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Research article

The Influence of Task Conditions on Side Foot-Kick Accuracy among Swedish First League Women's Soccer Players

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Abstract

The purpose of this study was to investigate the influence of the task conditions on 20-m side foot-kick accuracy among Swedish first league women's soccer players. Twenty-three players performed three side foot-kick tests under different task conditions: stationary ball using match-relevant ball speed (SBRS) and maximal ball speed (SBMS) and a 5-m run with the ball from different approach angles (0°, 30°, and 60°) to a predetermined position, where passing of the ball on the move was executed using match-relevant ball speed (RBRS). With each test, the players performed 30 side-foot kicks, alternating between kicking legs with the aim of hitting a target stick. The accuracy was determined using video analysis. The side foot-kick accuracy was significantly greater for SBRS, compared to RBRS and SBMS. For all three test variables, the preferred leg displayed greater accuracy. The preferred leg's accuracy was greater for the approach angle of 30° compared to both 0° and 60°. A significant deviation from the target stick was found for the straight-ahead approach, in which the right-foot and left-foot kicks deviated to respectively the left and right of the stick; in contrast, for the approach angle of 60°, the deviation from the target stick was on the opposite side of the approach side for both legs.

Key words: Football, passing, precision, approach angle, kicking effort

Introduction

Ball possession, through high passing accuracy, is an important characteristic for successful soccer teams independent of gender; it was reported that more goals were scored from longer passing sequences, compared to sequences with smaller numbers of passes (Hughes and Franks, 2005). For example, the total numbers of passes and pass completions, as well as the average number of touches per ball possession, were greater in Premier League teams than in lower standard teams (Bradley et al., 2013). During an elite soccer match, the mean number of technical actions (i.e., passes, receives, dribbles) for each player has been demonstrated to range between 50 and 110 actions, and short on the ground passes were the most frequently used passing activity (Bloomfield et al., 2007; Carling, 2010). A detailed analysis of completed passes in the UEFA Euro 2012 revealed that, for 60% of the total number of passes, the players used side-foot kicks (Mitschke and Milani, 2014). Therefore, the side-foot kick is regarded as an important technique, and efficient execution of this fundamental skill is essential for retaining possession of the ball within the team (O'Reilly and Wong, 2012).

The main reason for the frequent usage of side-foot kicks is likely the high success rate, which has been reported to be as great as 70 – 94% for short (< 10 m) passes, whereas the success rate decreases significantly for longer passes (Andersen et al., 2012; Andersen et al., 2016; Mitschke and Milani, 2014). The accuracy of technical skills has been suggested to influence the possession of the ball during match play in soccer (Russell and Kingsley, 2011). Consequently, the accuracy of kicking is considered an important component of soccer performance, and kicking accuracy has been defined as the ability to kick the soccer ball to a specified area (Finnoff et al., 2002).

Side foot-kick accuracy could be affected by several factors, such as kicking effort, approach angle, preferred or non-preferred kicking leg, and a stationary or rolling ball. Generally, there is a reduction in movement speed and subsequent ball speed when the task is to perform an accurate kick, compared to kicking with maximal effort (Andersen and Dörge, 2011; Lees and Nolan, 1998; Teixeira, 1999; van den Tillaar and Fuglstad, 2017); hence, it has been suggested that there is a speed/accuracy trade-off when an accuracy demand is introduced (Kellis and Katis, 2007). For instep kicks, it has been shown that ball speed decreases to between 73% and 96% of the maximal speed when accuracy of the kick is prioritized (Andersen and Dörge, 2011; Lees and Nolan, 2002; van den Tillaar and Ulvik, 2014). Moreover, evaluation of approach angles from 0° (straight ahead) to 135° has revealed that there is no significant difference in instep-kick accuracy between approach angles when kicking a stationary ball (Masuda et al., 2005; Scurr and Hall, 2009). However, to the best of our knowledge, no previous study has investigated elite female soccer players' side foot-kick accuracy for different kicking efforts, different approach angles, or passing on the move.

Another factor potentially influencing side foot-kick accuracy is the kicking leg (i.e., preferred or non-preferred leg). Generally, soccer players tend to favor one of the legs (Carey et al., 2001; Teixeira et al., 2003), and it is well established that the ball speed after an instep kick is greater when using the preferred leg, compared to the non-preferred leg (Barbieri et al., 2015; Dörge et al., 2002; Nunome et al., 2006). Correspondingly, the instep-kick accuracy is greater when the preferred leg is used (Barbieri et al., 2015; Berjan-Bacvarevic et al., 2012; McLean and Tumilty, 1993; van den Tillaar and Ulvik, 2014). This accuracy difference related to leg dominance has also been found for side-foot kicks in adolescent and male amateur soccer players (Teixeira et al., 2003; Zago et al., 2014). Moreover, the complexity of the task increases when the task is to kick a rolling ball, compared to a stationary-ball

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kick (Egan et al., 2007); however, there were no accuracy differences between task conditions for instep kicks in either experienced or inexperienced male players (Barbieri et al., 2010; Barbieri et al., 2015; Egan et al., 2007). Nonetheless, there is still a lack of knowledge concerning whether elite female players' side foot-kick accuracy is influenced by the task condition.

