An Insight into Coaches’ Knowledge and Use of Sprinting Drills to Improve Sprinting Technique and Performance

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ABSTRACT
Coaches’ knowledge of drills and their specificity to sprint movement patterns and muscle activations has become increasingly important. Drills are used to encourage the development of optimal movement and coordination. They are prescribed to help the athlete develop sprint technique and it is generally assumed that the drills are the parts within a whole-part-whole learning strategy. Previous literature has suggested some drills may be questionable as they may not replicate the muscle activations or movement pattern of sprinting [6]. 209 coaches completed an online questionnaire which examined coaches’ choice of drills; reasons for using drill and reasons for changing drills used. The results were analysed using qualitative and quantitative methods. Results showed that coaches believed that drills are vital part of training to improve performance but that they should be specific to sprinting technique.

Key words: Athletics, Drills, Sprinting, Coaches Knowledge

INTRODUCTION
Research on coaching and coach knowledge has become increasingly popular, especially in track and field sprinting [1]. Traditionally, coaches have emphasised the need for consistency in movement production [2], therefore maximum sprint performance may be seen as an idealised, invariant pattern. To simplify the learning of sprint technique or reduce its dimensionality, coaches often decompose a skill into its component parts. These component parts can be practiced in isolation in the form of specialised running drills. Coaches and athletes often use a variety of running drills to encourage the development of optimal movement and coordination patterns [6]. These exercises, or “isolation drills” are often prescribed to help the athlete to practise specific parts of the running skill, therefore it is assumed that the drills are the parts of a whole-part-whole learning strategy, where the whole skill is decomposed into constituent parts [2, 3]. For this approach to be successful, it is important that the part practice relates closely to desired sprint movements and activates the muscles in patterns that are consistent with sprinting. From a
pedagogical perspective, the use of varied part practices is well justified, provided the movement parts (drills) accurately mimic the component within the whole skill. Davids et al. [4] have shown that skill decomposition can have poor learning consequences if the key characteristics of the part practice change significantly when the decomposed part practices are performed in isolation. Davids et al. [4] concluded that the major goals for research in skill acquisition appear to be: (1) to achieve a better understanding of the information–movement relationship that constrains movement system components; (2) to focus on the implications of manipulating various constraints in the learning environment; (3) to improve understanding of how to organise practice regimens and break down sport tasks for the purposes of practice.

It appears then that isolation drills are valuable and can aid in learning and help refine key aspects to develop sprinting technique [5]. Drills are considered important as they establish the optimal movement and coordination patterns of sprinting. Despite this, information on isolation drills and various sprinting practices has failed to provide a clear and unequivocal description of how the practices/drills should be implemented to improve sprint performance or the reasons why certain practices may be effective and conversely, why other practices may not. While it is important that part practices mimic the correct sprinting technique, they should also invoke the appropriate muscle activation patterns. Drills that do not mimic the movement pattern or muscle activations of sprinting could be considered questionable [3]. A common example of a sprint drill which could be considered questionable is the use of heel flicks (See figure 1f). It is believed this drill mimics the knee flexion during the early swing phase of sprinting [6] since inspection of the sprinting action indicates that immediately after toe off, the knee and hip joints appear to flex as the knee moves through the swing phase. Studies using computer simulation and 3D kinematic analysis of sprinting show that during late swing, which involves hip flexion and knee extension, the hamstring muscles are highly active and are lengthening [6,7,8,9]. This suggests that heel flicks along with some other drills (straight leg bounds, running backwards and B-drills) which are widely used by coaches and athletes to improve sprinting technique, could be classed as questionable since the movements and muscle activations may not be consistent with the sprinting action [3].
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The peer reviewed scientific literature reveals very limited research on isolation drills in sprinting. Recent research has examined the technical knowledge of coaches with respect to the different phases of a sprint [1] and coaches’ understanding of the important characteristics of sprinting [10]. Jones et al. [1] examined the technical knowledge of expert sprint coaches using semi structured in-depth interviews. The coaches were asked about their understanding of race phases and technical constructs for sprinting. Similarly Thompson et al. [10] investigated expert sprint coaches and their technical knowledge of sprinting. Thompson’s study found that the characteristics of ground contact provided the greatest similarity between the coaches’ responses and the relevant sprint literature. However in relation to arm action coaches believed that the arms play a vital role in sprinting while the research literature shows that it is of little importance other than somewhat helping to maintain balance. Overall, both studies [1, 10] concluded that coaches appeared to rely on their experience rather information from research on sprint techniques to develop their knowledge of the technical constructs in sprinting.

