Journal of Sports Sciences

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rjsp20

How effective are external cues and analogies in enhancing sprint and jump performance in academy soccer players?

Jason Moran, Matt Allen, Joshua Butson, Urs Granacher, Raouf Hammami, Filipe Manuel Clemente, Megan Klabunde & Gavin Sandercock

JOURNAL OF SPORTS SCIENCES
https://doi.org/10.1080/02640414.2024.2309814

Routledge
Taylor & Francis Group

SPORTS PERFORMANCE

Check for updates

How effective are external cues and analogies in enhancing sprint and jump performance in academy soccer players?

Jason Moran[a], Matt Allen[b], Joshua Butson[a], Urs Granacher[c], Raouf Hammami[d,e], Filipe Manuel Clemente[f,g], Megan Klabunde[h] and Gavin Sandercock[a]

[a]School of Sport, Rehabilitation, and Exercise Sciences, University of Essex, Colchester, UK; [b]Tottenham Hotspur Football Club, London, UK; [c]Department of Sport and Sport Science, University of Freiburg, Breisgau, Germany; [d]Tunisian Research Laboratory 'Sports Performance Optimization (LR09SEP01), National Center of Medicine and Science in Sports (CNMSS), Tunis, TunisiaResearch Laboratory: Education, Motor Skills, Sports and Health, Higher Institute of Sport and Physical Education of Sfax, University of Sfax, Sfax, Tunisia; [e]Higher Institute of Sport and Physical Education of Ksar-said, University of la Manouba, Tunis, Tunisia; [f]Escola Superior de Desporto e Lazer, Instituto Politécnico de Viana do Castelo, Viana do Castelo, Portugal; [g]Instituto de Telecomunicações, Delegação da Covilhã, Lisboa, Portugal; [h]Department of Psychology, University of Essex, Colchester, UK

ABSTRACT

This study investigated the effect of external (EC) and internal coaching cues (IC), analogies with a directional component (ADC) on sprint (20 m) and vertical jump performance in academy soccer players ($n = 20$). A repeated-measures analysis, with post-hoc comparisons, was used to identify any differences between these cues and a neutral (control) cue. Significant differences were found for both sprint ($p < 0.001$) and jump ($p = 0.022$) comparisons among cue types. In post-hoc analyses for the 20 m sprint, significant differences were observed between the EC and the IC, favouring the EC ($p < 0.01$, ES = 1.27 [CI: 0.24, 2.30]), and "away" ADC and the IC, favouring the "away" ADC ($p < 0.01$, ES = 1.21 [CI: 0.19, 2.22]). No other cues showed significant differences. For vertical jump, there was just one significant difference between comparisons, that being for the "away" ADC vs. the neutral cue, favouring the latter ($p = 0.023$, ES = 0.4 [CI: −0.04 to 0.84]). It appears that ECs and ADCs are most effective when coaching sprinting performance in academy soccer players. However, simply encouraging maximal effort from a youth athlete also appears to be a reasonable cueing strategy to drive performance in youth athletes.

ARTICLE HISTORY
Received 15 March 2023
Accepted 18 January 2024

KEYWORDS
Fundamental movement skills; instructions; run; jump; youth; speed

Introduction

A coaching cue is an instruction that is delivered verbally and which can be used to direct an individual's focus of attention on a movement with a view to optimising its execution (Benz et al., 2016). Cues that focus a performer's attention on the outcome of their action on the external environment, such as an object (i.e., outside of the body) or internally (i.e., on a body part) have been shown to affect the performance of motor skills (Chua et al., 2021; Porter et al., 2013; Vance et al., 2004). On this, the constrained action hypothesis (McNevin et al., 2003) implies that directing one's attention internally leads to a more deliberate form of movement control which can constrain movement by disrupting automatic control mechanisms (Wulf, 2012). Conversely, the orientation of one's focus externally encourages greater automaticity of action in promoting unconscious, impulsive and reflexive control mechanisms (Wulf, 2012). This is because an external focus can reduce the attentional effort that is required to execute a given movement, contrasting with the effect of an internal focus which can promote a more conscious control of an action thus impeding the automaticity of execution (Wulf et al., 2001). It has been argued that coaches can leverage this concept by wording their instructions such that attention is focused externally in a way that promotes movement efficiency in a trainee (Guss-West & Wulf, 2016). Indeed, in the longer term, this can potentially enhance learning through repeated reinforcement of a targeted skill or ability over time (Nicklas et al., 2022).

Building on the above concept, Winkelman (2018) has previously indicated the effects of incorporating a directional component in a verbal cue to enhance motor performance. Cues that exhibit a distal focus of attention seem to be more beneficial to jump performance than those with a proximal focus. From a locomotion perspective, Winkelman conceptualised a proximal focus as an "away-focus" (i.e., "jumping as far past the start line as possible") and a distal focus as a "toward-focus" (i.e., "jumping as close to the cone as possible") (Winkelman, 2018). Accordingly, it appears that a performer could demonstrate improved performance when presented with a "toward" focus that fixes their attention on a point or target in the distance (Winkelman, 2018). In addition to this, a relatively underexplored issue in the literature relating to the coaching of motor skills is the utilisation of analogies to communicate the goal of a specific coaching instruction. An analogy can be a useful verbal coaching tool that conceals biomechanical cues in the spoken word. Analogies can be used to communicate to an athlete the required speed and body position during skill execution, conveying movement in a symbolic way that could be more relatable to an individual (Powell et al., 2021). In a recent study, Fasold et al. (2020) reported that children demonstrated enhanced performance in handball skills when coaching cues were

CONTACT Jason Moran jmorana@essex.ac.uk School of Sport, Rehabilitation, and Exercise Sciences, University of Essex, Wivenhoe Park, Colchester CO4 3SQ, UK

presented using an analogy format. Indeed, it has been recommended that this approach to coaching can be advantageous when working with youngsters because it can support the retention of information by making instructions more applicable to the specific task at hand, ultimately improving understanding and performance (Kushner et al., 2015; Radnor et al., 2020). Accordingly, additional investigations are required to examine the efficacy of such coaching tools.