The purpose of this study was to investigate the influence of the task conditions (i.e., kicking effort, preferred or non-preferred kicking leg, and stationary ball or passing on the move from different approach angles) on 20-m side foot-kick accuracy among Swedish first league women's soccer players.

Methods

Participants

Twenty-three Swedish first league women's soccer players (age: 23 ± 5 years old, stature: 1.67 ± 0.06 m, and body mass: 63 ± 7 kg) volunteered to participate in the study. The group consisted of three goal keepers, seven defenders, eight midfielders, and five forwards. Twenty of the players had the right leg as their preferred leg for side-foot kicks, whereas three of the participants had the left leg as their preferred leg for side-foot kicks. All of the participants provided their written informed consent to participate in the study, and the study was approved by the Regional Ethical Review Board. The test procedures were performed in accordance with the Declaration of Helsinki.

Study design

To investigate the influence of task conditions on side foot-kick accuracy, the participants performed three 20-m side foot-kick tests on the same day (Figure 1). To investigate the effect of kicking effort on 20-m side foot-kick accuracy, the participants were instructed to perform the same kicking-accuracy test with either a match-relevant ball speed or maximal ball speed. Furthermore, the effect of approach angle on 20-m side foot-kick accuracy was investigated using three different approach angles.

After a standardized 14-min warm-up (7 min of jogging and 7 min of side foot-kick passes between players), the execution of each test was explained. The tests were performed at an indoor soccer field with artificial grass turf (XM 40, Fieldturf Tarkett, Nanterre, France) and the same set of 25 pressured controlled balls (Beau Jeu, Adidas AG, Herzogenaurach, Germany) of size 5 was used. Each side-foot kick was preceded by a 3-s countdown with one beep every second, followed by higher tone (Stopwatch, Fitlb, San Jose, CA, USA), which was regarded as the intended time of the kick. The computer program was set to have 20 s between kicks in each series. Each of the tests consisted of 30 side-foot kicks (6 series with 5 kicks/series). The rest period between the last side-foot kick in a series and the first kick in the subsequent series was 40 s. The first series was started with the right leg; thereafter, the participant alternated between legs in each series (i.e., for even series, the participant started with left leg).

All three side foot-kick tests were performed with a 20-m distance between the ball-strike position and each of the orange target sticks with a diameter of 26 mm (Figure 1). At each test station, the target stick was positioned on the center of a score line, which was perpendicular to the line between the ball-strike position and the target stick. With spacing of 1 m, twenty cones were placed on the score line.

