AN INTERDISCIPLINARY APPROACH TO ASSESS MOVEMENT COORDINATION PATTERNS IN SPORTS

Tom Wu1, Pierre Gervais2, Pierre Baudin2, Marcel Bouffard2
1Department of Movement Arts, Health Promotion and Leisure Studies, Bridgewater State University, Bridgewater, USA, twu@bridgew.edu
2Faculty of Physical Education and Recreation, University of Alberta, Edmonton, Canada

INTRODUCTION
In the area of motor learning, ecological task analysis uses a dynamic system approach to examine the change of a performer’s movement pattern as a result of dynamic interactions between the performer, environment and task constraints, and the performer may use multiple movement patterns to achieve a task goal [1]. In the area of biomechanics, coordination is defined as proper movement sequencing and a shared positive contribution (SPC) technique may be used for assessment [2-3]. A sports biomechanics research study may follow a traditional task analysis concept that there is only one best possible movement pattern without considering the influence of constraints that are imposed on the movement [1]. Therefore, the purpose of this study was to use an interdisciplinary approach that is guided by the ecological task analysis in the motor learning area and to utilize biomechanics principles and techniques to assess movement coordination patterns on the skill of slo-pitch hitting technique with the influence of constraints on task goal (stride technique) and environment (pitch location).

METHODS
Ten right-handed skilled male slo-pitch players were recruited to participate in the study. Twenty-two reflective markers were placed on various joints on the participants, and two additional reflective markers were placed on the bat. This study took place in an indoor field house. A Jugs Lite-Flite pitching machine (Jugs Softball, Jug Inc.) was used, and small strips of reflective tape were placed on the surface of the balls to identify the instant of ball contact. Participants were instructed to use either a closed, open or parallel stride technique to hit an inside or outside pitched ball. Each participant hit six balls in each of six conditions. An 8-camera Qualisys motion capture system (ProReflex MCU 240, Qualisys) was operated at 240 Hz to conduct a 3D analysis. The body rotational angles and velocities were calculated and used for coordination pattern analyses. A shared positive contribution (SPC), a proximally initiated to distal joint movement, was calculated based on Hudson’s (1986) technique [3]. However, this technique does not apply to all participants, so a reversed shared positive contribution (RSPC), a distal joint initiated to proximal joint movement, was developed by the authors. A SPC or a RSPC of 0% indicates a sequential type of movement, and a SPC or a RSPC of 100% indicates a simultaneous type of movement.

RESULTS
A two-way ANOVA (2 pitch locations x 3 stride techniques) repeated measure study was conducted at \( \alpha = 0.05 \) on the combined % SPC and % RSPC for two different pairs of body rotational angular velocities (lower body and trunk, and trunk and upper body). No statistically significant difference was found in both of these pairs (Table 1). Further, a rescaled Euclidean distance analysis was conducted to evaluate each participant’s variability in response to treatments. Cumulatively, approximately 83% of participants illustrated a degree of dissimilarity below 0.40.

DISCUSSION & CONCLUSIONS
From the results of this study the participants demonstrated both types of body movement and both types of coordination pattern. Participants showed a proximal to distal or a distal to proximal type of movement either with a sequential or a simultaneous coordination pattern. Participants were able to use multiple movement coordination patterns to achieve the same task goal. Since all participants were skilled players and did not have any practice in each condition prior to the testing, the individual participant’s change in coordination pattern across six different conditions was the result of their skill adaptation due to the influence of both task and environmental constraints. Therefore, this study supports the rationale that the participant’s change in coordination pattern is influenced by various constraints in action [4]. Also, since participants from this study have demonstrated a low degree of dissimilarity, coaches may apply the findings to other players with similar skill level.

REFERENCES

Table 1: Combined % SPC and % RSPC of coordination pattern

<table>
<thead>
<tr>
<th>Coordination Pattern</th>
<th>Inside Pitch</th>
<th>Outside Pitch</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower body and trunk (%)</td>
<td>26.4 ± 41.0</td>
<td>28.8 ± 33.9</td>
<td>0.85</td>
</tr>
<tr>
<td>Trunk and upper body (%)</td>
<td>32.2 ± 29.4</td>
<td>33.3 ± 29.4</td>
<td>0.85</td>
</tr>
</tbody>
</table>

*Statistical significant at \( p < 0.05 \)