Throughout the literature, it has generally been documented that using an external coaching cue (EC), or focus of attention, can result in enhanced performance outcomes relative to an internal cue (IC), or focus of attention (Li et al., 2022; Makaruk et al., 2020; Wulf, 2012). However, recently, it was demonstrated across a large diversified international sample of youths, that the same principle may not necessarily hold true in young individuals (<18 years of age) (Moran et al., 2023). Based on the results of that study, the adoption of the aforementioned coaching techniques to develop skills, such as running and jumping, may not necessarily represent the optimal coaching strategy in youths. To date, though some studies have examined the effect of attentional focus on motor skill performance in youth, the pattern of results in studies with children appears to be more variable than those undertaken in adults. Because of this, it has been very difficult to determine whether or not the manipulation of attentional focus through cuing can enhance performance in young individuals, as it appears to do in adults. As youths grow and develop, their ability to follow instructions can vary between individuals (Kushner et al., 2015). Moreover, whilst adults appear to demonstrate greater propensity to focus on relevant information, youths exhibit a tendency to focus on both relevant and irrelevant information (Jung et al., 2023), which, though potentially advantageous, could negatively impact on the level of attention they devote to a specific instruction (Connell, 2003). Youths could therefore be classified as "naive perceivers" (Connell, 2003) and so may interpret coaches' instructions differently to that which has been reported in older individuals (Halperin et al., 2016; Porter et al., 2010).

In the light of results reported in youth performers by (Moran et al., 2023), it has been speculated that, due to their comparatively shorter span of attention, and less advanced cognitive development, younger individuals could be less receptive to certain coaching cues than adults (Yamada et al., 2022). However, of the cohorts included in the aforementioned study (Moran et al., 2023) in youths, none could necessarily have been considered "elite" in terms of the longevity and quality of training that they had been exposed to in their athletic careers. Accordingly, in an effort to address the limitations of that study, we set out to establish the effectiveness of ECs, ICs and "analogies with a directional component" (ADC) on motor skill performance in elite professional academy soccer players. ADCs could be very useful in coaching; however, to date, research that investigates the effect of this technique paired with a directional component (i.e., "towards" vs. "away") is very sparse (Winkelman, 2020). Accordingly, based on previous literature (Fasold et al., 2020; Li et al., 2022; Makaruk et al., 2020; Moran et al., 2023; Wulf, 2012), it was hypothesised that ECs and ADCs would be more effective than ICs and neutral control cues, and that ADCs would be more effective than ECs, at enhancing vertical jump and 20 m sprint performance in youth academy soccer players.

Methods

Experimental design

An experiment was conducted to examine any potential effects of ECs, ICs and ADCs on jump and sprint performance in English professional academy soccer players ($n = 20$; mean age: 14.7 ± 0.25 yrs; mean biological age 14.6 yrs; mean stature: 166.9 ± 5.9 cm; mean mass: 53.9 ± 6.4 kg). A repeated measures analysis was utilised to determine any effects of the various coaching cues. Participants undertook vertical jumps and 20 m sprints prior to which they were given a specific coaching cue relating to their performance. The players had an average of 2 years of experience of both maximal sprinting and jumping. Only individuals under the age of 18 were eligible to take part and only healthy individuals (i.e., those free of any musculoskeletal injuries as determined by the club medical staff) were considered. The research was approved by the university ethics committee and conformed to the Declaration of Helsinki. Parental consent and participant assent were attained to take part.

The elite population was carefully chosen on the basis of previous research, which suggested that if young individuals were naive to the form of coaching cue delivered in this study, they may not respond in the conventional way in which adults have been shown to do in previous investigations (Moran et al., 2023). A power analysis was conducted and for the sprint testing component, a type I error rate of 0.05% and 80% statistical power were set. The estimated Cohen's d effect size of 0.4 was based on findings from previous research on this topic (Moran et al., 2023). The power analysis suggested that a sample of 12 participants would be sufficient to detect the anticipated effect. However, to account for potential attrition and ensure robustness of the findings, a total of 20 participants were recruited. For the jump test component, we maintained the same type I error rate and statistical power. An estimated effect size of Cohen's d = 0.56, informed by the aforementioned study, was utilised. The initial analysis indicated that eight participants would provide adequate power. Nevertheless, considering the possibility of participant dropout and to ensure the study's capacity to detect smaller yet meaningful effects, 20 participants were ultimately included in the study.

Each participant performed 10 jumps and 10 sprints with a single instructional cue provided to them immediately before each action. There were five different cues for the sprints and five different cues for the jumps meaning each participant received each individual cue twice. The cues themselves fell into five distinct categories based on type and these can be seen in Table 1. They were informed by the work of (Winkelman, 2020) and their formulation was based on achieving a balance between scientific rigour and the potential to be used by coaches in the field. In line with previous literature (Comyns et al., 2017; Makaruk et al., 2012), the terms "jump as high as you can" and "sprint as fast as you can" were neutral cues used as controls against which the various ICs, ECs and ADCs were compared.

