AFFORDANCE AND ITS ROLE IN *SEPAKTAKRAW KUDA* AND *SILA* SERVE NON-PLANAR KICKING TECHNIQUES – A PRELIMINARY QUALITATIVE ANALYSIS FOR COACHING IMPLICATION

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This study aimed to establish the affordance and its role in *Sepaktakraw* serve for coaching implications. Five successful *kuda* and *sila* trials performed by two trained male players, captured using a high-speed optical camera system, were analyzed. Variations in kicking limb hip-knee joint coordination to impact suggest ball placements be an affordance in *Sepaktakraw* serve. This affords what the server must do to ensure optimal foot-to-ball impact velocities without compromising ball velocities. With differences in kicking limb length, this coordination becomes player specific, and the ability to adapt and adjust his coordination pattern depends on such affordance. Servers must vary their movement pattern when executing the *kuda* or *sila* serve kicking by manipulating the knee-hip joint coordination with what the affordance affords the servers to do as it swings to impact.

KEYWORDS: *non-planner kicking*, affordance, adaptation, movement patterns, coaching

INTRODUCTION: Affordance in sports performance refers to the objective properties of the environment in which the performer acts in relation to their capabilities (Hristovski et al., 2016; Ulrich, Thelen & Niles, 1990). Having generated positive outcome measures with minimal disparity, it is possible that these affordance directly specify what the athletes must do when executing the technique. The technique or movement patterns of trained soccer players will vary and be adjusted according to where the ball is targeted to land at different zones. Thus, the affordance is the target zone which then affords what the kicker has to do to ensure that the ball lands where it is supposed to (Chow et al., 2006). As opposed to this, *Sepaktakraw* coaches generally advocate consistency of technique or movement patterns when executing the *kuda* and *sila* serves. Any variation in technique or movement patterns reflects an incorrect execution of the skill, which is believed to inevitably lead to adverse performance outcomes (i.e., points lost due to the ball hitting the net or placed out-of-court boundaries across the court). Since it has been highlighted in the literature that affordance directly affects the coordination variability of joint couplings to achieve the goal (Davids et al., 2003), it is uncertain what the affordance for *Sepaktakraw* serve kicking skills is that could affect the coordination of the kicking limb to generate optimal kicking performance outcomes. This study aimed to establish the affordance in *Sepaktakraw kuda* and *sila* serve non-planar kicking techniques and their roles in serving performance for coaching implications.

METHODS: Two trained male *Sepaktakraw* players of the same age (22yrs old) and playing experience participated in this preliminary study. Both represented the Singapore National Team at international competitions and were free from musculoskeletal injuries. Ten high-speed cameras (MAC Eagle 4, California, USA), operating at 240Hz, captured all 25 *kuda* and 25 *sila* serve trials from each player. Only the best five kuda and five sila trials from each player (highest ball velocity and ball lands within playing boundaries across the court) were used for analysis. A makeshift *Sepaktakraw* court, with exact dimensions and nettings, was laid inside the lab, complete with makeshift 'opponents' positioned across the court to mimic actual competition. The same team-mate (who has played with the server for every international competition) was tasked to toss the ball into mid-air. The participants were instructed to execute the serve optimally within playing boundaries across the court.

Passive retro-reflective markers were attached to selected anatomical landmarks according to Chow et al. (2006). Reflective tape attached to the *takraw* ball enabled the capture of ball velocities in 3D space. Data were smoothed using the Butterworth low-pass digital filter at a cut-off frequency of 7 Hz and interpolated with a maximum gap fill of thirty frames using a 3rd polynomial established within the Visual 3D software. The initial range of cut-off frequencies, between 5 and 9 Hz, was selected based on the accepted cut-off frequencies used in published studies. The final cut-off frequency of 7 Hz was determined using residual analysis of raw data captured at different cut-off frequencies from a sampled serve trial (Chow et al., 2006). Time-to-ball impact was the time the kicking limb took to contact the ball. Time-to-ball-ball impact was measured from when the foot is no longer in contact with the floor to when the foot impacts the ball. Time to ball impact was measured in seconds (s). Participants' height was measured using SECA, and participants' limb and segment lengths were measured using an anthropometric tape following ISAK standards. Ethical clearance for this study was sought by Republic Polytechnic Institution Review Board.

RESULTS: Between serve types, both players generated faster kuda ball velocities sila. No differences were reported for time-to-ball impact between service types. Between players, Player B generates faster kuda ball release velocities than Player A. Although longer, minimal differences in time-to-ball impact between players.

