A Theoretical Framework for Integrating Virtual Reality Systems in an Enrichment Programme of a Professional Football Youth Academy Practice Programme

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&

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Q: What's concerning me right now?
A: Adult pressure for early specialised training in children

February 2015: Chinese President Xi Jinping announced a 'football reform plan' to lift China from 82nd place in FIFA's world rankings. This required the country's babies being encouraged to develop their talent as footballers (see http://www.bbc.co.uk/sport/0/football/31658273).

2018: UK Government introduces testing of 4 yr olds starting at school
Coutinho et al. (2016).....specialised training during the early stages of development associated with several negative consequences.....

Evidence that:
(i) intensive, repetitive training during early periods of development increase s risk of specific types of over-use injuries, decrease d sport enjoyment, increase d drop out rates and stifle s psychosocial development.

(ii) early specialisation may increase risk of boredom and stress and anxiety in young children
Specialised training of 'processes' to enhance excellence and expertise in sport?

- **Brain Training** (Moreau, MacNamara & Hambrick, in press)
- **Development of ultra-fast cognition** (Riley et al., 2012)
- **Computerised cognitive training** (Walton et al., 2018)
- **Training with 'commercial cognitive devices'** (Harris, Wilson & Vine, 2018)
- **Enhancing 'meta-cognition'** (Price et al., 2018)
- **Sports vision training** (Appelbaum & Erickson, 2016)
- **Use of Virtual Reality (VR) systems** (Neumann et al., 2018)
"Commercial CT (CCT) devices......extent to which this training transfers to performance.... is....unclear...... limited support for far transfer benefits from CCT devices to sporting tasks, mainly because studies did not target the sporting environment."
The problem with this type of enrichment activity in sport? ....A clue in the title.....

Can specialised training improve cognitive performance in sport (e.g., decision-making, attention, problem-solving, planning)? .....“evidence that training with commercial brain-training software can enhance cognition outside the laboratory is limited and inconsistent” (Simons et al., 2016, p.173).

Can playing digital video games help you learn how to play football?

Sala, Tatlidil & Gobet (2017) “....no evidence of a causal relationship between playing video games and enhanced cognitive ability” (p. 111).

Modified Perceptual Training (on and off field) neglects the importance of actions?

"MPT [sometimes] coupled with non-specific manual gestures or manipulations (e.g. finger pointing or using the hands to adjust the training equipment), though this is generally rare."

Conclusion: Current evidence supports trainability but not transfer....(Near, rather than Far Transfer)
What do I mean by Near and Far Transfer to sport performance?

How Southampton train their players' brains
Southampton are using a device called the Neurotracker to train their players' brains
https://www.fourfourtwo.com/performance/training/how-southampton-train-their-players-brains#7WsGypQK1Sde8gqw.99
Moreau et al. (in press):

".....after more than a decade of intensive research on brain training, it is clear that far transfer is elusive. Several meta-analyses have demonstrated that the benefits of brain training are limited to the trained task, or to very similar tasks (near transfer)."

Practising on an enrichment task makes you better at that task and not necessarily at the target sport....
Research on cognitive and perceptual and brain training.....dominated by cognitive psychology models of human behaviour: The importance of Actions?
Pro-Batter:
Cricket Australia’s Centre of Excellence, Brisbane, Australia, 2010

Re-design of ball projection machines to include images of advanced information from bowlers to contextualise batting actions.....(Pinder et al., 2011)
Embedding an enriched environment in an acute stroke unit increases activity in people with stroke: a controlled before–after pilot study

Ingrid CM Rosbergen¹,², Rohan S Grimley³, Kathryn S Hayward¹,⁴,⁵,⁶, Katrina C Walker², Donna Rowley⁷, Alana M Campbell², Suzanne McGufficke², Samantha T Robertson², Janelle Trinder⁷, Heidi Janssen⁶,⁸ and Sandra G Brauer¹

Results: The enriched environment group (n = 30, mean age 76.7 ± 12.1) spent a significantly higher proportion of their day engaged in ‘any’ activity (71% vs. 58%, P = 0.005) compared to the usual care group (n = 30, mean age 76.0 ± 12.8). They were more active in physical (33% vs. 22%, P < 0.001), social (40% vs. 29%, P = 0.007) and cognitive domains (59% vs. 45%, P = 0.002) and changes were sustained six months post implementation. The enriched group experienced significantly fewer adverse events (0.4 ± 0.7 vs. 1.3 ± 1.6, P = 0.001), with no differences found in serious adverse events (0.5 ± 1.6 vs. 1.0 ± 2.0, P = 0.309).
How to enrich athlete performance?
The Athletic Skills Model: Figure 5.4
Wormhoudt, Savelbergh, Teunissen & Davids (2018)

The ASM continuum: Importance of Specificity and Generality of Practice and Transfer of Training.
Athlete enrichment programmes in high performance sport should be effective and efficient....

The challenge of contextualising performance in practice......