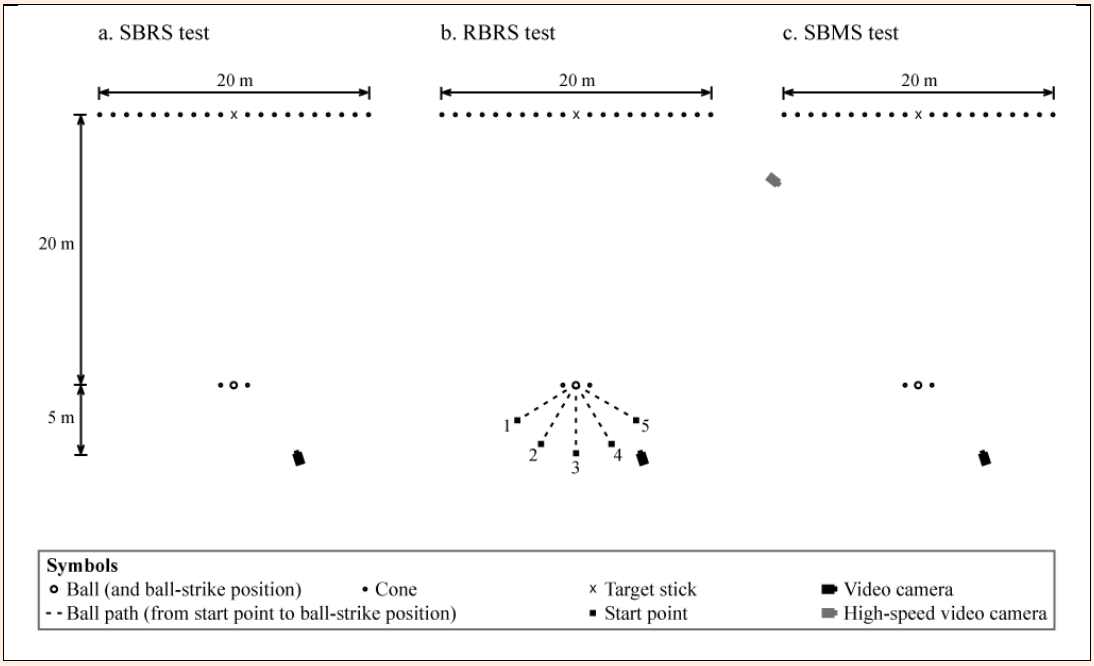

Figure 1. The arrangement of the three side foot-kick tests. a) SBRS test with freely chosen approach angle, stationary ball, and match-relevant ball speed; b) RBRS test with fixed approach angle (0°, 30°, and 60°), moving ball, and match-relevant ball speed; c) SMMS test with freely chosen approach angle, stationary ball, and maximal ball speed while maintaining a high accuracy.

Side-foot kick of a stationary ball using a match-relevant ball speed (SBRS)

In the SBRS test, the side foot-kick accuracy was measured at 20 m with a stationary ball using a match-relevant ball speed. There was no restriction considering approach speed and angle. However, the participants were instructed to use a kicking effort relevant for a 20-m side foot-kick pass in a match and to be considered as a match-relevant ball speed the ball should travel at least 10 m behind the score line. Moreover, to be considered as an acceptable kick, the ball had to roll on the artificial grass turf for a minimum of the last 5 m in front of the score line. To enable a visual estimation of the 20-m side foot-kick accuracy of each side-foot kick, a video camera (HC-V750, Panasonic, Osaka, Japan) was used to record all side-foot kicks in the SBRS test. The camera was positioned 5 m behind the ball-strike position and 4 m to the right of the center line (Figure 1a). Based on the video recordings, the distance between the target stick and the center of the ball was determined using Kinovea, version 0.8.15 (Kinovea, France). Based on the results of the video analysis, the mean absolute distance (without sign) from the target was calculated for preferred and non-preferred leg as well as for both legs combined. In addition, the mean distance with sign was calculated for both legs separate and combined. The sign of the mean value indicates to which side of the centrally positioned target stick the ball passes the score line, where a positive and negative sign represent right and left side, respectively.

Side-foot kick of a stationary ball using a maximal ball speed (SBMS)

In the SBMS test, the side foot-kick accuracy was measured at 20 m with a stationary ball using maximal ball speed. There was no restriction considering approach speed and angle. However, the participants were requested to have a maximal ball speed while maintaining high accuracy. The criteria to be considered as an acceptable kick was the same as in the SBRS test (i.e., the ball should roll at least the last 5 m in front of the score line). The setup of the video camera (HC-V750, Panasonic, Osaka, Japan), to determine the accuracy, was identical to the setup in the SBRS test (i.e., the same position in relation to the ball-strike position) (Figure 1c). Based on the results of the video analysis, the mean absolute distance (without sign) from the target was calculated for preferred and non-preferred leg as well as for both legs combined. In addition, the mean distance with sign was calculated for both legs separate and combined. The sign of the mean value indicates to which side of the centrally positioned target stick the ball passes the score line, where a positive and negative sign represent right and left side, respectively.

All kicks in the SBMS test were also recorded with a high-speed video camera (GC-PX100, JVC, Yokohama, Japan), which was positioned 5 m in front of the score line and 10 m to the left of the center line (Figure 1c). The video recording enabled calculation of the ball speed based on the time difference between the ball strike and score-line passage.

Side-foot kick of a rolling ball using a match-relevant ball speed (RBRS)

In the RBRS test, the side foot-kick accuracy at 20 m was measured subsequent to a 5-m run with the ball, from the approach angles 0°, 30°, and 60°, to a predetermined ball-strike position where passing of the ball on the move was executed using a match-relevant ball speed (i.e., the ball should travel at least 10 m behind the score line). The criteria to be considered as an acceptable kick was the same as in the SBRS test (i.e., the ball should roll at least the last 5 m in front of the score line). The participants were instructed to execute the side-foot kick within 3 s from the start beep and to move the ball in a straight path from the start point to the ball-strike position (see dotted lines in Figure 1b). Hence, running with the ball was initiated at the first countdown beep, and the side-foot kick on the move was supposed to be performed at the time of the higher tone, which ended the countdown sequence. Each of the five different start points was placed 5 m from the pre-determined ball-strike position and the start points were evenly distributed on a semicircle with an angular difference of 30° between points (Figure 1b). Start point 3 centered on the target stick, i.e., 25 m from the target stick and the approach angle for the centered start point was 0°. The angle of approach for start points 2 and 4 was 30°, and for start points 1 and 5, the approach angle was 60°. The start-point order for uneven series was 2-5-3-4-1, whereas the corresponding order for even series was 4-1-3-2-5. For start points 1 and 2, the participant used the right leg for the side-foot kick and for start points 4 and 5, the left leg was used. During uneven series, the right leg was used for start point 3, whereas the left leg was used for the centered start point in even series.