Table 1: Comparison of selected variables between two *Sepaktakraw* Players

	Player A	**Player B**
Subject Height (m)	1.78	1.78
Segment Length (m)		
Thigh	0.40	0.44
Shank	0.39	0.40
Foot	0.14	0.17
Limb Length (m)	0.93	1.01
Ball Velocities (m/s)		
Kuda	22.1 ± 1.4	24.8 ± 1.8
Sila	16.9 ± 0.4	19.9 ± 0.8
Time to Ball Impact (s)		
Kuda	0.31 ± 0.02	0.30 ± 0.01
Sila	0.33 ± 0.01	0.32 ± 0.02

Ball placements at impact for both *kuda* (White) and *sila* (Black) serve for each trial are illustrated in Figure 2. Ball placement at impact for each trial is different regardless of service type. Kicking limb hip-knee joint coordination for both service types from forward swing to impact is also illustrated in Figure 2. The coordination differs for each trial as the kicking limb swings forward to impact.

DISCUSSION: In sports, affordances refer to the opportunities for action that are presented by the environment to the player whereas movement variability refers to the degree of variation in movement patterns that the player exhibits when performing a particular task (Davids, Araújo, Seifert and Orth, 2015). Nevertheless, the relationship between affordances and movement variability have found that athletes presented with affordances that are consistent with the demands of their sport exhibit less movement variability than when presented with affordances that are inconsistent with those demands (Seifert, Button and Davids, 2013). This suggests that the perceived affordances of the environment can influence movement variability. Akin to the ace serve in Tennis, the goal when serving in *Sepaktakraw* is to relay the ball as fast as possible across the court to augment receiving errors, possibly influencing the progression of points scored. Unlike Tennis, ball toss is not by the server but by a team-mate to where the server points in mid-air, thus explaining why ball placements at impact are never at the same spot (Figure 2). Because of this, both the *Kuda and Sila serve* kicking technique would demand major adjustments in kicking patterns as it swings to impact.