Clearly, there appears to be a gap between the research-based knowledge on sprinting technique and what coaches implement while coaching their athletes to improve performance. While research on sprint drills appears to be very limited, anecdotal evidence suggests that a wide variety of drills are used extensively by coaches in a wide range of track and field events. Sprinting drills may be an important aspect of learning correct sprinting technique through establishment of optimal movement patterns and coordination, but there is a need for research to establish the range of drills used by athletic coaches and examine coaches’ rationale for using those drills. Therefore, the aims of this investigation were: 1. to determine the range of drills commonly used by track and field coaches with a particular focus on the coaching of sprint events; 2. to examine the reasons that coaches provide for selecting drills. Since drills are often seen as part practices as they mimic the movement or muscle activations, the analysis of the data considered the extent to which coaches prescribed potentially questionable drills. It is expected that the data obtained from this study will provide important insights on the practices of sprint coaches and athletes and their understanding of the learning process.

METHODS:

PARTICIPANTS
Participants were Irish based coaches of various qualification levels (n=209). The courses range from level 0 to level 3 (the highest athletic coaching qualification in Irish Athletics; recognised as equivalent to IAAF Level 4). Ethical approval was obtained from the local University Research Ethics Committee. Coaches were contacted via a third party source, Coaching Ireland.

Questionnaire Development

As a first step in preparing the questionnaire, a desk based search of existing academic databases (Web of Science and Sports Discus) was completed. The search terms included “sprinting drills”, “sprinting drills athletics”. No relevant articles were found with this search. Therefore the majority of the information obtained on drills was from internet sources such as YouTube™, and coaching websites. Following a detailed review of the drills most commonly used, a comprehensive list of drills and their various names was formed this aided in the development of answer options within the questionnaire. This list was then examined to determine duplicate drills and names and a definitive list of the top ten most frequently used drills according to the available literature was derived. The questionnaire was piloted with a small sample to ensure clear and easy understanding. Following piloting and final refinement, the questionnaire consisted of 16 questions including closed and open (i.e. textual response) questions.

To gain an understanding of which drills the coaches incorporated into their training sessions, a list of drills described using picture sequences (figure 1a – 1j) were provided to supplement several tick the box questions for the coaches. While the coaches were asked to select the drills they used in sprint sessions from the prescribed list, they were also able to name and describe additional drills not included in the questionnaire and their reasons for using these drills. The coaches were also asked to identify three key drills they would use to help an athlete improve their sprinting technique. This provided further insight into the most commonly used sprint drills for developing performance. Survey Monkey™ analysis tools were used for text analysis and to identify the key themes in the textual responses. Drills1g, 1h, 1i and 1j were designated as “questionable drills” since the movement patterns and/or expected muscle activations do not appear to mimic the movement pattern and/or muscle activation sequences in sprinting [3, 6, 9].
Frame Number

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>A-march</td>
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**Figure 1a:** Picture sequence of A-march drill.

| A-run |

**Figure 1b:** Picture Sequence of A-run drill.

| A-skip |

**Figure 1c:** Picture sequence of A-skip drill.

| Quick Step |

**Figure 1d:** Picture sequence of Quick Step drill.
Bounds

Figure 1e: Picture sequence of Bounds drill.

Heel Flicks

Figure 1f: Picture sequence of A-march drill.

Backward Running

Figure 1g: Picture sequence backward running drill.*

B-skip

Figure 1h: Picture sequence of B-skip drill.*
DATA COLLECTION
Information was collected using the finalised online questionnaire. Participants were invited by email via the Coaching Ireland data base to participate in the investigation via a link to the questionnaire on Survey Monkey™.

DATA ANALYSIS
The data were analysed using a combination of descriptive statistics (percentages, means and frequencies of responses). The textual responses were analysed using a thematic approach adapted from a seven stage process by Braun and Clark (2006) [11]. This involved: familiarisation with the data, generating initial codes, searching for themes, reviewing these themes and defining and naming the themes. Histograms were used to display the data trends.

RESULTS
COACHES’ EXPERIENCE
The results of the survey indicated that 319 coaches commenced the survey, but 209 coaches completed the survey correctly. Coach qualification levels ranged from ‘athletic leader’ to National level 3. Most of the athletics coaches had a national level 1 qualification (n=93) while 15 had a level 3 qualification and had selected sprints and hurdles as one of their coaching disciplines. All coaches used drills within their training sessions (n=209). Figure 2 shows the percentages of coaches who prescribed each of the ten drills illustrated with picture sequences in figure 1. Table 1 describes the proportion of coaches selecting questionable drills in relation to their coaching qualification level.

**Figure 2:** Drills used by coaches in order of most popular. A skip and heel flicks were the most popular drills selected by the coaches. **Table 1:** Percentage of coaches who selected at least one questionable according to their coaching level.