Table 1. Jump and sprint cues.

Type	Jump cue
Control/neutral	"Jump as high as you can"
Internal	"As you jump, focus on extending your legs"
External	"As you jump, focus on pushing the ground away"
Analogy (away)	"Jump as if the ground is suddenly hot and you have to get off it as quick as possible"
Analogy (towards)	"Jump as if you are trying to catch a ball overhead at its highest point"
	Sprint cue
Control/neutral	"Sprint as fast as you can"
Internal	"Sprint and focus on driving your legs back"
External	"Sprint and focus on driving the ground back"
Analogy (away)	"Sprint as if you are being chased up a hill"
Analogy (towards)	"Sprint as if you are a jet taking off into the sky ahead"

Warm up prior to performance

Prior to the fitness tests, a standardised 8-min warm up was carried out following previous protocols (Chaabene et al., 2020; Jeffreys, 2007; Thompsen et al., 2007). In brief, this included low-intensity running, dynamic movement drills (high knee walks, forward leg swings, overhead lunge walks, straight leg walks, lateral lunges, high knee skips, skip for height) and submaximal jumps and sprints. Before performing, participants were permitted to execute two sub-maximal repetitions over 5 m and one maximal repetition over 10 m to familiarise themselves with the sprint test format (Winkelman et al., 2017). No cues were provided for these efforts. Between testing efforts, participants were encouraged to maintain general low-intensity movement to remain prepared for performance.

Jumps

The vertical countermovement jump test was performed with the OptoJump apparatus (Microgate, Bolzano, Italy). This equipment has been found to be highly valid (intra-class correlation coefficient [ICC] = 0.997–0.998) and reliable (ICC = 0.982 0.989) for the measurement of vertical jump height (Glatthorn et al., 2011). Prior to any jumps taking place, each participant was individually requested to "jump as high as you can in the remaining ten jumps". They were also informed "prior to each jump you will be given a specific coaching cue. Focus as hard as you can on this cue during the jump" (Winkelman et al., 2017). All cues were read from a seated position that was around a metre to the left of the jump position where the participant stood (Winkelman et al., 2017). When jumping, participants executed a downward movement to a self-selected depth/knee flexion angle before performing a vigorous extension of the lower-body limbs to jump as high as possible. The arms were positioned akimbo (i.e., with the hands on the hips and the elbows turned outward) and the feet positioned approximately shoulder width, at a distance comfortable for the participant. There was at least 2-min rest between efforts and each participant's best effort from two trials was used in the analysis (Moran et al., 2017).

20-metre sprint

To measure sprint speed, timing gates (Brower Timing Systems, Draper, UT, USA) were used. This equipment has been shown to have excellent test–retest reliability (ICC = 0.91–0.99) in the measurement of sprint speed (Shalfawi et al., 2012). One sprint demonstration was collectively provided for all participants at the start of the session (Winkelman et al., 2017). In relation to the starting position only, the participants were instructed to assume a typical two-point stance, with their feet hip width apart, by placing one foot behind the start line and the other foot back at a comfortable distance. They were requested to position their arms such that they were set opposite to their legs (Winkelman et al., 2017). They were also instructed to "load into your legs and shift forward so that you feel tension and a readiness to sprint forward with no delay" (Winkelman et al., 2017). Prior to any sprints taking place, each participant was individually informed that "the remaining ten sprints will be completed as fast as you can at 100% of your full speed. Prior to each sprint you will be given a specific coaching cue. Focus as hard as you can on this cue during the entire sprint" (Winkelman et al., 2017).

All cues were read from a seated position that was around a metre to the left of the start line where the participant stood (Winkelman et al., 2017). The test was initiated when the participant voluntarily started the sprint immediately following the provision of one of the instructional cues. At least 2 min of rest was taken between each sprint. The timing gates were set at the start line (1 m in front of the participants), and 20 m away from the start line. They were positioned 0.7 m above the ground (i.e., at hip level), allowing the capture of trunk movement only and to avoid a false trigger from a limb (Ramirez-Campillo et al., 2021).

Coaching cues

A Latin square design was used to simplify the randomisation process and offset order effects due to fatigue or other factors that could impact participants' performance. Each participant was randomly allocated a specific "order scheme" (between 1 and 10 [Table 2]). This "order scheme" determined the sequence in which each individual received their instructional cues prior to jumping or sprinting. Each letter corresponded to a particular coaching cue, which can be seen in Table 3. The order of the cues in Table 3 was also randomised, and as participants sprinted and jumped twice, each cue appeared twice.

As an example, if the participant drew scheme number 4, both the jump and sprint cues would be delivered in the following order as seen in Table 2.

D E C F B G A H J I

So, "sprint and focus on driving the ground back" (D) would be delivered first, "sprint as if you are a jet taking off into the sky ahead" (E) would be second, "sprint and focus on driving the ground back" (C) would be delivered third, and so on for all 10 performances.

Table 2. Cue order schemes.

Scheme No.	Order Schemes									
Scheme 1	A	B	J	C	I	D	H	E	G	F
Scheme 2	B	C	A	D	J	E	I	F	H	G
Scheme 3	C	D	B	E	A	F	J	G	I	H
Scheme 4	D	E	C	F	B	G	A	H	J	I
Scheme 5	E	F	D	G	C	H	B	I	A	J
Scheme 6	F	G	E	H	D	I	C	J	B	A
Scheme 7	G	H	F	I	E	J	D	A	C	B
Scheme 8	H	I	G	J	F	A	E	B	D	C
Scheme 9	I	J	H	A	G	B	F	C	E	D
Scheme 10	J	A	I	B	H	C	G	D	F	E

Table 3. Coaching cues in correspondence with cue order schemes.

