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Change Of Direction Actions in Goal Scoring Situations in Male and Female Professional Soccer

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ABSTRACT

The aim of this study was to analyse the frequency of change of direction (COD) actions in goal scoring situations. Data was collected through time motion analysis of goal scoring actions from teams participating in English Premier League (EPL) and Women's Super League (WSL) during the 2018/2019 season using a modified version of the Bloomfield Movement Classification with differences analysed through chi-square ($p < 0.05$).

In (total percentage [95% CI]) 71.6% (±1.7%) and 70.6% (±3.1%) of players involvements in EPL and WSL there was a COD action. For EPL and WSL, respectively, attackers performed COD actions in 71.9% (±2.3%) and 72.9% (±4.1%) of the involvements while defenders in 71.2% (±2.6%) and 67.8% (±4.7%). In 56.1% (±1.9%) and 57.1% (±3.3%) of the involvements there was at least 1 COD action performed at high intensity for EPL and WSL, respectively.

Soccer players are frequently exposed to different COD actions during goal involvements, with these being performed frequently at high intensity and so, this physical ability could play an important role in the performance outcomes of a match. Therefore, emphasis should be placed on increasing player's COD speed capabilities taking into account the tendency for specific COD actions for different players' based on their roles.

Keywords: Agility; Soccer; Sprint; Goal Scoring Situations; Women's Super League; English Premier League.

INTRODUCTION

Change of direction (COD) ability is considered one of the most important physical capabilities in soccer and is theorised to involve different types of actions based on the field position during matches (McBurnie & Dos'Santos, 2021). COD actions can be included as part of an agility task but also as part of a movement where there is no need to react to a stimulus (Sheppard & Young, 2006). COD ability has shown to discriminate between levels of performance (Kutlu et al., 2017; Kaplan et al., 2009) with males compared to females showing faster performances (Mujika et al., 2009). More so, COD ability has shown to predict high intensity accelerations and decelerations on a match (Gonçalves et al., 2021). It is therefore not surprising that COD ability is habitually targeted by practitioners as a physical capacity to enhance through specific training methods (De Keijzer et al., 2021). COD actions have shown to lead to different joint and muscle injuries in both male and females. In particular, movements such as cutting and decelerating commonly performed in COD actions have shown to lead to anterior cruciate ligament (ACL) injuries in both male and females, with higher recurrence for the latter (Lucarno et al., 2021; Della Villa et al., 2020). On the other hand, hamstring injuries, which show to be more common in males (Larruskain et al., 2018), also show to occur during braking or stopping (Gronwald et al., 2022). Due to its key importance, COD tests are frequently used as part of testing batteries (Gonçalves et al.,

2021; Reilly et al., 2000; Risso et al., 2017; Walker & Turner, 2009). Consequently, there is an ample variety of COD tests performed by researchers, not only to assess physical capacities in soccer players (Walker & Turner, 2009) or for talent identification purposes (Mirkov et al., 2010; Reilly et al., 2000) but also to assess changes in performance after specific training protocols (Aloui et al., 2021, Tous-Fajardo et al., 2016) or assess injury risk (Dos'Santos et al., 2021a).

