this study aimed to determine whether male student-athletes would benefit equally from VE provided by either

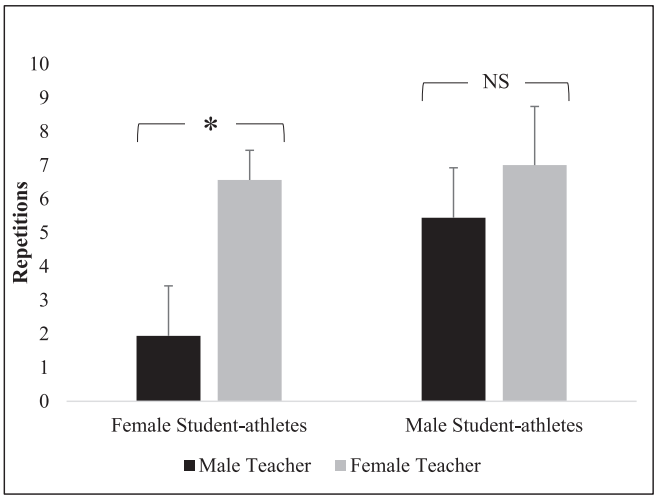

Fig. 5. Comparison of 8MTT test performance improvements (Δ) under male and female teacher verbal encouragement.
NS. not significant; * significant difference at $p < 0.05$.

a male or a female teacher during strength and endurance assessments. Based on the main results, it can be concluded that the performance of male student-athletes significantly improved in most tests when VE was provided, regardless of whether it came from a same- or opposite-gender teacher. The results might suggest a slight advantage of VE from female teachers through descriptive comparisons, as indicated by the stronger significance levels observed at the "within-subjects" level under female VE. Moreover, a significant improvement in male student-athletes' performance was absent in the bench press test under male VE but appeared highly significant when VE was provided by a female teacher. Nevertheless, no statistically significant "between-teacher" effects were identified to confirm this difference.

Although the inferential statistics did not reveal any significant gender effects, confirming that performance improvements among male student-athletes were consistent across squat, deadlift, and 8MTT assessments, it is essential to note that the improvement values were consistently higher when VE was provided by female teachers. This discrepancy suggests that further investigations are warranted, as these differences may achieve statistical significance in future studies, particularly with larger sample sizes. These thoughts can be understood through the lens of societal norms and gender roles that associate femininity with nurturing, empathy, and emotional expressiveness (Fischer & Manstead, 2000; Mestre et al., 2009). Female teachers often embody traits that are traditionally perceived as supportive and caring (Flaherty & Richman, 1989). With this in mind, the observed higher performance levels—despite the lack of statistically significant differences may hint at a superior potential for verbal VE from a female teacher. More intriguingly, these perspectives are reinforced by a previous findings of Cruz and Kim (2017), which suggest that male athletes, particularly badminton players, preferred female coaches. This preference was attributed to the perceived democratic leadership style, autocratic approach, and social support behaviors exhibited by female coaches. Similarly, the participating student-athletes in the study by Shuman and Appleby (2016) reported feeling more comfortable and anticipated better performance in strength exercises when coached by a female instructor.

It is also reasonable to consider the primary findings indicating that male student-athletes benefit from VE during strength and endurance assessments, irrespective of the teacher's gender. Male athletes' more pronounced competitive nature (Deaner et al., 2012), particularly in activities where they can demonstrate their strength and power (Cashdan, 1998), may have shifted their focus away from analyzing the characteristics of the individual providing the encouragement. Instead,

they may have perceived the VE as a neutral yet motivating stimulus that aids in generating greater force and sustaining resistance, with the primary objective of superior performance compared to peers. This suggests that the dynamics of VE may transcend teacher gender considerations in contexts where competition and performance are of utmost importance for male student-athletes. While not specifically focused on gendered VE, recent findings by Kuntz and Moorfield (2024) may lend support to the present ones. Their research indicates that athletes, regardless of gender and across various sports, do not exhibit strong preferences for the gender of their coach (Kuntz & Moorfield, 2024).

The findings differed for female student-athletes, who exhibited significantly greater improvements in nearly all strength and endurance assessments, except for the squat test, when VE was provided by a female teacher. While this finding aligns with the previously discussed emotionally supportive traits often associated with female pedagogues (Flaherty & Richman, 1989), it is important to exercise caution in interpreting these results, as the observed effects were generally small in magnitude. In reviewing the literature for potential explanations, it is important to note that while there may be a lack of prior research specifically focused on gendered VE, several studies have investigated the influence of coach gender on female athlete experiences, yielding conflicting findings. For instance, the findings of Magnusen and Rhea (2009) suggest that female athletes do not exhibit a gender preference for strength and conditioning coaches. The results of Kalin and Waldron (2015), which further contrast the present findings, indicate that female collegiate basketball players prefer male head coaches over their female counterparts. Still, some findings may help explain the present results, supporting the same-gender effect in the relationship between coaches and female student-athletes. For example, Medwechuk and Crossman (1994) argue that female swimmers prefer and rate same-gender coaches higher in their ability to motivate, as well as in their perceived desire to support them and anticipated future success. Similarly, Wasend and LaVoi (2019) suggest that female collegiate basketball players coached by female coaches are 4.1 times more likely to persist in their training careers compared to those coached by male coaches. More interestingly, Everhart and Chelladurai (1998) found that female basketball players experienced less concern about perceived discrimination and felt more secure when coached by a female.