**Ecological Dynamics:** practice tasks (re)designed for athletes to regulate actions using cognition and perception
An ecological dynamics rationale for using VR technology in football training to enrich athlete performance....

"The research findings to date indicate that VR can be a promising adjunct to existing real-world training and participation in sport."

"Future research would benefit from a theoretical framework of VR application to sport (see Fig. 1)."

Ecological Dynamics: Athletes and sports teams are complex adaptive systems.....
Skill Adaptation to interacting constraints

Adapted from Newell (1996)

Discovery, exploration and exploitation of a wide range of affordances of the environment (invitations to act).....
Affordances as invitations: A gap for scoring a goal
England v Columbia, World Cup Round of 16, Penalty shoot out, July 2018
Deeply intertwined relations between cognition, perception and actions: Key principle for designing practice tasks to enhance performance...

Specifying Information (Gold standard)

Non-Specifying Information (Less useful)

100% Specificity of Transfer

0% Generality of Transfer

Near Transfer

Far Transfer
Figure 1: Relations between the macro-structure of talent development and the micro-structure of practice in sport and physical activity. Traditional practice design has a 'default' mode situated at the highly structured end of the continuum of task constraints, emphasising direct teaching/prescriptive coaching in athlete talent development. Skill acquisition and talent development needs coaches to move between different regions of the practice structure spectrum based on the individual needs of an athlete at any one point in time (Davids, Güllich, Shuttleworth & Araujo, 2016).

Early Specialization

Highly Specific Activities

- ‘Movement Template’ drives Rehearsal and Reproduction; Set Plays in Team Sports
- Drills, Movement Repetitions
- Deliberate Practice Activities

Early Engagement

Highly Varied Activities

- Deliberate Play including Small-Sided and Conditioned Games
- Unstructured practice and play
- Rest and Recuperation from work, study, school

Early Diversification

Teacher-led activities

- Guided Discovery in Learning: Nonlinear Pedagogy, TGfU, Constraints-Based Coaching
- Informal Peer Coaching and Modelling
- Discovery Learning; Exploratory Practice; Differential Learning

A Varying Landscape of Affordances
Embedding VR systems in athlete development programmes to enrich deeply intertwined relations between cognition, perception and action in football.....

Scanning behaviours, Orientation of the body when receiving the ball and weight distribution and postural regulation

Using VR to enrich athlete performance can be individualised according to player needs. Performance Analysis methods can help individualise player learning with VR systems to perceive affordances for playing a penetrative pass.

Data from a professional football club academy U18s programme. Shows individual differences in capacity to play penetrative (through the lines) passes in a Small Sided Conditioned Game – 7v7 – 20 minutes

<table>
<thead>
<tr>
<th>Player</th>
<th>Position</th>
<th>Total Forward Passes</th>
<th>Successful Forward Passes</th>
<th>Successful Forward Passes between 2 players</th>
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<tbody>
<tr>
<td>1</td>
<td>Goalkeeper</td>
<td>26</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>2 (10 mins)</td>
<td>Goalkeeper</td>
<td>13</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Defender</td>
<td>19</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>Defender</td>
<td>10</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Defender</td>
<td>11</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
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<td>4</td>
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<tr>
<td>7</td>
<td>Midfielder</td>
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<tr>
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<td>Midfielder</td>
<td>19</td>
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<tr>
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<tr>
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<td>Forward</td>
<td>5</td>
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<td>1</td>
</tr>
</tbody>
</table>

Task Constraints designed in the SSGC by the U18s Coach:

1. Players asked to look to play forward at every opportunity (seek affordances for penetrative pass).
2. All players in the team in possession of the ball had to be on the half way line or in the opposition half for a scored goal to be valid (playing higher up the pitch and in a compact state).
3. If any opposition players were left in their opponent's half when a goal was scored, another goal would be added to the score for every player that was left in the opponent's half (constraint manipulated to ensure compactness when defending).
Scenario 1 – The receiver in red must control the pass from a teammate and turn to play a pass penetrating the defensive line into either small goal. Affordances for penetrative passing change emerge in the defensive line (largest distance between defenders invites penetrative passing)

**Option to Receive the ball and turn quickly**

**Affordances of Gaps/Spaces for passing**
Scenario 2 – Find the biggest gap/space – Affordances for penetrative passing changes over time due to defender mobility in the defensive line (distance between defenders change)

Perception of bigger gap/space between defenders that affords a penetrating pass

Receive the ball and turn

Gaps/Spaces have changed – Second scan needed
Take home messages:

• Problems of over specialisation and repetitive practice may be avoided by using enrichment programmes in sport

• Current problems with enrichment programmes to train brains, perceptual systems, cognitive capacities, vision, deliberate practice separately and in isolation...

• Major Issues with transfer....research inconclusive

• Ecological Dynamics: Emphasises the complex, intertwined relations between action, cognition and perception in practice designs

Use of VR systems in athlete enrichment embedded in complementary training alongside practice in small sided games?

Individualisation of training, searching specific fields in affordance landscape.....