Different studies have analysed the amount of COD activities during matches (Baptista et al., 2018; Bloomfield et al., 2007; Dos'Santos et al., 2022a; Granero-Gil et al., 2020; Morgan et al., 2021; Nedelec et al., 2014). These studies differ in the total amount of CODs performed during a match, going from 11.9 hard changes of direction to more than 700 turns and swerves (Bloomfield et al., 2007; Nedelec et al., 2014). These differences could be related to the different definitions of CODs utilised as well as the different methods used for analysis (e.g., video analysis, GPS and gyroscope). For example, Nedelec et al. (2014) used 'hard changes in direction while running' for analysis while Morgan, et al. (2021) defined COD actions as 'path change caused by an identifiable plant of a leg that led to the change in path travelled'. On the other hand, some studies only considered turning actions, again with different definitions. While Baptista et al. (2018) defined this as 'a continuous and significant rotation of the body in one direction', Bloomfield et al. (2004) defined this movement based on the degrees of rotation (e.g., 0°-90°: 'Turn ≤ ¼ circle'). Therefore, it is not surprising that there are differences in the number of COD actions reported between studies. Another challenge to consider is the fact that analysis is performed usually throughout a whole match or 15' periods. While these studies can assist in the understanding of physical match demands and guide the design and selection of drills they lack the ability to describe the specific context in which these actions occur in games. One study specifically analysed COD actions during goal scoring situations (Faude et al., 2012). These authors analyzed 360 goals of the second leg from the German national league 2007/and found 83% of the goals to be preceded by a powerful action. While sprint showed to be the most common, COD sprint accounted for 8% (5% - 11%) and 9% (6% - 12%) for assisting and scoring players respectively. Anyhow, COD sprint was defined as high intensity run with two separate accelerations in different directions. More so, the angle between these runs had to be of more than 50°, and so, other movements which could also be considered as COD actions where possibly excluded. In this sense, rotations, which could also be considered as a COD action, showed to be the second (although with no statistical difference with the third and fourth most common movements) and third (although with no statistical difference with the fourth movement) most frequent action involved in goal scoring situations for assisting (8% (5% - 11%)) and scoring player (13% (9% - 17%)) respectively. Although this could as well be considered as a modest percentage, authors defined rotations as whole body turns of over 90° and so, rotations of less than 90°, which have shown to be predominant in goal scoring situations were not analysed. Martínez-Hernández et al. (2022) and Martínez-Hernández et al. (2023) have also shown movements considered as CODs to be frequent in goal scoring situations in English Premier League (EPL) and Women's Super League (WSL). These studies found deceleration (EPL: 20.2% ±0.9%, WSL: 20% ±1.6%) and turn (EPL: 19.8% ±0.9%, WSL:18.4% ±1.5%) to be the 2nd and 3rd most common actions in goal scoring situations (no significant differences between these), with change in angle run (cut and arc run) being the 4th most common action (EPL: 8.7% ±0.6%, WSL: 9.9% ±1.2%).

While the above-mentioned studies analysed different movements that can be considered COD actions in isolation, to understand the total frequency of COD actions at all intensities as well as differences between positions and genders, further analysis is required. This would lead to an improvement on the knowledge of the importance of COD actions in goal scoring situation and assist practitioners in the design of training strategies. Therefore, the aim of this study was to gain a clear understanding of the frequency of COD actions in goal scoring situations. To accomplish this aim, the study had the following objectives: 1. Examine the percentage of involvements where a COD action was performed. 2. Acknowledge the percentage of involvements where a COD action at high intensity was performed. 3. Explore any difference between roles (attackers and defenders) and between leagues (EPL and WSL).

METHODS

A more detailed description of methodology can be found in Martínez-Hernández et al. (2022). Goals from 2018/2019 season in EPL and WSL were analysed through video analysis utilising the same broadcast provider. All goals were analysed by the

lead researcher, who had access to goals recorded at slow motion and different angles. Analysis was performed for the following players involved in the goal: scoring player, assisting player (assistant), closest defender to the scorer (defender of scorer) and closest defender to the assisting player (defender of assistant). Scorer and assistant were named as 'attackers' while defender of scorer and defender of assistant were named as 'defenders'. Analysis was performed on the last 6 movements of each player, with this sequence of movements being called 'involvement'.