Jump cues
A = "as you jump, focus on extending your legs"
B = "as you jump, focus on extending your legs"
C = "jump as high as you can"
D = "jump as if the ground is suddenly hot and you have to get off it as quick as possible"
E = "as you jump, focus on pushing the ground away"
F = "as you jump, focus on pushing the ground away"
G = "jump as high as you can"
H = "jump as if the ground is suddenly hot and you have to get off it as quick as possible"
I = "jump as if you are trying to catch a ball overhead at its highest point"
J = "jump as if you are trying to catch a ball overhead at its highest point"

Sprint cues
A = "sprint as if you are being chased up a hill"
B = "sprint as if you are a jet taking off into the sky ahead"
C = "sprint and focus on driving the ground back"
D = "sprint and focus on driving the ground back"
E = "sprint as if you are a jet taking off into the sky ahead"
F = "sprint as fast as you can"
G = "sprint and focus on driving your legs back"
H = "sprint and focus on driving your legs back"
I = "sprint as if you are being chased up a hill"
J = "sprint as fast as you can"

Statistical analyses

A repeated-measures ANOVA was undertaken to determine if there were any differences between the ECs, the ICs, the two ADCs and the neutral cue. These analyses were carried out using JASP (version 10.2, University of Amsterdam). Data normality was determined with the Shapiro–Wilk test and sphericity with Mauchly's test. For post-hoc analyses, a Bonferroni adjustment was used to detect any statistically significant ($p <$ 0.05) changes in the dependent variables. Cohen's *d* effect sizes were used to quantify the magnitude of any differences between conditions and are presented alongside 95% confidence intervals (CI).

All calculated effect sizes were interpreted using the conventions outlined for the standardised mean difference by (Hopkins et al., 2009) (<0.2 = trivial; 0.2–0.6 = small, 0.6–1.2 = moderate, 1.2–2.0 = large, 2.0–4.0 = very large, >4.0 = extremely large).

Results

Figure 1 presents a visual depiction of the results of the study.

In the repeated measures ANOVA, both sprint ($p < 0.001$; SS = 0.106; df = 4; MS = 0.026; F = 6.431) and jump ($p = 0.022$; SS = 29.395; df = 4; MS = 7.349; F = 3.036) analyses revealed significant differences between the various cue types. In the post-hoc analyses, for the 20 m sprint, there were significant differences detected between the EC and the IC (favouring the EC, $p < 0.01$, ES = 1.27 [confidence interval: 0.24, 2.30]) and the IC and "away" ADC (favouring the "away" ADC, $p < 0.01$, ES = 1.21 [confidence interval: 0.19, 2.22]). No significant differences were detected between any of the other cues. For vertical jump, there were no significant differences between any of the cues with the exception of the "away" ADC and the neutral control cue, favouring the latter ($p = 0.023$, ES = 0.4 [−0.04 to 0.84]). The post-hoc results can be seen in Table 4.

Discussion

The purpose of this study was to compare the effects of ECs, ICs and two different ADCs ("towards" and "away") on vertical jump and 20 m sprint performance in youth academy soccer players. Accordingly, based on previous literature (Fasold et al., 2020; Li et al., 2022; Makaruk et al., 2020; Moran et al., 2023; Wulf, 2012), it was hypothesised that ECs and ADCs would be more effective than ICs and neutral control cues, and that ADCs would be more effective than ECs, at enhancing vertical jump and 20 m sprint performance in youth academy soccer players. These hypotheses were partly supported by our results in that in the sprint protocol, as expected, the EC was far more effective in increasing performance than the IC ("large" ES = 1.27 [$p < 0.01$]) and the "away" ADC was superior to the IC ("large" ES = 1.20 [$p < 0.01$]). Previously, Moran et al. (2023) undertook a multidimensional study on the effectiveness of ECs, ICs and two different ADCs ("towards" and "away") on vertical jump and 20 m sprint performance in youths in various different populations, ranging from school children to academy athletes, and across a variety of international contexts and languages (Moran et al., 2023). Some results of that study suggested that ADCs could be more effective than both ECs and ICs in enhancing performance in youths; however, this was observed in the French language only and applied only to sprinting and not jumping. Conversely, where significant differences were seen, instructing an individual to jump as high, or sprint as fast, as possible (i.e., the neutral control cue) was more commonly effective at eliciting improvements in performance. This indicated that encouraging a young athlete to perform to the best of their ability was often no less effective than manipulating language to focus on the surrounding environment, despite the widely reported positive additive effect of ECs on physical performance across populations (Makaruk et al., 2020; Wulf, 2012). This is a result that is also partly replicated in the current study. It has previously been suggested that both trained and

