

## Information and Coordination: Implications for Research and Clinical work in DCD

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## Information and Coordination

- How do we use information in the performance/learning of motor skills?
- How do children with coordination difficulties differ from, and are similar to, typically developing children in the use of this information?
- How can these similarities and differences inform us about skilled performance in general and intervention in particular?
- CAUTION-Speculation!

## Genesis of Ideas

"...what we as gymnasts want to know is how the sensory events result in the corresponding motor events."

*Sheila Headridge et al (1965) Essay on Kinaesthesia and gymnastics for Mr Carlisle at Dunfermline College of Physical Education.*

## Development of Ideas

Continuous visual feedback provides an advantage by

".....permitting integration of visual information with other sources of feedback and its direct mapping on to the motor control system."

*Sheila Henderson, 1977, Journal of Experimental Psychology.*

The role of feedback in the development and maintenance of a complex motor skill.

- 3 experiments:
  - Systematic variation of visual feedback-deprived, delayed, continuous.
  - Role of auditory feedback
  - Performance improvement without visual feedback.

## Experiment 1

- Task- 'dart' throwing in darkness at a luminous target.
- 3 groups of 6 subjects
- 3 conditions:
  - No visual feedback-dark all of the time, just auditory and P information.
  - Delayed visual feedback-no flight information but terminal visual information as lights came on when dart hit target.
  - Continuous visual feedback throughout-light came on when throwing arm breaks photo electric beam-flight and landing information.

## Experiment 1

- Measures used:
  - > Absolute error –average distance off target.
  - > Consistency-grouping of throws, distance between successive throws. Clever argument here about variance due to noise or deliberate adjustment {referring to Jack Adams CLT}.

## Experiment 1 Results

- Continuous visual feedback-good improvement in absolute error and consistency but when removed fell back to level of no visual feedback group.
- Delayed visual feedback-some small improvement but no different to no visual feedback
- No visual feedback-did improve so where is it coming from? Auditory? P?
- **Second experiment** looked at role of auditory feedback and showed some crude location information.

## Experiment 3

- Reinvestigation of no visual feedback but with removal of subtle forms of non visual feedback.
- 2 groups-Experimental Group practiced over 10 days; Control just day s 1 and 10.
- Accuracy suffered but not consistency and after several days of practice improvement did return.

## From this study into DCD

- Feedback information
  - Ongoing visual feedback has big advantages
  - When denied V, other sources or information are sought out-A & P.
  - Differential effects for accuracy and consistency
  - Relationship of information to motor output
- Questions surrounding vision and other forms of information and motor control not fully answered in DCD and intervention not always linked to available evidence

## Information and Motor Control

- Ongoing work on link between perception and action.
- Long history in adults and tdc
- Fundamental questions surround:
  - how interrelated they are?
  - can they be separated?
  - If they can, do we now have 2 different skills/tasks?
  - If not, why do we do this in intervention?
- 3 recent studies that hopefully will spark debate

## Progression into DCD

- Examine recent (in Press) work of ourselves and others which may link with this – with such topics as:
  - > DCD and TDC-similarities and differences.
  - > Planning and execution of actions
  - > Vision and proprioception
  - > Research and Clinical Implications

## Planning and Execution

- Footprint study-with Amanda Kirby and Lisa Roberts
  - Problem solving-planning and executing 'crossing the river'
  - Allows choices in natural contexts using natural tasks
  - Quantitative and qualitative data-video
  - Travel from one line over a 'river' to next line
  - Do not fall in!
  - As few strides as possible
  - Continuous

## Footprint study

- Results point to:
  - Developmental trends in tdc-estimates of number of steps fewer in 9-11 than 7-9. eg; estimates more accurate; more control during action
  - Children with DCD (aged 9-11) more like tdc 7-9 eg
  - Personal variables such as confidence or playing safe
  - Corrections after attempt
  - Manner of execution-from film

## Footprint Study

- Some findings:
  - DCD>TDC number of mats used
  - DCD>TDC greater distance travelled (2 metres more in 8 metre course)
  - Changes to mat placement following trial 3
  - TDC>DCD consistency of stepping across trials
  - DCD>TDC 'unusual' movements/patterns
  - DCD>TDC difficulties on non motor items-SDQ, SNAP IV, ASSQ
  - Other differences but not significant-high within group variability-DCD 'play safe', attend to one item.
  - But is this a sound test of perception-action?