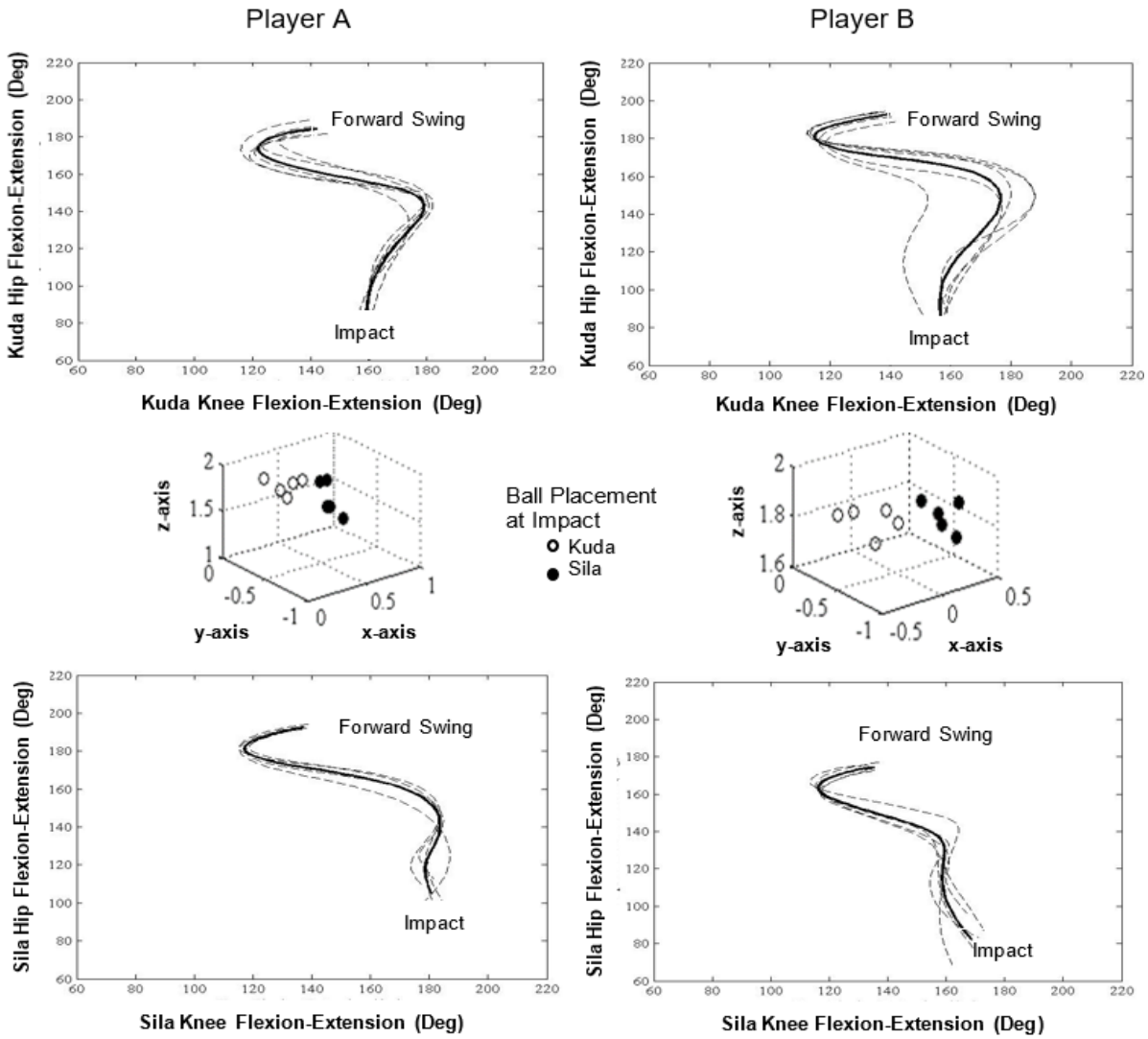

Figure 2: *Kuda* (Top) and *Sila* (Bottom) kicking limb hip-knee angle-angle plots of Player A (Left) and Player B (Right) from forward swing to ball impact.

One significant adjustment would be hip-knee joint coupling variability (Figure 2) without compromising performance outcomes (ball velocities). Such demand appears to depend on ball placements at impact. As the players execute the serve technique, they vary their movement patterns and adjust their kicking limb trajectory as it swings to impact according to where the ball is tossed in mid-air (Figure 2). Ball placement at the impact may be the affordance in *Sepaktakraw* serve, and this then affords what the kicker has to do to ensure optimal foot-to-ball impact. Indeed, affordance in sports performance refers to the objective properties of the environment in which the performer acts in relation to their capabilities (Hristovski et al., 2016; Ulrich et al., 1990).

Individual hip-knee joint coordination variability points to how each player adapts to the differences in ball placements at impact through manipulating DOFs. Even if the ball were tossed to similar heights (z-axis), the ball's placement at impact becomes relatively different depending on the ball's coordinates along along the horizontal and vertical axes. Thus, to impact the ball optimally, the relative height of each subject at impact now becomes different depending on the individual kicking limb length. For this reason, the coordination pattern or the kicking action becomes player specific, and the ability of each player to adapt and adjust his coordination pattern to kick the ball regardless of its placement at impact supports the notion that ball placement at impact may be possible affordance, more so when the decision to kick or not to kick the ball depends strongly on the athletes' perception of such affordances. Having generated positive outcome measures (ball velocities) and with a minimal disparity in the time taken to swing to impact regardless of service type and players, it is possible to suggest that

these affordance directly specify what the environment affords the Sepaktakraw servers to do, i.e., to vary their movement patterns (joint coordination couplings) when kicking the takraw the ball in mid-air to achieve its goal. Indeed, is as been reported that the affordance (i.e. the target zone) affords what the kicker has to do to ensure that the ball lands where it is supposed to in football (Chow et al., 2006). Overall, research on affordances and movement variability suggests that there is a complex relationship between the two, with affordances influencing movement variability, and movement variability being an adaptive response to changes in affordances.

Similar to the literature (Sidthilaw, 2000; Usman et al., 2004, Hamdan et al., 2012*), kuda* ball velocities were faster than *sila* (Table 1). Of the two, Player B generated faster *kuda* ball velocities than Player A (22.1 m/s ± 1.4 vs 23.8 m/s ± 1.81). This may be attributed to the player's B longer kicking limb length (0.93m vs 1.01m). Swinging a longer limb would require more adjustment of the hip-knee joint coordination to impact the ball optimally, given that ball placements at impact are never at the same spot (affordance). Despite swinging further as it travelled over a more extensive knee joint range of motion (Figure 2), the time taken time-to-impact was faster for Player B (0.31s ± 0.02 vs 0.30s ± 0.01). As such, it is also possible to suggest that the ability to generate optimal impact impulse needed for optimal ball velocities, therefore, does not depend entirely on the height of individual players *per se* but also on individual kicking limb length and how together with the affordance (ball placement at impact) affords what the kicker has to do to ensure optimal foot-to-ball impact via adjustment of kicking limb movement patterns as it swings to impact.

CONCLUSION: The emphasis during coaching intervention should be towards varying the movement pattern of the *kuda* and *sila* serve by forcing the athlete to manipulate their knee-hip joint coordination to what the affordance (ball placement in mid-air) affords the servers to do. Hence, coaches should look at ensuring variation in movement patterns in response to the affordance necessary for optimal impact impulse so as not to compromise performance outcomes measures (ball velocities) when serving in Sepaktakraw. Because body morphology and kicking limb lengths differ between participants, it is also recommended that coaches do not assume that subject height alone is critical for optimal performance outcome measures.

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