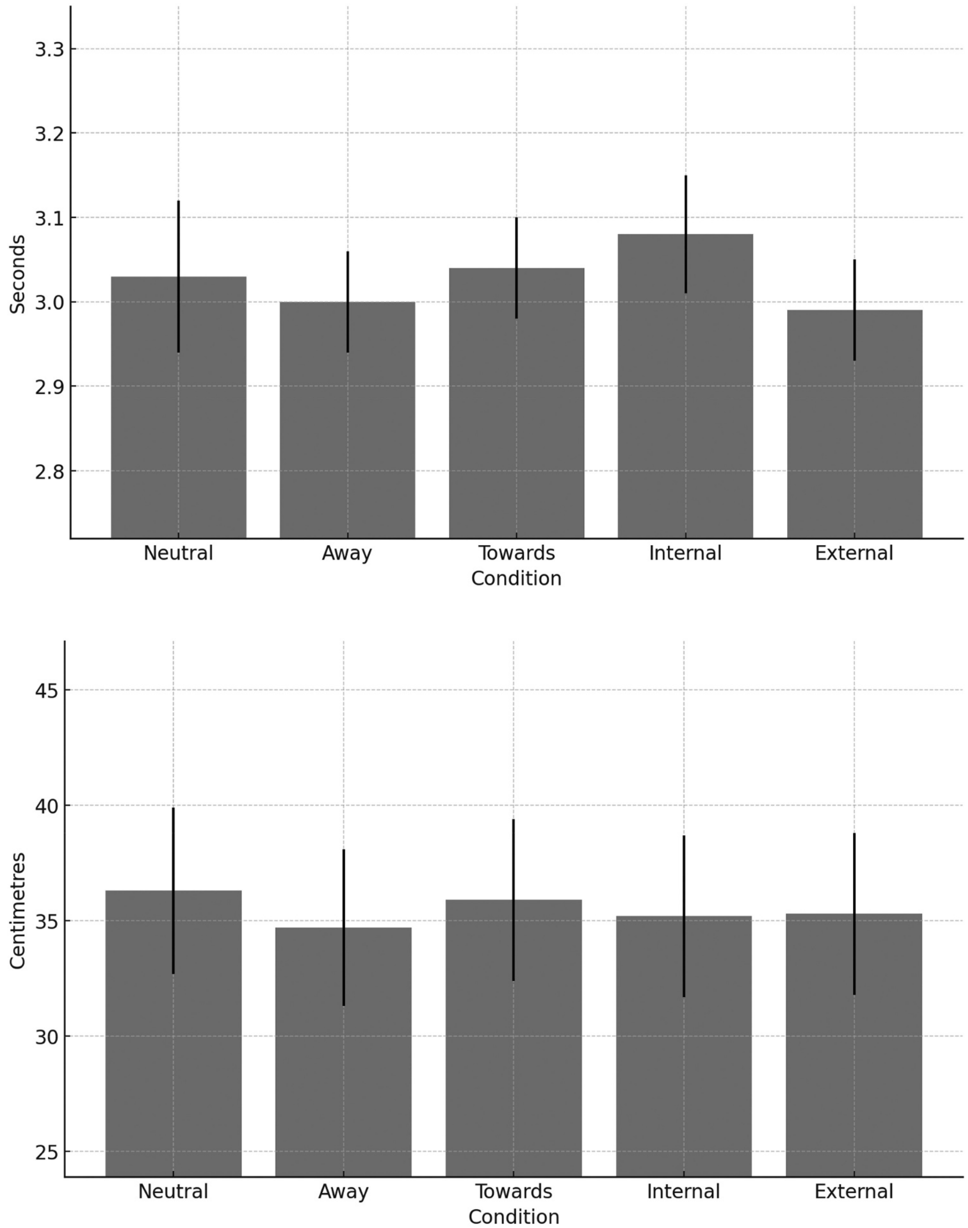

Figure 1. Mean sprint time (top, in seconds) and jump height (bottom, in centimetres) for the group of 20 players under different attentional focus conditions: neutral, away, towards, internal and external.

intermediate athletes may perform equally well, or even better, when presented with a normal (or control) focus of attention prior to performance (Porter & Sims, 2013; Winkelman, 2018). Novice athletes, on the other hand, may benefit from the more specific instructions associated with an external focus (Porter & Sims, 2013), potentially explaining the differences between individuals and studies and prompting the selection of a more experienced youth population in the current investigation

The results of the current study demonstrate that when coaching sprinting movements in youth athletes, coaches can successfully utilise ECs and ADCs over ICs as in some cases, they appear to elicit greater performances in sprinting speed. However, instructing an individual to simply perform as well as they can also appear to be as useful as more sophisticated cues that purport to manipulate attentional focus with descriptive or analogy-based language. Moreover, there appears to be very few differences between the effects of the various instructional cues on jump performance in youth soccer players with only one significant difference observed across the comparisons made in this study. In the multi-study investigation by (Moran et al., 2023), it was speculated by the authors that the potential naivety of the study populations could perhaps have made them less receptive to the delivered coaching cues due to a lack of high-level training experience. Indeed, it has been suggested that because younger people have fewer past life experiences than adults, they could be classified as “naive perceivers” (Connell, 2003). Accordingly, in terms of the current investigation, the elite youth population was an important characteristic of the study design as, if a young individual accumulates a sufficient volume of high-quality training, it is possible that they would no longer be considered a naive

Table 4. Post-hoc analyses of the effect of each cue type on jump and sprint performance.