Experimental Approach to the Problem

A modified version of Bloomfield Movement Classification (BMC), which has been previously utilised in Martínez-Hernández et al. (2022) and Martínez-Hernández et al. (2023) was used for data collection. We defined COD as a sudden or gradual change in movement path from a moving or static position. A COD could occur both when the player starts from a static or semi-static position and must move into a different direction (type 1) and when this advances in a certain direction prior to having to maneuver into a new direction (type 2). The main difference between these 2 types would be that the first wouldn't involve a deceleration, while the latter would generally do, although this will depend on the angle and approaching velocities (Dos'Santos et al., 2018). The third type of COD would be a change in the initial path without changing the direction that the player is facing with a combination of linear (backwards or forward) and lateral movements were deceleration is always present. Finally, the fourth type of COD would involve an arc run or curvilinear type run. The different types of COD with the different possible variations can be found in Table 2. Based on this, individual movements that an action would integrate to then be considered as a COD where: turn, cut, arc run and deceleration, although the latter is delimited by certain factors to consider (Table 1). While during turn and cut there is a body rotation and a change of initial path direction as well as a change in the direction that the player is facing, which also occurs in an arc run, performing a deceleration wouldn't always imply that the next movement involves a change in the initial direction. Regardless, deceleration would always be the link when during a COD there is a change in path without the player changing the way they face (Table 2, Type 3 CODs). For example, when performing a lateral movement to the left followed by a lateral movement to the right or when performing a lateral movement (e.g. shuffle or crossover) prior to a linear forward action (e.g. sprinting) as seen in Table 2. In these scenarios, the only combination of movements where there is a deceleration, but the action is not considered as a COD is: 1. When there is a linear advancing action + deceleration + linear advancing action in the same direction. 2. When there is a lateral action + deceleration + lateral action in the same direction. In these 2 scenarios, deceleration did not count as part of a COD action.

Statistics

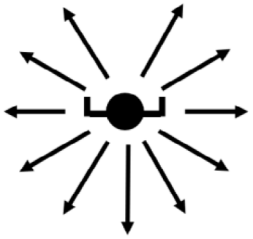
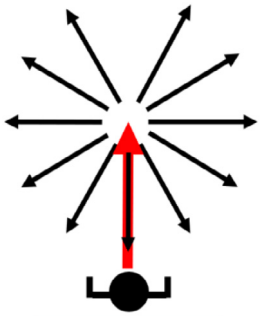
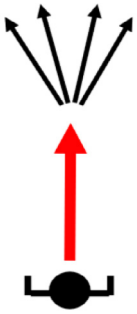
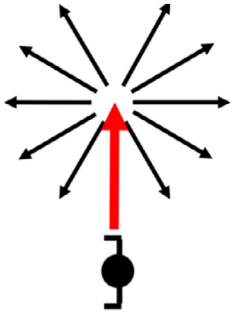
Data is presented as absolute frequencies and percentages alongside 95% confidence intervals [95% CI]. More so, data was treated as ordinal. Data analysis was performed through SPSS for Windows software version 22.0 (SPSS, Inc., Chicago, IL). Normal distribution of the data was analysed through Kolmogorov-Smirnov test and significance level was set at $p < 0.05$. Chi-square (x2) was performed to analyse differences between leagues and roles. Reliability was obtained through pilot data from 22 goals scored in 10 matches, where 72 players were involved. Intraclass correlation coefficient (ICC) (two-way mixed model, single rater, consistency) was then performed, obtaining values of 0.87 which is considered good level of agreement (Koo & Li et al., 2016).

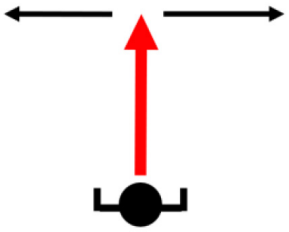
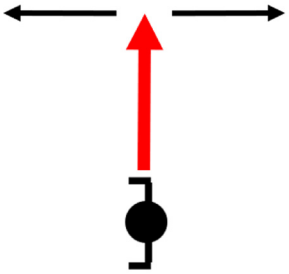
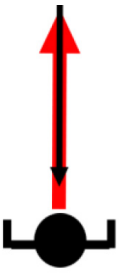
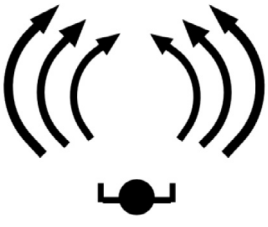
Table 1. Definition of COD movements

Deceleration:	To slow down or brake suddenly.**
Turn:	To rotate while standing, decelerating or accelerating/sprinting.***
Cut:	Path change of less than 45° with this involving little or no-previous deceleration to accomplish the task.***
Arc Run:	Player (often leaning to one side) moving in a semi-circular direction.*

**Definition from Bloomfield et al. (2004)*
*** Modified definition from Bloomfield et al. (2004)*
****Definition from Martínez-Hernández et al. (2022)*