The setup of the video camera (HC-V750, Panasonic, Osaka, Japan), to determine the accuracy, was identical to the setup in the SBRS test (i.e., the same position in relation to the ball-strike position) (Figure 1b). Based on the results of the video analysis, the mean absolute distance (without sign) from the target was calculated for preferred and non-preferred leg for each approach angle as well as for both legs combined. In addition, the mean distance with sign was calculated for all angle/leg combinations. The sign of the mean value indicates to which side of the centrally positioned target stick the ball passes the score line, where a positive and negative sign represent right and left side, respectively.

Statistical analyses

Test results are presented as the means and standard deviations (SDs). The homogeneity of the variances of the test variables was tested using Levene's test. Normality of the test variables was assessed using the Shapiro-Wilk test, and if the investigated variable was not normally distributed, the detected outliers were removed. One-way repeated measures analysis of variance (ANOVA) was used to compare differences in accuracy between the overall mean values in the three side foot-kick test conditions. To investigate the effect of kicking effort (i.e., match-relevant or maximal ball speed) and leg preference (i.e., preferred or non-preferred leg) on 20-m side foot-kick accuracy in the tests with a stationary ball (i.e., SBRS and SBMS test), a two-way repeated measures ANOVA was performed.

Correspondingly, a two-way repeated measures ANOVA was used to investigate the effect of approach angle (i.e., 0°, 30°, or 60°) and leg preference on 20-m side foot-kick accuracy in the RBRS test. Student's paired samples *t*-test was used as post hoc test to investigate accuracy differences between test variables. Student's one-sample *t*-test was conducted to investigate whether the accuracy for the 20-m side foot-kick accuracy tests deviated from the central position. Cohen's *d* effect sizes were calculated for main effects and they were classified as: small effect, $0.2 \leq |d| < 0.5$; moderate effect, $0.5 \leq |d| < 0.8$, and large effect, $|d| \geq 0.8$ (Cohen, 1988). Linear regression was used to establish which angle of approach that corresponds to a zero deviation from the target stick by determining the relationship between approach angle and mean deviation from the target stick. The statistical analyses were conducted using IBM SPSS Statistics software, version 23 (IBM Corporation, Armonk, NY, USA) and all of the statistical analyses were assumed to be significant at alpha level 0.05.

Results

Differences in side foot-kick accuracy between test conditions

A significant difference in kicking accuracy was found between the three side foot-kick tests ($F_{2,44} = 8.81$, $p < 0.001$, partial $\eta^2 = 0.29$). Post hoc test showed that the side foot-kick accuracy in the SBRS with stationary ball and match-relevant ball speed (0.82 ± 0.14 m) was greater compared to the accuracy in the SBMS test where the task was to have a maximal ball speed and while maintaining high accuracy (0.94 ± 0.21 m) ($t = -4.60$, $p < 0.001$, $d = -0.96$). A significant difference in side foot-kick accuracy was also found between the accuracy in the SBRS test and the accuracy in the RBRS test where the side-foot kick was executed on the move from three different approach angles (1.00 ± 0.21 m) ($t = -2.48$, $p = 0.021$, $d = -0.52$). However, there was no significant difference between the accuracy in the SBMS test and RBRS test ($t = -1.45$, $p = 0.16$, $d = -0.30$).

The ball speeds in the SBMS test were 49.0 $km \cdot h^{-1}$ and 43.4 $km \cdot h^{-1}$ for the preferred leg and non-preferred leg, respectively, and the ball speed was significantly greater for the preferred leg ($t = 7.40$, $p < 0.001$, $d = 1.54$).