		t	Cohen's d	Lower	Upper	p
Jump cue						
Internal vs.	External	0.173	0.02	0.41	−0.37	1
	"Towards"	1.341	0.17	0.57	−0.23	1
	"Away"	−0.976	−0.12	0.27	−0.52	1
	Neutral	2.185	0.28	0.69	−0.14	0.32
External vs.	"Towards"	1.169	0.15	0.55	−0.25	1
	"Away"	−1.148	−0.15	0.25	−0.55	1
	Neutral	2.012	0.26	0.67	−0.16	0.477
"Towards" vs.	"Away"	−2.317	−0.30	0.12	−0.71	0.232
	Neutral	0.843	0.11	0.50	−0.29	1
"Away" vs.	Neutral	3.161	0.40	0.84	−0.04	0.023*
Sprint cue						
Internal vs.	External	4.343	1.27	0.24	2.30	<.001***
	"Towards"	1.727	0.51	−0.37	1.38	0.882
	"Away"	4.121	1.21	0.19	2.22	<.001***
	Neutral	2.492	0.73	−0.18	1.64	0.149
External vs.	"Towards"	−2.615	−0.77	−1.68	0.15	0.107
	"Away"	−0.222	−0.07	−0.91	0.78	1
	Neutral	−1.851	−0.54	−1.42	0.34	0.681
"Towards" vs.	"Away"	2.393	0.70	−0.20	1.61	0.192
	Neutral	0.765	0.22	−0.63	1.07	1
"Away" vs.	Neutral	−1.628	−0.48	−1.35	0.40	1

A positive effect size favours the cue listed second.
***p < .001.
In each performance test, p-value and confidence intervals adjusted for comparing a family of 10 estimates (confidence intervals corrected using the Bonferroni method).

perceiver and so may respond more readily to ADCs or ECs (Barillas et al., 2022). This also relates to the apparent differences between youths and adults which could have an effect on the way instructional cues are processed and executed upon by a trainee. As youths grow and develop, their neurocognitive abilities, and their propensity to follow instructions, can vary between individuals (Kushner et al., 2015). Moreover, whilst adults appear to demonstrate greater propensity to focus on relevant information, youths exhibit a tendency to focus on both relevant and irrelevant information (Jung et al., 2023), which, though potentially advantageous, could negatively impact on the level of attention they devote to a specific instruction (Connell, 2003). Comparative research (Cowan et al., 2006) that has been carried out in children and adults is suggestive of a shorter span of attention in the younger of the groups. The reason for this could potentially be explained by the rate of cognitive development in children and adolescents whose frontal lobes continue to mature as they grow (Cowan et al., 2006). However, if a young individual is not naive to the coaching processes they are exposed to, it could be argued that they might respond similarly to an adult. This is important as even though previous research has demonstrated that coaching language, such as ECs, can have a positive effect on sprint and jump performance, a majority of the evidence relates to adult rather than youth populations (Barillas et al., 2021).

Based on our results and owing to the above-described differences between youths and adults, coaches may be presented with more challenging situations when trying to coach younger groups than when they are working with more experienced groups (Kushner et al., 2015). On this basis, a coaching practitioner's skills in utilising instructive cues that a youth trainee can easily comprehend may be vital in ensuring optimal performance and ongoing skill development (Barillas et al., 2021). The results of the current study are indicative of this with a variable set of outcomes that support the use of ECs and ADCs in sprinting, but not in a consistent pattern across cues and performers. Indeed, simply using a neutral cue encouraging maximal performance appeared to draw out superior efforts by the study participants, particularly in the executed jump tests, and this could be a viable cueing option for youth coaches. Interestingly, these results appear to corroborate the internal meta-analytical results of Moran et al. (2023) who found that in seven of the eight comparisons of an EC, an IC or an ADC with a neutral control cue, there were no differences in sprint or jump performances observed. On that basis, in supposedly naive populations of youths, the choice of language appears to matter less than it does in the supposedly elite population in the current study. However, that elite population's responses appear to be variable indicating that they might have only some understanding, and not a *full and comprehensive* understanding, of the instructional cues that were delivered to them in the current study. Future studies could incorporate a control for this factor in their designs.

There are some limitations to this study. The terms "jump as high as you can" and "sprint as fast as you can" were neutral cues that were used as controls against which the various cues were compared (Comyns et al., 2017; Makaruk et al., 2012). This was based on previous research (Comyns et al., 2017; Makaruk et al., 2012), but the experimental terms in the current study were not universally more effective than these neutral control cues. This could have been because, such is the subjectivity of spoken language, there is no accepted standard as to what constitutes a "control cue" meaning these cues were just as, or more, effective as the experimental cues in inciting high performance in the study participants. Also, though participants were requested to perform maximally before executing any jumps or sprints, it is unclear as to whether they delivered upon this instruction before each and every effort. Coaches should ensure that athletes are reminded to remain focused on the task at hand so as to maximise performance on each occasion. The ECs and ICs that were used required participants to retain a specific focus for performance whereas the neutral cues simply requested maximal performance. This small differential could impact on an individual's comprehension of a particular cue and though it was deliberate in nature, researchers must work to standardise cues across various tasks to ensure the most effective form of communication. Accordingly, alternative cues with different compositions could be examined to determine the most effective coaching terms to underpin high performance in youth athletes. It could also be particularly interesting to determine if effective cues exert an influence on the level of the individual, rather than the group as a whole. Such an investigation might require a pre-experimental determination of each participant's inherent understanding of the meaning of the utilised cues, thus controlling for any variation in how the delivered cues are interpreted before being acted upon in the study itself. Parallel research should also investigate the underlying neurocognitive mechanisms that direct attentional focus during dynamic movement in youth athletes.

Conclusion

In the current study, there was evidence to support the use of ECs and ADCs when coaching sprinting speed in elite youth soccer players. The use of analogies in coaching youths may well constitute a more relatable model of communication that facilitates a better understanding of a coach's cue than the use of traditional biomechanical terminology (Kushner et al., 2015). Accordingly, a more evocative coaching language could be preferable to conventional coaching cues if it results in an enhanced contextual understanding of what a coach requires a trainee to do. However, the study results did not indicate that the experimental cues had a universally positive effect on the utilised performance tests. Simultaneously, it appears that simply encouraging maximal performance might be just as effective a verbal coaching strategy to drive performance in youth soccer players, particularly in relation to jumping actions. These findings should not necessarily deter practitioners from using ECs and ADCs when coaching youth populations as such strategies can still help in the execution of a motor skill, as evidenced by the wider body of literature on this topic. However, coaches should be cognisant that a youth's level of experience, contextual understanding and attentional capacity could all affect motor performance to one extent or another and so an individualised approach to instructional cueing is advised.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This study was funded by the University of Essex which awarded faculty funds to Dr Jason Moran in the amount of £5,980.