Table 2. COD Actions and Frequency

Type of COD	Variation	Diagram	Frequency
Type 1 COD: Turn to new direction from static or semi-static (slow linear or lateral movements (e.g. walking, low intensity shuffle)) position.	-Turn to new direction		+ Defender + Attacker
Type 2 COD: turn/cut to new direction from moving position (deceleration included unless slow velocity approach and/or low degrees of turning)	-Linear advancing (forward or backward) + deceleration + turn/cut to new direction		+++++ Defender ++++ Attacker
	-Linear advancing (forward or backward) + turn/cut to new direction (usually slow approach and/or low degrees of turn)		++ Defender +++ Attacker
	-Lateral + deceleration + turn to new direction		++ Defender + Attacker
	Lateral + turn to new direction (usually slow approach and/or low degrees of turn)		++ Defender + Attacker

Type of COD	Variation	Diagram	Frequency
Type 3 COD: change in path without a change in the direction that player is facing	-Linear advancing (forward or backward) + deceleration + lateral	 LINEAR LATERAL	++ Defender + Attacker
	-Lateral + deceleration + linear forward/backwards movement	 LATERAL LINEAR	++ Defender + Attacker
	-Lateral + deceleration + lateral to opposite direction	 LATERAL LATERAL	++ Defender + Attacker
	-Linear advancing + deceleration + Linear advancing (forward to backwards or backwards to forward)	 LINEAR LINEAR	++ Defender + Attacker
Type 4 COD: arched run performed to maintain velocity	-Arc run performed with different degrees	 ARC RUN	++ Defender + Attacker

Scale of frequency: + = Low, ++ = Low - medium, +++ = medium, ++++ = medium – high, +++++ = high

RESULTS

This study investigated COD actions specifically in goal scoring situations. In 71.6% (±1.7%) and 70.6% (±3.1%) of players involvements in EPL and WSL there was a COD action, with no significant differences between leagues ($x^2_{(1)} = 0.319$, $p = 0.571$). Moreover, attackers performed COD actions in 71.9% (±2.3%) and 72.9% (±4.1%) of the involvements for EPL and WSL, respectively, while defenders executed these in 71.2% (±2.6%) and 67.8% (±4.7%) of the involvements, respectively (Figure 1). Chi-square analysis showed no differences between attackers and defenders in EPL ($x^2_{(1)} = 0.121$, $p = 0.727$) or WSL ($x^2_{(1)} = 2.611$, $p = 0.106$). More so, Chi-square showed no difference between leagues for attackers ($x^2_{(1)} = 0.191$, $p = 0.661$) as well as for defenders ($x^2_{(1)} = 1.635$, $p = 0.200$). When looking at COD actions with at least one movement at high intensity (turn, deceleration (only on certain occasions considered COD), cut and arc run) EPL and WSL showed similar percentages. In EPL and WSL a COD action was performed in 56.1% (±1.9%) and 57.1% (±3.3%) of the involvements, with no significant differences between leagues ($x^2_{(1)} = 0.200$, $p = 0.638$).

DISCUSSION

Results show that COD actions occur in 71.6% (±1.7%) and 70.6% (±3.1%) of players involvements while in 56.1% (±1.9%) and 57.1% (±3.3%) at least 1 of these actions was performed at high intensity in EPL and WSL, respectively. Moreover, leagues as well as different players' roles showed similar trends, with no significance difference between these. The high percentage of CODs at all intensities and at high intensity is in contrast with findings from Faude et al. (2012), who found COD sprint in assisting and scoring players to be performed in 8% and 9% of the goals and rotations in 8% and 13% in assisting and scoring players, respectively. This could be related to the definitions provided for these actions, which could have potentially excluded a certain number of movements. The fact that our study shows COD actions and those with at least 1 high intensity action to be present in more than 2/3 and more than half of the players involvements, respectively shows the key role that these complex physical capacity plays in goal scoring situations. CODs are not only highly frequent but are usually performed at a high intensity, with the performance and injury prevention implications that this presents. For example, it has been reported that over 20m, female players playing at international level would be at least 1m ahead compared to second division players of the same country (Haugen et al., 2012) which could then be decisive in goal scoring situations requiring linear advancing motion (e.g., sprint). Similarly, it could be hypothesized that being able to change direction in a faster manner would allow players to have certain advantage vs slower players. For example, when the attacker is facing the defender (this being between the attacker and the goal), if the first is able to turn to one side and accelerate faster than the defender, this could be in an advantageable position to shoot to goal. In this respect the different types of CODs are shown to be ample (Table 2), implying that football players should effectively dominate a wide variety of movements to succeed as well as to reduce the likelihood of injury.

