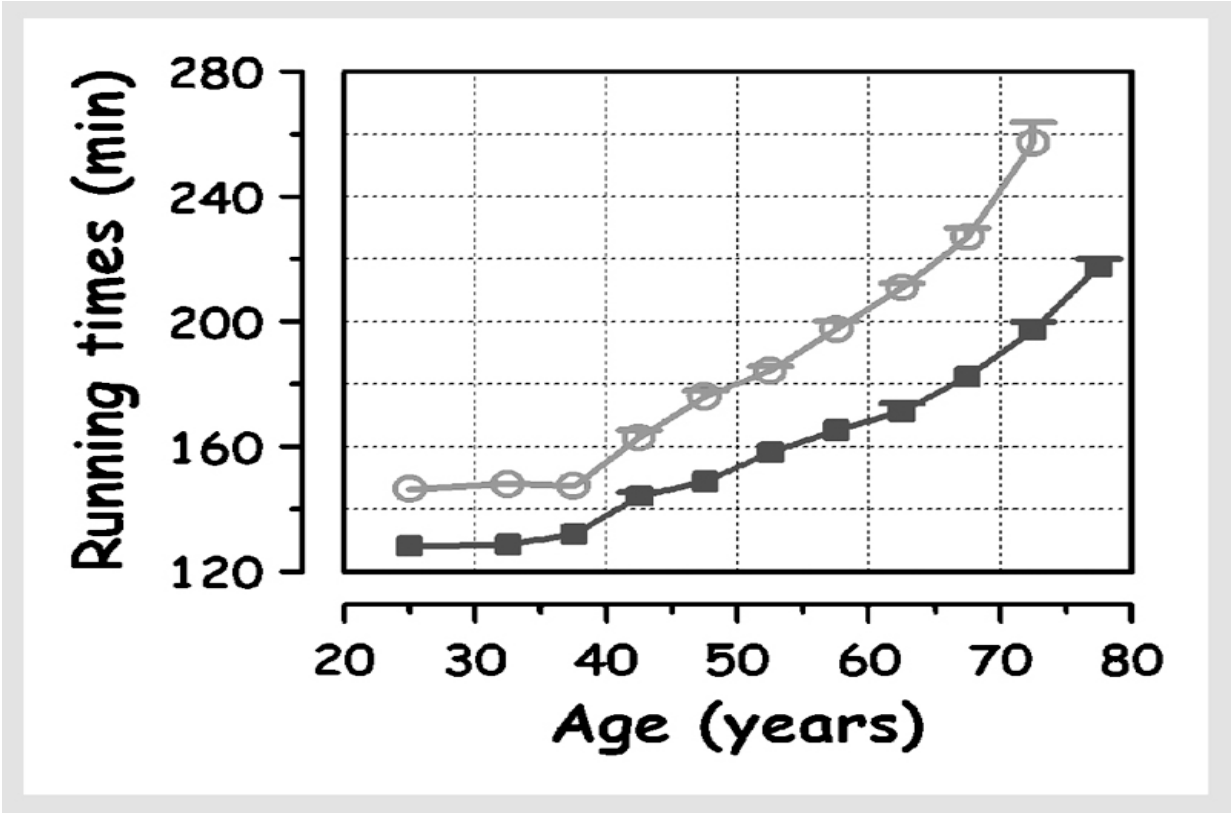
Evaluating the validity of lower limb coordination and range of movement tests for classification of runners with ataxia, athetosis and hypertonia

Mark J. Connick; Emma Beckman; Rebecca Deuble; Sean M. Tweedy

School of Human Movement Studies, The University of Queensland, Australia.