Based on an analysis of the publications mentioned above, a cogent explanation emerges. Specifically, research indicates that men often underestimate the athletic capabilities and competitive spirit of female athletes compared to their male counterparts (Angelini, 2008; Brawley et al., 1979; Deaner et al., 2016). This phenomenon extends beyond mere scientific observation; it reflects a broader societal trend. Even when a female athlete possesses confidence in her abilities, she remains acutely aware that societal perceptions, particularly those influenced by masculine norms, tend to regard her as inferior to male athletes (Krane, 2001; Trbojević & Petrović, 2021). Indeed, gender stereotype threat negatively affects female athletes' performance in sports, particularly in masculine-stereotyped (Gentile et al., 2018), such as the strength and endurance exercises examined in this study. This can lead to heightened anxiety and self-doubt among female athletes, ultimately hindering their ability to perform at their best (Dolenc, 2015). This context suggests that female student-athletes in this study may have perceived the VE from their female teacher as more authentic and genuine. Specifically, the stereotypes and biases held by male individuals (Romney & Johnson, 2020; Gentile et al., 2018), which often lead to an underestimation of female athletes' capabilities (Angelini, 2008; Deaner et al., 2016), may have created a perception among female student-athletes that encouragement from male teachers—such as the phrase “You can do it!”—is disingenuous or merely a superficial compliment.

In contrast, when receiving VE from a female teacher, the female student-athletes might have found these expressions more credible and supportive. Such encouragement could foster a stronger sense of self-efficacy, which is critical for optimal performance in sports (Bandura, 1986). The effectiveness of VE is contingent upon its delivery—specifically, its sincerity and relevance—thereby significantly affecting performance outcomes (Daniels, 1993). This enhanced belief in the sincerity of the encouragement may have mitigated the effects of stereotype threat and promoted resilience in the face of societal biases, ultimately enabling female student-athletes to perform to their fullest potential in the strength and endurance assessments.

Future research should also explore the effects of VE using a larger sample of teachers to determine whether the observed trends persist across different teaching styles and personalities. Furthermore, studies should systematically control for the order of teacher assignment to better isolate its impact on performance outcomes. Investigating other potential moderating factors, such as student personality traits or prior experiences with specific teachers, may also provide deeper insights into the mechanisms underlying VE effectiveness.

4.2. Limitations of the study

While this study paves the way for further investigations into the effects of gendered VE on performance in strength and endurance assessments, one of its major limitations is the small sample size. Even the significant effects observed were of small magnitude, necessitating caution in interpreting and generalizing these findings. Another limitation of this study is the cross-sectional nature of the data collection, as participants experienced the conditions only once. Specifically, each participant was exposed to normal conditions and verbal encouragement VE from both a male and a female teacher, albeit in a randomized order. This single exposure may not fully capture the potential impact of repeated measures, which could foster adaptive attitudes and, consequently, lead to the development of specific gender preferences over time. The absence of qualitative data on participants' overall experience with VE is also a notable limitation of this study. Such insights could have clarified the root causes of the observed differences in the performances of female students when they received VE from a female teacher. The explanations provided in this discussion rely on previous findings and theoretical perspectives, making them speculative in nature.

4.3. Practical recommendations

This study contributes to the existing literature on the efficacy of VE as a strategy employed by teachers and coaches during strength and endurance assessments (Belkhiria et al., 2018; Bullinger et al., 2012; Pacholek, 2024; Romdhani, Sahli, Ghouili, et al., 2024, among others). A notable contribution of this study lies in its provision of novel data that support advocating for greater representation of women in athletic coaching and physical education teaching. We advocate for considering the gender of the coach or teacher when working with athletes during strength and endurance assessments. The findings of this study demonstrated that female student-athletes responded more positively to verbal encouragement from a female teacher, as evidenced by statistical analyses. Male student-athletes also demonstrated improved performance under female teachers, though this difference did not reach statistical significance. Until future research provides more conclusive evidence on these gender effects, stakeholders in athletic clubs and policymakers in educational settings should consider these findings when appointing sports educators to mixed groups of athletes. This is to ensure the optimal impact of VE, particularly during strength and endurance exercises.

5. Conclusions

The main conclusion drawn from the present findings suggests that male student-athletes perform better during strength and endurance assessments when receiving VE, regardless of the teacher's gender. It is worth noting that while the mean improvements in male student-athletes performance were in favor of the female teacher's VE in all

tests, these differences did not reach statistical significance. On the other hand, female student-athletes also show improved performance under VE, with an even greater enhancement when the encouragement comes from a same-gender teacher.

CRediT authorship contribution statement

Amir Romdhani: Conceptualization. **Omar Trabelsi:** Conceptualization. **Okba Selmi:** Conceptualization. **Noomen Guelmami:** Conceptualization. **Katja Weiss:** Writing – review & editing. **Thomas Rosemann:** Writing – review & editing. **Makram Zghibi:** Conceptualization. **Beat Knechtle:** Writing – review & editing.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

Data will be made available on request.

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