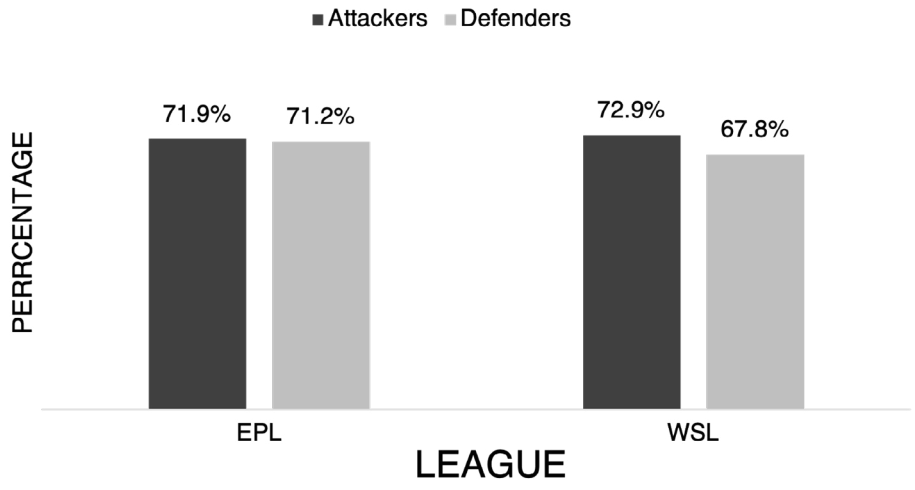


Figure 1. Percentage of goal involvements where a COD action was performed.

This study showed no significant percentage differences between leagues (EPL vs WSL) or roles (attackers vs defenders), or leagues and roles combined (EPL attackers vs WSL attackers, EPL defenders vs WSL defenders). When it comes to COD performed in goal scoring situations, studies have shown players to follow similar trends with certain differences between studies. Faude et al. (2012) found very small differences for COD sprints between assisting and scoring player with 8% (5% - 11%) and 9% (6% - 12%), respectively, while rotations showed a bigger difference, with 8% (5% - 11%) and 13% (9% - 17%), respectively. On the other hand, Martínez-Hernández et al. (2022) and Martínez-Hernández et al. (2023) found higher percentage of cuts and subtle turns (0°-60°) for attackers while defenders performed higher ratio of sharp turns (60° - 120°), high intensity decelerations and arc runs in both EPL and WSL. While in our study there were no significant differences in the percentage of COD actions, the same database as Martínez-Hernández et al. (2022) and Martínez-Hernández et al. (2023) was utilised. Therefore, although the frequency of COD actions is similar, the type of COD performed would somehow differ between attackers and defenders, with this being relevant for injury risk as well as performance, more so, when attacking vs defending agility shows to have different characteristics in team sports (Dos'Santos et al., 2022b; Drake et al., 2017; Sheppard et al., 2006; Young et al., 2022).