The effect of kicking effort and leg preference/kicking leg on side foot-kick accuracy

The absolute distance from the centrally positioned target stick was influenced by both kicking effort ($F_{1,22} = 6.58$, $p = 0.018$, partial $\eta^2 = 0.23$) and leg preference ($F_{1,22} = 20.50$, $p < 0.001$, partial $\eta^2 = 0.48$), but no interaction between kicking effort and leg preference was found ($F_{1,22} = 0.40$, $p = 0.53$, partial $\eta^2 = 0.02$). Hence, the kicking accuracy in the SBRS test with a stationary ball using a match-relevant ball speed (0.82 ± 0.14 m) was greater than when using maximal ball speed in the SBMS test (0.94 ± 0.21 m) (Figure 2). In the SBRS test, where a match-relevant ball speed was used, the preferred leg (0.68 ± 0.13 m) showed a greater accuracy compared to the non-preferred leg (0.95 ± 0.27 m) ($t = -4.04$, $p < 0.001$, $d = -0.84$) (Figure 2). A significant kicking-accuracy difference was also found between the preferred leg (0.78 ± 0.19 m) and non-preferred leg (1.10 ± 0.39 m) in the SBMS test ($t = -3.44$, $p = 0.002$, $d = -0.72$) (Figure 2), where the task was to have a maximal ball speed and while maintaining high accuracy.

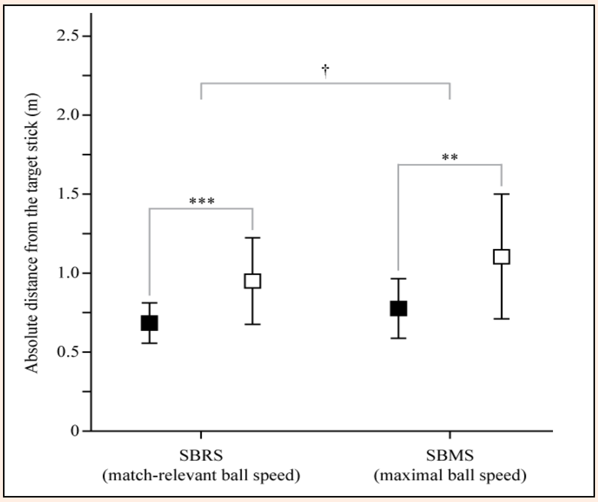

Figure 2. The effect of kicking effort and leg preference on side foot-kick accuracy, measured as the absolute distance from the centrally positioned target stick. Squares represent mean values and error bars represent ±1 standard deviation, where black squares represent preferred-leg kicks and white squares represent non-preferred-leg kicks. Significant differences are reported as: † for $p < 0.05$ (difference between tests); ** for $p < 0.01$ (between leg difference); and *** for $p < 0.001$ (difference between legs).

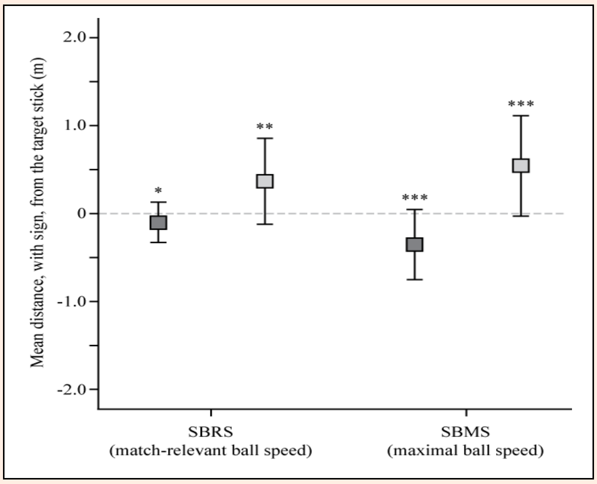

Figure 3. The effect of kicking effort and kicking leg on side foot-kick accuracy, measured as deviation from the centrally positioned target stick, where minus sign indicates a left-side deviation and a positive sign indicates a right-side deviation. Squares represent mean values and error bars represent ±1 standard deviation, where dark-grey squares represent right-leg kicks and light-grey squares represent left-leg kicks. Significant differences from the target stick (zero point) are reported as: * for $p < 0.05$; ** for $p < 0.01$; and *** for $p < 0.001$.

The right side-foot kicks showed a significant deviation from the centrally positioned target stick (zero point) in both the SBRS test with match-relevant ball speed (-0.10 ± 0.23 m) ($t = -2.10$, $p = 0.047$, $d = -0.44$) and in the SBMS with maximal ball speed (-0.35 ± 0.40 m) ($t = -4.25$, $p <$

0.001, d = -0.89) (Figure 3); hence, for both of these tests, the players generally missed the target to the left when kicking with the right foot. Conversely, the left side-foot kicks deviated to the right of the target stick in both the SBRS test (0.37 ± 0.49 m) (t = 3.59, p = 0.002, d = 0.75) and SBMS test (0.54 ± 0.57 m) (t = 4.54, p < 0.001, d = 0.95) (Figure 3).