## Judgements of change in action capabilities- Wade and Johnson-In Press

- Perception clearly implicated in movement skill but strength and nature of this relationship is unclear.
- Authors in Gibsonian camp- 'perception shares a reciprocal relationship with action'.
- How accomplished are children with DCD compared to TDC at adjusting judgements of their maximum capabilities in response to actual capabilities?

## Wade, Johnson study

- Two groups: DCD and TDC; 12 in each group aged 11-12. (DCD 'At risk' 15%)
- Task-judge horizontal reach, bend at hip, reach out with one hand, estimate using ball on pedestal. Forward and backwards-6 trials.
- 3 separate manipulations:
  - Hand: 1 or 2
  - Foot length: blocks- standard (24-9-2)cms versus effective short (12-9-4)cms.
  - Support surface: rigid versus compliant-concrete or high density foam.

## Wade, Johnson study-Results

- 'Normal' condition was one hand, standard foot length, rigid floor.
- Measures: scaled Judged HR max to Actual HR max.
- Under all 3 manipulations children's Actual HR max was lower in altered conditions.
- During altered conditions-TDC greater adjustments-50-70% cf DCD -27(wrong direction) to 11%. DCD group made smaller or incorrect alterations to the altered conditions.
- Individual analysis

## Wade, Johnson study

- DCD less adept at detecting when action capabilities are altered.
- May learn to use more conservative strategies
- Not clear what information is being used.
- Reciprocity between poor movement skills and perception
- DCD-less exploratory movements leading to difficulty in detecting own capabilities. 'Do they know what they can and cannot do?'

## Rod Welding Study-Dynamic Touch

- With Amanda Kirby, Lisa and Angela-taking work of Turvey, Solomon into children
- Characteristics of unseen rod-eg length, weight, shape through wielding-dynamic touch-movement oriented.
- Nature of the variables that are being attended to.
- Use of more functional implements such as sports rackets.
- 43 TDC 13 DCD-all aged 9-11.

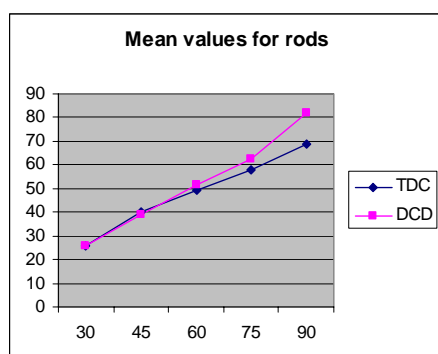
## Results

- Consistent underestimation which increased with rod length but similar when taken as a proportion of rod length.
- DCD children - surprisingly as good as tdc- so what is going on?
- Scaled: TDC 47% DCD 39%
- 'Weight': Both groups over 75%

## Rod Welding-Mean estimation of length

	TDC	DCD
<b>30</b>	26.12 (9.3)	26.38 (7.78)
<b>45</b>	40.93 (12.06)	37 (11.7)
<b>60</b>	48.84 (15.18)	52.15 (13.99)
<b>75</b>	56.95 (16.47)	64.69 (21.9)
<b>90</b>	67.41 (19.07)	78.23 (22.19)

All in cms



## Role of Information

- Vision
  - In original SEH studies what is vision providing? Not ongoing control as ballistic skill.
  - In visual condition-specifying environment and error correction
  - Two visual streams?
    - **Ventral**-inferotemporal cortex-specifying objects and layout of the environment
    - **Dorsal**-primary visual cortex to posterior parietal-visual control of movement.

## Role of Information

- Vision
  - Footprints-ventral for the planning and placement of mats; dorsal for the action?
  - Wade and Johnson-ventral for judged HR max; dorsal for actual HR max?
  - So where does the difference lie between TDC and DCD?
  - Do these experiments appropriately tease out 'real' differences?
- Proprioception
  - Unexpected results-because experiment tested proprioception in isolation-a psychophysics study with no purposeful action attached?
  - Is it only when we do not separate proprioception (perception) and action that we obtain differences?
  - Is there mileage in a dichotomy in proprioception like the ventral-dorsal one in vision?

## DCD Intervention

- Should we we teach perception-V or P in isolation from action? What is it giving us? (cf- Sir C. Woodward hiring 'visual awareness coach', 'eyerobics'!
- But if we don't how do we present tasks-make them easier, break them down, build back up again?

## Final Note

From Headridge et al 1965

*"The whole movement involves doing, thinking and feeling .....and it is difficult for ...(kinaesthesia) ...to be isolated and estimated by an observer."*