COD involving high intensity decelerations and sharp turns, usually seen in defenders, would mean that these are at higher risk as these could be exposed to higher frontal plane loading which may reflect higher loading in the knee (Havens & Sigward, 2015a). Furthermore, from a biomechanical point of view different studies show greater knee abduction moments, which is potentially linked to higher ACL loading (Kiapour et al., 2016), in greater COD angles (Havens & Sigward, 2015a; Schreurs et al., 2017). In addition to the potentially higher loads imposed to defenders due to greater ratio of high intensity decelerations and sharp turns, the fact that these would be commonly reacting to attackers' unpredicted movements would impose higher loads in the knee, as research shows that decision making and dividing attention influences several biomechanical variables related with higher risk of ACL injury (Brown et al., 2014; Hughes & Dai et al., 2021). In this sense, when comparing between male and female players, although the latter has 1.5 times higher occurrence rate of ACL injury (Montalvo et al., 2019), injuries in both genders occur commonly in movements performed during CODs (deceleration and cutting), with the mechanism also being similar (without direct contact to the knee), (Lucarno et al., 2021; Della Villa et al., 2020). In addition, hamstring injuries, which show to be almost 2 times more frequent male (Larruskain et al., 2018), occur in numerous occasions when braking or stopping (Gronwald et al., 2022). Not only defenders, but also attackers would be at risk during these movements as although in general they would likely 'lead' the movement to create time and space and be proactive vs reactive, the continued changes in the environment as well as the tactical decision from defenders, would also lead these to react by changing direction. For example, when the defender 'offers' with tactical purpose a certain space, this would possibly force the attacker to react rapidly to gain this space by cutting. In addition, although attackers show to perform higher percentage of shallow turns and low intensity decelerations they are not exempt of these high intensity decelerations and sharp turns performed in a greater percentage by defenders, as 37% and 43% of the total turns show to be between 60° and 180°, and 26% and 29% of the total decelerations are performed at high intensity for EPL and WSL, respectively (Martínez-Hernández, et al., 2022; Martínez-Hernández et al., 2023).

Specific resistance training could be individualised based on how the player is involved in COD actions for performance and injury prevention purposes, although more research is needed. For example, an important factor that distinguishes between CODs with different angles is the ground contact time (GCT), as these would usually increase with higher degrees of CODs (Havens & Sigward, 2015b; Marshall et al., 2014; Spiteri et al., 2015), and so, the time required for force application would differ, which would have implications for exercise selection.

To conclude, both attackers and defenders in EPL and WSL show to perform COD actions in more than 2/3 of the involvements. Moreover, CODs with at least 1 movement at high intensity show to be performed in more than half of the involvements, showing the importance of performing these in an explosive manner, with faster outputs potentially influencing players' chances of success in certain game situations. Moreover, considering the ample variety of CODs (Table 2) that players are exposed to, these also need the ability to effectively perform a wide range of multidirectional movements. While attackers and defenders show similar percentages of COD actions, these would be exposed to different

type of CODs, and so, training strategies for injury prevention and performance enhancement would vary based on the role.

Due to the high percentage of CODs performed in goal scoring situations by attacking and defending players, COD actions should be trained through a holistic force – velocity approach with specificity being a priority. COD and agility drills should be performed at maximum pace and with a wide variety of movements and combination of these (Table 2). When individualising COD training, defending players should prioritise drills with sharp turns and fast approaching velocities which allows high intensity decelerations as well as the inclusion of lateral movements and arched type runs. On the other hand, attackers would benefit more from drills with shallow turns and cuts where lower intensity decelerations are required compared to defenders. Attention should be placed on players' execution of the correct technique, as it's been shown that technique modification training can reduce knee loading and improve performance (Dempsey et al., 2009; Dos'Santos et al., 2019a; Dos'Santos et al., 2021b). Small sided games should also be included as part of COD training, as this would form the ultimate specific mode of training.

Attackers, who perform more CODs with shallow turns as well as cuts, would be exposed to shorter GCTs and would preferentially enhance reactive strength with short SSC plyometric drills (Dos'Santos et al., 2018) performed in a multidirectional manner as well as other exercises that replicate repeated rapid braking and propulsive actions (e.g. plyometrics, flywheel exercises with low inertia, etc.). On the other hand, defenders, who perform commonly sharp turns with frequent decelerations at high intensity would be exposed to longer GCTs and higher eccentric forces. Therefore, eccentric strength development, especially for quadriceps muscles (Dos'Santos et al., 2019b; Morris et al., 2022) to enhance the absorption of greater kinetic energy to decelerate (Morris et al., 2022) is recommended. Moreover, long SSC plyometric exercises (Dos'Santos et al., 2018) as well as power exercises applying rotational movements would also be beneficial.

In order to better cope with unplanned movements occurring in COD actions and reduce knee loads, exercises promoting muscle preactivity through perturbations and unexpected situations should be added. These have shown to reduce knee load (Weltin et al., 2017), improve muscle preactivity (Zebis et al., 2016) and increase muscle coordination (Oliveira et al., 2017) during cuts.

DISCLOSURE OF INTEREST

The authors report no conflict of interest.

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