ORCID

Jason Moran http://orcid.org/0000-0001-7452-6855

References

Barillas, S. R., Oliver, J., Lloyd, R., & Pedley, J. S. (2022). Kinetic responses to external cues are specific to both the type of cue and type of exercise in adolescent athletes. *The Journal of Strength & Conditioning Research*, *37* (3), 597–605. In press. https://doi.org/10.1519/JSC.0000000000004307

Barillas, S. R., Oliver, J. L., Lloyd, R. S., & Pedley, J. S. (2021). Cueing the youth athlete during strength and conditioning: A review and practical application. *Strength & Conditioning Journal*, *43*(3), 29–42. https://doi.org/10.1519/SSC.0000000000000567

Benz, A., Winkelman, N., Porter, J., & Nimphius, S. (2016). Coaching instructions and cues for enhancing sprint performance. *Strength & Conditioning Journal*, *38*(1), 1–11. https://doi.org/10.1519/SSC.0000000000000185

Chaabene, H., Negra, Y., Moran, J., Sammoud, S., Ramirez-Campillo, R., Granacher, U., & Prieske, O. (2020). The effects of combined balance and complex training versus complex training only on measures of physical fitness in young female handball players. *International Journal of Sports Physiology and Performance*, *16*(10), 1439–1446. In press. https://doi.org/10.1123/ijspp.2020-0765

Chua, L., Jiménez Diaz, J., Lewthwaite, R., Kim, T., & Wulf, G. (2021). Superiority of external attentional focus for motor performance and learning: Systematic reviews and meta-analyses. *Psychological Bulletin*, *147*(6), 618–645. https://doi.org/10.1037/bul0000335

Comyns, T., Brady, C., Harrison, A., & Warrington, G. (2017). Focus of attention for diagnostic testing of the force-velocity curve. *Strength & Conditioning Journal*, *39*(1), 57–70. https://doi.org/10.1519/SSC.0000000000000271

Connell, R. (2003). Understanding the learner: Guidelines for the coach. In M. Lee (Ed.), *Coaching children in sport: Principles and practice* (2nd ed., pp. 78–90). Routledge.

Cowan, N., Fristoe, N. M., Elliott, E. M., Brunner, R. P., & Saults, J. S. (2006). Scope of attention, control of attention, and intelligence in children and adults. *Memory & Cognition*, *34*(8), 1754–1768. https://doi.org/10.3758/BF03195936

Fasold, F., Houseman, L., Noel, B., & Klatt, S. (2020). Handball-specific acquisition by use of different instruction methods. *Human Movement*, *22*(3), 45–53. https://doi.org/10.5114/hm.2021.100323

Glatthorn, J. F., Gouge, S., Nussbaumer, S., Stauffacher, S., Impellizzeri, F. M., & Maffiuletti, N. A. (2011). Validity and reliability of optojump photoelectric cells for estimating vertical jump height. *The Journal of Strength & Conditioning Research*, *25*(2), 556–560. https://doi.org/10.1519/JSC.0b013e3181ccb18d

Guss-West, C., & Wulf, G. (2016). Attentional focus in classical ballet: A survey of professional dancers. *Journal of Dance Medicine & Science*, *20*(1), 23–29. https://doi.org/10.12678/1089-313X.20.1.23

Halperin, I., Williams, K. J., Martin, D. T., & Chapman, D. W. (2016). The effects of attentional focusing instructions on force production during the isometric midthigh pull. *He Journal of Strength & Conditioning Research*, *30*(4), 919–923. https://doi.org/10.1519/JSC.0000000000001194

Hopkins, W. G., Marshall, S. W., Batterham, A. M., & Hanin, J. (2009). Progressive statistics for studies in sports medicine and exercise science. *Medicine & Science in Sports and Exercise*, *41*(1), 3–12. https://doi.org/10.1249/MSS.0b013e31818cb278

Jeffreys, I. (2007). Warm up revisited – the 'ramp' method of optimising performance preparation. *Professional Strength and Conditioning*, *6* (January 2007), 15–19.

Jung, Y., Forest, T. A., Walther, D. B., & Finn, A. (2023). Neither enhanced nor lost: The unique role of attention in children's neural representations. *Journal of Neuroscience*, *43*(21), 3849–3859. https://doi.org/10.1523/JNEUROSCI.0159-23.2023

Kushner, A. M., Kiefer, A. W., Lesnick, S., Faigenbaum, A. D., Kashikar-Zuck, S., & Myer, G. D. (2015). Training the developing brain part II: Cognitive considerations for youth instruction and feedback. *Current Sports Medicine Reports*, *14*(3), 235–243. https://doi.org/10.1249/JSR.0000000000000150

Li, D., Zhang, L., Yue, X., Memmert, D., & Zhang, Y. (2022). Effect of attentional focus on sprint performance: A meta-analysis. *International Journal of Environmental Research and Public Health*, *19*(10), 6524. https://doi.org/10.3390/ijerph19106254

Makaruk, H., Porter, J. M., Czaplicki, A., Sadowski, J., & Sacewicz, T. (2012). The role of attentional focus in plyometric training. *The Journal of Sports Medicine and Physical Fitness*, *52*(3), 319–327.