The effect of approach angle and leg preference/kicking leg on side foot-kick accuracy

The absolute distance from the centrally positioned target stick was influenced by both approach angle ($F_{2,44}$ = 4.29, p = 0.020, partial η^2 = 0.16) and leg preference ($F_{2,44}$ = 4.97, p = 0.036, partial η^2 = 0.18) in the RBRS test where the side-foot kick was executed on the move from three different approach angles. However, no interaction between approach angle and leg preference was found ($F_{2,44}$ = 1.22, p = 0.30, partial η^2 = 0.05). When comparing the kicking accuracy for the three different approach angles in the RBRS test, post hoc tests showed that approach of the strike position from 30° (0.89 ± 0.30 m) was related to a significantly greater accuracy than from approach angles 0° (1.11 ± 0.37 m) (t = -2.62, p = 0.016, d = -0.55) and 60° (1.06 ± 0.23 m) (t = -2.49, p = 0.021, d = -0.52) (Figure 4). No significant difference in side foot-kick accuracy was found between 0° and 60° (t = 0.64, p = 0.53, d = 0.13). For the leg preference, post hoc tests revealed that that kicking accuracy for the approach angle 30° was significantly greater for the preferred leg (0.76 ± 0.29 m) compared to the non-preferred leg (1.03 ± 0.43 m) (t = -3.21, p = 0.004, d = -0.67) (Figure 4). No significant differences in kicking accuracy was found between preferred leg and non-preferred leg for either 0° (1.09 ± 0.46 m versus 1.12 ± 0.57 m) (t = -0.22, p = 0.83, d = -0.05) or 60° (0.99 ± 0.32 m versus 1.12 ± 0.31 m) (t = -1.51, p = 0.15, d = -0.31).

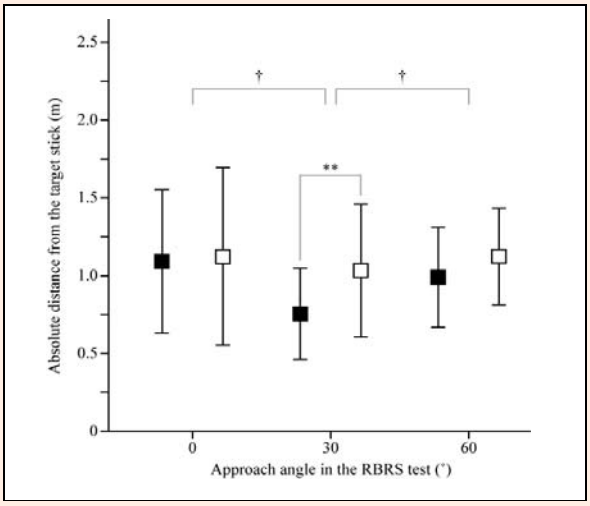

Figure 4. The effect of approach angle and leg preference on side foot-kick accuracy, measured as the absolute distance from the centrally positioned target stick. Squares represent mean values and error bars represent ±1 standard deviation, where black squares represent preferred-leg kicks and white squares represent non-preferred-leg kicks. Significant differences are reported as: † for p < 0.05 (difference between angles); and ** for p < 0.01 (difference between legs).

For the preferred leg, significant differences in accuracy were found between 0° and 30° (t = 3.67, p = 0.0013, d = 0.77), as well as between 30° and 60° (t = -2.87, p = 0.009, d = -0.60), with the accuracy for the approach angle of 30° greater than for both 0° and 60° (Figure 4). However, no accuracy difference was detected between 0° and 60° (t = 0.97, p = 0.34, d = 0.20). For the non-preferred leg, no significant accuracy differences related to different approach angles were found (p = 0.38 to 0.99).

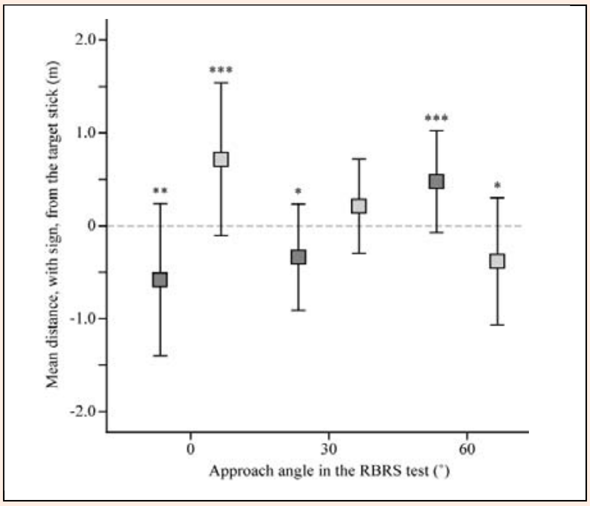

Figure 5. The effect of approach angle and kicking leg on side foot-kick accuracy, measured as deviation from the centrally positioned target stick, where minus sign indicates a left-side deviation and a positive sign indicates a right-side deviation. Squares represent mean values and error bars represent ±1 standard deviation, where dark-grey squares represent right-leg kicks and light-grey squares represent left-leg kicks. Significant differences from the target stick (zero point) are presented as: * for p < 0.05; ** for p < 0.01; and *** for p < 0.001.

