

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

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Festschrift for Sheila Henderson
Oxford Brookes University
17th June 2008

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.

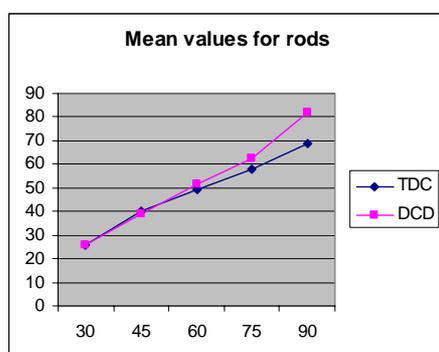
Results

- 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
30	26.12 (9.3)	26.38 (7.78)
45	40.93 (12.06)	37 (11.7)
60	48.84 (15.18)	52.15 (13.99)
75	56.95 (16.47)	64.69 (21.9)
90	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 feelingand it is difficult for ...(kinaesthesia) ...to be isolated and estimated by an observer."