<table>
<thead>
<tr>
<th>Coaching Level</th>
<th>% Who selected at least one questionable drill</th>
<th>% who did not select any of questionable drills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 3 (7%)</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Level 2 (23%)</td>
<td>82</td>
<td>18</td>
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<tr>
<td>Level 1 (44%)</td>
<td>73</td>
<td>27</td>
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</tbody>
</table>
Figure 3: a The reasons coaches considered drills were important included, technique alone or a combination of answers - technique, strength, balance and warm up. b: 91% of the coaches who completed the survey had changed the drills used. The ways in which they had changed drills involved: progressing a drill, adding a new one, removing a drill or a change in focus of the drill.

Textual Response Analysis
The textual responses of the coaches provided additional information on the drills most commonly used by sprint coaches and in particular, their reasons for selecting
them. Table four provides a summary of these additional drills which are categorised according to the nature of the movements involved.

### Table 2: Other drills added by coaches used for sprint training

<table>
<thead>
<tr>
<th>Skips</th>
<th>Variations of A-skips</th>
<th>Sideways movements</th>
<th>Hurdle and ladder drills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee Drive for height</td>
<td>Single leg skips (same as A-skip but just</td>
<td>Carioca (Crossovers)</td>
<td>SAQ drills</td>
</tr>
<tr>
<td>Knee Drive for speed</td>
<td>doing the same leg)</td>
<td>Side step</td>
<td>Micro hurdles</td>
</tr>
<tr>
<td>Skipping laterally</td>
<td>Claw back</td>
<td>Sideways running</td>
<td>Hurdle step overs (same leg or alternate)</td>
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<tr>
<td>Backward skip</td>
<td>Double A-skip</td>
<td>Back to front side run</td>
<td></td>
</tr>
<tr>
<td>Skips with open arms</td>
<td></td>
<td>Sideways jogging</td>
<td></td>
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<tr>
<td><strong>Body weight exercises/stretches</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Squats- air squats</td>
<td></td>
<td>Walking drills</td>
<td></td>
</tr>
<tr>
<td>Skip and scoop</td>
<td></td>
<td>Stationary A-march</td>
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</tr>
<tr>
<td>Stretching while walking</td>
<td></td>
<td>Walking on toes</td>
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<tr>
<td><strong>Plyometric</strong></td>
<td></td>
<td>Walking on heels</td>
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</tr>
<tr>
<td>Squat jumps</td>
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<td>Heel lifts</td>
<td></td>
</tr>
<tr>
<td>Bunny hops</td>
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<td></td>
<td></td>
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<tr>
<td>Double leg bound</td>
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<tr>
<td>Kangaroo hops</td>
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<tr>
<td>Star jumps</td>
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<tr>
<td>Frog hopping</td>
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<tr>
<td>Single leg hops</td>
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<tr>
<td>Side to side long bounding</td>
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<tr>
<td>Vertical jumps on spot</td>
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<td>Two legged bounds (Forward and back)</td>
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<td>Frog hopping</td>
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The textual analysis using Survey Monkey™ analysis tools identified the thirteen most important words and phrases of the coaches’ responses; these are shown in Figure four.

**Figure 4:** Textual analysis showing the thirteen most important words and phrases that coaches used when asked to select three drills they would select to help an athlete with their sprint performance.
The key points from the textual analysis (illustrated by sample text in italics) showed that:

- Coaches believe drills are an integral and important part of training and should be practiced frequently. "Drills are vital part of training I believe one day per week should be spent solely on drills."
- Coaches believe drills help develop correct sprinting technique and should be linked to movements similar to sprinting. "Drills are specific to the running action and must mimic it closely"
- Coaches believe drill practice is very important for young athletes. "You couldn’t do enough drills with young athletes but the drill has to be broken down at an early stage so that they can learn it properly as more often than not you see a lot of drills being done wrong...."
- Coaches believe that drills should mimic sprinting "..... I believe that they are the important two for sprint running they mimic sprint running the most”.
- Coaches’ sources of information on which drills to use, generally stemmed from what other successful coaches were doing rather than why drills were actually specific to sprinting. "I feel we (coaches) just listen to other coaches and try the same, however, sometimes we do not know why we are doing a particular drill and if we are doing them correctly, I believe that the top coaches should be providing videos on AI (Athletics Ireland) website that we can look at and telling us the focus that we should be looking for.
- Finally there is need/desire from coaches for more information to be made available on which drills to use. “The hardest question I have to answer is: what do I teach next, it would be good to have a little book of drills that gave progression and a method to evaluate what drill suits what athlete.”
- The general responses of coaches can be effectively summarised in a single quote from one of the coaches: “I think drills are a really important part of the technical training of my athletes, however, it is important that they are done correctly & work on a specific part of the technique of their event. If the drill is not specific and not conducted correctly, it will reinforce bad technique rather than foster good technique. I believe it is easier to change an athlete’s overall technique with the use
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of drills as they are only practising a section of ‘the whole’ rather than having to try and alter everything at the same time”

Some additional comments from coaches provided further information on why they changed the drills:

**Athlete rationale**- Feedback from the athlete, athlete injury (limited drills), challenge athlete observation of the athlete (more able to do certain drills), athlete not transferring, drills into running technique, athlete progression, athlete had matured and developed (more able to do certain drills).