The right side-foot kicks in the RBRS test displayed significant deviations from the centrally positioned target stick (zero point) for all three approach angles; for approach angles 0° (-0.58 ± 0.82 m) (t = -3.39, p = 0.003, d = -0.71) and 30° (-0.34 ± 0.57 m) (t = -2.81, p = 0.010, d = -0.59) the right side-foot kicks missed the target to the left, whereas an approach from 60° (0.48 ± 0.55 m) (t = 4.15, p < 0.001, d = 0.87) resulted in a deviation of the kicks to the right of the target stick (Figure 5). For the left side-foot kicks, significant deviations from the target stick were found for the approach angles 0° (0.72 ± 0.82 m) (t = 4.19, p < 0.001, d = 0.87) and 60° (-0.38 ± 0.68 m) (t = -2.70, p = 0.013, d = -0.56), where they generally missed the target to the right and left, respectively (Figure 5). For the left leg with an approach angle of 30°, an outlier was detected, and after removal, no significant deviation from zero was found (0.21 ± 0.51 m) (t = 1.97, p = 0.062, d = 0.42). The equations that described the linear relationship between approach angle and mean deviation from the target stick were for the right leg “deviation = 0.0177 · angle - 0.677” (R^2 = 0.909) and left leg “deviation = -0.0183 · angle + 0.733” (R^2 = 0.998). The approach angles that corresponded to a zero deviation were 38.2° and 40.1° for right and left leg, respectively.

Discussion

The current study provided novel insights into the influence of task conditions (i.e., kicking effort, approach angle, preferred or non-preferred kicking leg, and stationary ball or passing on the move) on the 20-m side foot-kick accuracy of first league women's soccer players. The results revealed that a maximal kicking effort and passing on the move with fixed approach angles had negative effects on side foot-kick accuracy. The preferred leg displayed greater accuracy than the non-preferred leg in all three tests. In the RBRS test, where the participants were executing a side-foot kick on the move from three different approach angles, it was shown that the preferred leg's accuracy at 30° was greater than the preferred legs approach angles 0° and 60° as well as the non-preferred leg's approach angle of 30°. Moreover, significant deviations from the centrally positioned target stick were found for an approach angle of 60°, with the side-foot kicks deviating to the opposite side from the approach side for both legs. Also the right side-foot kicks with an approach angle of 30° deviated to the opposite side from the approach side. For the straight-ahead approach, kicks with the right leg missed the target to the left, and conversely, the use of the left leg generally resulted in a deviation to the right. Factors possibly contributing to these results are discussed below.

It was reported that muscle-activation patterns for an accurate kick are more finely controlled (Kellis and Katis, 2007), allowing for more precise acceleration and deceleration of the leg segments during the swing motion of the kicking leg (Barbieri et al., 2015; Dörge et al., 2002; Egan et al., 2007). When the complexity of the kicking task is increased, as a consequence of, for example, kicking a moving ball or exerting a greater kicking effort, the accuracy is generally effected negatively (Barbieri et al., 2010; 2015; Lees and Nolan, 1998). This notion is further supported by the results of the current study, in which the kicking accuracy in the SBMS and RBRS tests was less precise than the accuracy in the SBRS test. With increased complexity, high levels of prospective ability and neuro-motor coordination are required to maintain accuracy (Egan et al., 2007). In the RBRS test, the player ran with the ball from three different approach angles for each leg to the predetermined position where the passing of the ball on the move was executed; hence, this task placed high demands on the timing of the support-leg placement and swing motion of the kicking leg and their relationships to the movement of the ball.

Previous investigations comparing kicking accuracy between a stationary ball and a rolling ball have found no significant differences between conditions (Barbieri et al., 2010; 2015; Egan et al., 2007); however, in these studies, the test was performed with the ball rolling towards the player, and the accuracy task was to hit a target approximately 1.5 m above the ground with an instep kick, which makes it inappropriate to compare these results with the results presented in the current study. Moreover, the better precision in the SBRS test than in the SBMS test was not surprising because accuracy is known to deteriorate as ball speed increases (Lees and Nolan, 1998). The results of the current study were in agreement with previous studies which reported that both side foot-kick and instep-kick accuracy were higher when the kicking effort was lower (i.e., a reduced ball speed) (van den Tillaar and Fuglstad, 2017; van den Tillaar and Ulvik, 2014). The accuracy difference related to kicking effort is likely associated with decreases in movement speeds, which were found when there was a focus on accuracy (Teixeira, 1999; van den Tillaar and Fuglstad, 2017); hence, a high kicking effort would in general result in impaired ability to achieve the optimal contact characteristics between the foot and ball.