Makaruk, H., Starzak, M., & Porter, J. (2020). Influence of attentional manipulation on jumping performance: A systematic review and meta-analysis. *Journal of Human Kinetics*, *75*(1), 65–75. https://doi.org/10.2478/hukin-2020-0037

McNevin, N., Shea, C., & Wulf, G. (2003). Increasing the distance of an external focus of attention enhances learning. *Psychological Research*, *67*(1), 22–29. https://doi.org/10.1007/s00426-002-0093-6

Moran, J., Hammami, R., Butson, J., Allen, M., Mahmoudi, A., Vali, N., Lewis, I., Samuel, P., Davies, M., Earle, J., Klabunde, M., & Sandercock, G. (2023). Do verbal coaching cues and analogies affect motor skill performance in youth populations? *PloS One*, *18*(3), e0280201. https://doi.org/10.1371/journal.pone.0280201

Moran, J., Sandercock, G. R. H., Ramírez-Campillo, R., Todd, O., Collison, J., & DA, P. (2017). Maturation-related effect of low-dose plyometric training on performance in youth hockey players. *Pediatric Exercise Science*, *29*(2), 194–202. https://doi.org/10.1123/pes.2016-0151

Nicklas, A., Rein, R., Noël, B., & Klatt, S. (2022). A meta-analysis on immediate effects of attentional focus on motor tasks performance. *International*

Review of Sport and Exercise Psychology, In press, 1–36. https://doi.org/10.1080/1750984X.2022.2062678

Porter, J. M., Anton, P. M., Wikoff, N. M., & Ostrowski, J. B. (2013). Instructing skilled athletes to focus their attention externally at greater distances enhances jumping performance. *The Journal of Strength & Conditioning Research*, *27*(8), 2073–2078. https://doi.org/10.1519/JSC.0b013e31827e1521

Porter, J. M., Ostrowski, E. J., Nolan, R. P., & Wu, W. F. W. (2010). Standing long-jump performance is enhanced when using an external focus of attention. *The Journal of Strength & Conditioning Research*, *24*(7), 1746–1750. https://doi.org/10.1519/JSC.0b013e3181df7fbf

Porter, J. M., & Sims, B. (2013). Altering focus of attention influences elite athletes sprinting performance. *International Journal of Coaching Science*, *7*(2), 41–51.

Powell, D., Wood, G., Kearney, P. E., & Payton, C. (2021). Skill acquisition practices of coaches on the British para swimming world class programme. *International Journal of Sports Science & Coaching*, *16*(5), 1097–1110. https://doi.org/10.1177/17479541211026248

Radnor, J. M., Moeskops, S., Morris, S. J., Mathews, T. A., Kumar, N. T., Pullen, B. J., et al. (2020). Developing athletic motor skill competencies in youth. *Strength & Conditioning Journal*, *42*(6), 54–70. https://doi.org/10.1519/SSC.0000000000000602

Ramirez-Campillo, R., Moran, J., Drury, B., Williams, M., Keogh, J. W., Chaabene, H., et al. (2021). Effects of equal volume but different plyometric jump training intensities on components of physical fitness in physically active young males. *Journal of Strength & Conditioning Research*, *35*(7), 1916–1923. https://doi.org/10.1519/JSC.0000000000003057

Shalfawi, S. A., Enoksen, E., Tønnessen, E., & Ingebrigtsen, J. (2012). Assessing test-retest reliability of the portable Brower speed trap II testing system. *Kinesiology*, *44*(1), 24–30.

Thompsen, A. G., Kackley, T. E. D., Palumbo, M. A., & Faigenbaum, A. D. (2007). Acute effects of different warm-up protocols with and without a weighted vest on jumping performance in athletic women. *The Journal of Strength and Conditioning Research*, *21*(1), 52–56. https://doi.org/10.1519/00124278-200702000-00010

Vance, J., Wulf, G., Töllner, T., McNevin, N., & Mercer, J. (2004). EMG activity as a function of the performer's focus of attention. *Journal of Motor Behavior*, *36*(4), 450–459. https://doi.org/10.3200/JMBR.36.4.450-459

Winkelman, N. C. (2018). Attentional focus and cueing for speed development. *Strength & Conditioning Journal*, *40*(1), 13–25. https://doi.org/10.1519/SSC.0000000000000266

Winkelman, N. C. (2020). *The language of coaching: The art and science of teaching movement*. Human Kinetics.

Winkelman, N. C., Clark, K. P., & Ryan, L. J. (2017). Experience level influences the effect of attentional focus on sprint performance. *Human Movement Science*, *52*(April 2017), 84–95. https://doi.org/10.1016/j.humov.2017.01.012

Wulf, G. (2012). Attentional focus and motor learning: A review of 15 years. *International Review of Sport and Exercise Psychology*, *6*(1), 77–104. https://doi.org/10.1080/1750984X.2012.723728

Wulf, G., McNevin, N., & Shea, C. (2001). The automaticity of complex motor skill learning as a function of attentional focus. *The Quarterly Journal of Experimental Psychology Section A*, *54*(4), 1143–1154. https://doi.org/10.1080/713756012

Yamada, M., Higgins, L. Q., & Raisbeck, L. (2022). How external and internal focus are used in the field: A review. *International Journal of Sports Science & Coaching*, *17*(3), 647–654. https://doi.org/10.1177/17479541211068955