**Source information**- elite athletes, coaching courses, college, books, DVD, athletics Ireland workshops.

**Other rationale**- experimentation, variability (keeping the session fresh, keeping the athlete interested), gaining in own personal knowledge, drills not working.

**DISCUSSION:**

The aims of this study were: (1) to determine the range of drills commonly used by coaches with a particular focus on the coaching of sprint events and (2) to examine the reasons that coaches provide for selecting drills.

**(1) The range of drills commonly used.**

From the current analysis, the majority of coaches believed that drills were very important for sprint performance and improving technique. The majority of coaches believed that drills should be specific to the sprinting action. The results of the closed questions showed that several drills were considered important by most coaches and these included: A-skip, A-march and A-run (Figure 2). Visual inspection of these movement patterns revealed that these drills appeared to mimic the sprint movement pattern of sprinting [6, 7, 8, 9], however, further experimental work is needed to determine the exact muscle activation pattern of the drills. From the textual and quantitative analysis of the data, the most popular drill selected by coaches was the A-skip; this was closely followed by heel flicks (Figure 2). The heel flick drill emphasises hamstring activation during and immediately after toe off to mid-swing phase, however, research has suggested that the hamstrings are most active in sprinting from the late swing phase until toe off [6, 7, 8, 9]. This suggests that the activation pattern of sprinting is different from the activations of the hamstrings during the heel flick drill. There is a noticeable lack of research which directly
examines the levels of similarity in the kinematics and muscle patterns of drills and sprinting. Further research is also required to establish whether practice of the drills results in effective development of sprint performance and technique. The coaches’ additional comments about other drills they used provided further insight into the range and variety of drills being used by coaches to develop sprint technique. The additional comments identified a wide range of exercises including, variations of A-skips, skips to plyometric exercises and sideways movements (see Table 2). Coaches appeared to incorporate plyometric training with their drills. Plyometric training does not necessarily have to mimic sprinting, but these exercises effectively train fast and slow stretch shortening cycle response, condition the athlete and help reduce injury prevalence [12]. When the coaches were asked which three drills they would prioritise if they had a limited amount of time, the two most popular answers were the heel flick and the quick step. Clearly on the basis of these responses, some potentially questionable drills are highly prioritised by coaches.

(2) Coaches’ reasons for selecting drills.

Analysis of the data on coach reasons for selecting drills showed that most coaches believed sprint drills were important for technique, strength, balance and warm up (Figure 3a). The need for drills to have similar movement patterns was highlighted by coaches, but some stated that drills needed to be implemented at the optimal time and movement patterns should be similar. For example, one coach most effectively summarised this link between drill performance and technique, stating:

“The limiting factors of speed are primarily technique, therefore you can only sprint as fast as your technique will allow………”

Although coaches appear to be using many drills, the results showed that coaches provided limited justification for using these drills (figure 3a). While it would be expected that drills should be similar to sprinting in movement pattern and muscle activation, the results of Figures 3a and 3b and the text analysis show that coaches’ knowledge of muscle activations and movement patterns appears to be limited. While some coaches mentioned the need for similarity between drill and sprint movement patterns, there was no mention of muscle activations in any of the questionnaire responses. Based on the responses, it appears that coaches primarily
base their drill choice on what other successful coaches and athletes do, rather than having a scientific rationale for their decisions. This may be due to the limited amount of scientific research available on kinematics and muscle activations of sprinting drills. This lack of understanding of research is illustrated in the quote of one coach who stated, contrary to the findings of research [6, 7, 8, 9]:

“Butt kicks and high knees, I believe that they are the important two for sprint running they mimic sprint running the most”.

Since the available evidence of muscle activations in sprinting shows limited hamstring activation during the early to middle swing phase of sprinting [6, 7, 8, 9], it appears that the coach may have an understanding of movement but limited knowledge of muscle activations in sprinting.

CONCLUSION
The main findings of this study were that A-skips were the most popular drill selected by the coaches. This was closely followed by heel flicks, which according to some literature may be considered a questionable drill. Further research is necessary to determine the kinematics and muscle activations of drills. Coaches’ reasoning for selecting drills were primarily based on what other coaches were doing rather than scientific evidence on coaching practices. Coaches believed that drills are a very important aspect of technical training, but it is important that these drills are done correctly and that they mimic sprinting.

REFERENCES