In common for all three 20-m side foot-kick tests was the superior accuracy of the preferred leg, compared to the non-preferred leg. This accuracy difference was consistent with findings for both instep (Barbieri et al., 2015; Berjan-Bacvarevic et al., 2012; McLean and Tumilty, 1993; van den Tillaar and Ulvik, 2014) and side-foot kicks (Teixeira et al., 2003; Zago et al., 2014) in adolescents and male experienced and amateur players. Hence, the results of the current study demonstrated that leg preference also influences the side foot-kick accuracy in high-level women's soccer players. One possible explanation for the accuracy difference was suggested to be related to an error of the movement sequence as a consequence of impaired inter-segmental coordination in the non-preferred leg, compared to the preferred leg (Dörge et al., 2002).

Another novel finding of the current study was that the preferred leg's side foot-kick accuracy was greater for an approach angle of 30°, compared to approaches from 0° and 60°. Previous studies investigating instep-kick accuracy found no significant differences between different approach angles (Masuda et al., 2005; Scurr and Hall, 2009). To the best of our knowledge, no information about optimal approach angles related to side foot-kick accuracy has previously been presented. However, a study investigating the kinematics of side-foot kicks showed that the attack angle of the swing foot and the angle of direction of the ball after kicking were significantly different for approach angles of 0°, 30°, and 60° (Bubanj et al., 2010). One potential explanation for the greater side foot-kick accuracy for 30° in the current study is that this approach angle, compared to 0° and 60°, entails a better trade-off among the necessary external rotation of the kicking leg, the support-leg placement, and perception of the target stick's position relative to the direction of the approach and position of the kick. The three tested approach angles have obviously different neuro-motor and perceptual-cognitive requirements. An approach angle of 60° places high demands on the player's neuro-motor and perceptual skills as a consequence of both the relatively large angular difference between the approach and the kicking direction and the support-foot placement in relation to the ball. Conversely, the straight-ahead approach requires large rotation of the hip to orient the foot so that the medial side is perpendicular to the intended direction of the side-foot kick. This notion is supported by the finding that the right and left side-foot kicks at an approach angle of 0° significantly deviated to the left and right of the target stick, respectively (Figure 5), indicating that the hip rotation was not sufficient to position the foot perpendicular to the target. In contrast, for the approach angle of 60°, the deviation from the target stick was on the opposite side of the approach side for both the right and left side-foot kicks (Figure 5). This finding indicates that the support foot is not oriented towards the desired kick direction; hence, for the right side-foot kick, the left foot points to the right of the desired kick direction, likely due to insufficient outward angulation of the support leg. The importance of the support-foot orientation for the direction of side-foot kicks was previously investigated, and the angle of the support foot at ball impact coincided with the direction of ball projection (Lees and Owens, 2011). Based on the zero-point deviations presented in Figure 5, it indicates that the optimal approach angle is between 30° and 60°, and an assumed linear relationship for the mean deviation at each approach angle suggests that an approach angle of approximately 40° is related to zero deviation from the target stick independent of kicking leg. However, further investigations are needed to establish the approach angle that optimizes side foot-kick accuracy.

Conclusions

The task condition had a significant influence on 20-m side foot-kick accuracy for Swedish first league women's soccer players, with more complex tasks (i.e., higher kicking effort or kick of a rolling ball with different approach angles) resulting in less accurate side-foot kicks. These results contribute important knowledge for both players and coaches that want to improve their own or the team's side foot-kick accuracy. Based on the results it appears that the approach angle has a large influence on the kicking accuracy. In fact, even though the participants were allowed to freely choose their approach angle, in the stationary-ball condition with a match-relevant ball speed, there was a significant deviation from the target independent of kicking leg. Therefore, as practical application, it could be valuable to determine the optimal approach angle(s) for each individual player to increase the awareness of the variables, such as kicking effort and kicking leg, which could influence the side foot-kick accuracy as well as to perform training focused on improving the side foot-kick accuracy. If the team's overall side foot-kick accuracy is improved, it is likely to assume that the team will be more successful.

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Key points

- Task condition had a significant influence on 20-m side foot-kick accuracy, with more complex tasks (i.e., higher kicking effort or kick of a moving ball with different approach angles) resulting in less accurate side-foot kicks.
- The side foot-kick accuracy was greater for the preferred leg than for the non-preferred leg independent of task condition.
- For the preferred leg, an approach of 30° was related to greater side foot-kick accuracy than approach angles of 0° and 60°.

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