CRICOS Provider No 00025B

Age classification and running

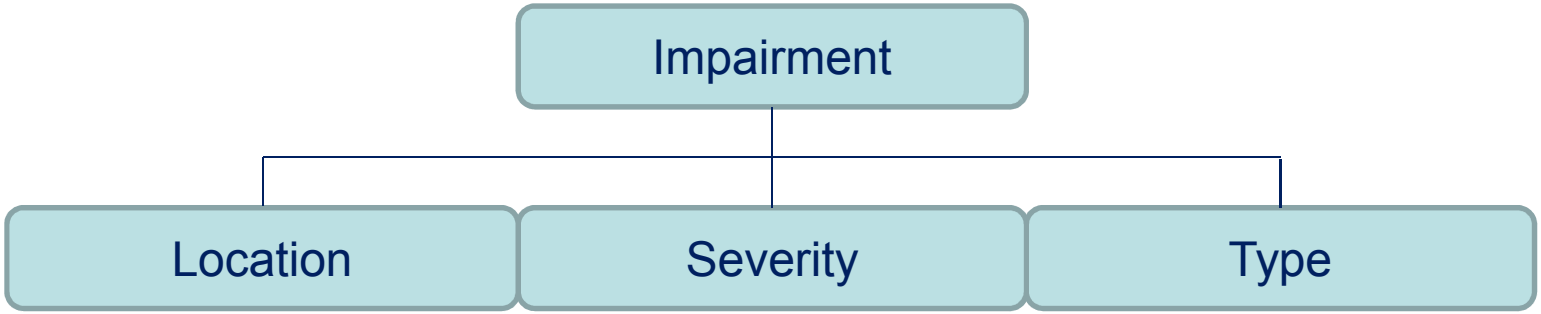


Leyk et al., (2009)

Classification in Paralympic Sport

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

- Paralympic sport includes impairment-based classification
- The aim of impairment-based classification is to minimise the impact of impairment on the outcome of competition (Tweedy and Vanlandewijck, 2011)
- Impairment is multi-dimensional

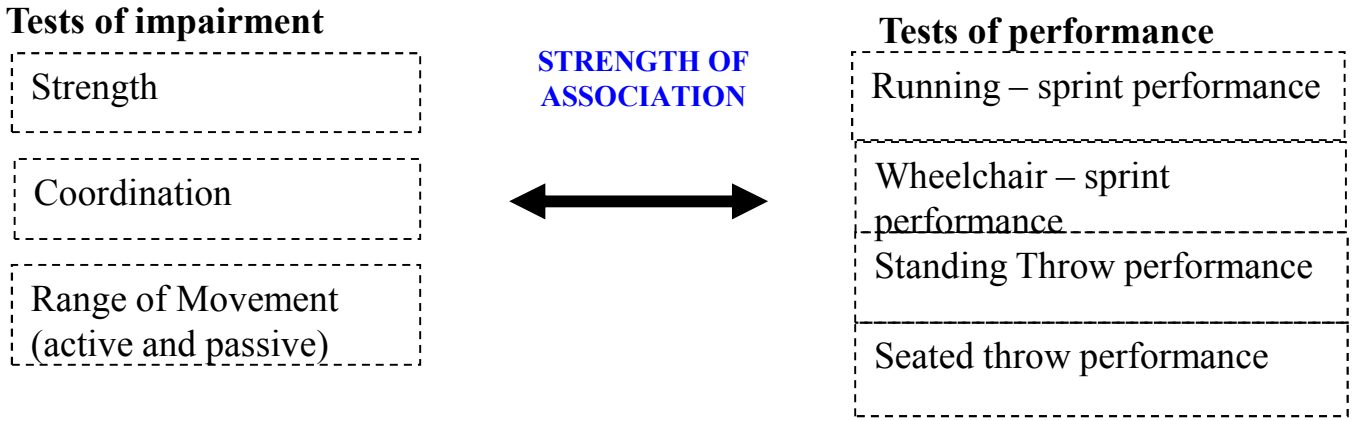


- Currently there is a need to develop objective and instrumented tests of impairment
- The IPC mandated evidence-based methods for classification in Paralympic sport.

Classification research - valid tests of impairment

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

- Develop objective tests of impairment for the purposes of classification



- Tests must satisfy 3 validity criteria (Campbell and Fiske, 1959)
  - AWD will be significantly more impaired compared to non-disabled
  - test of impairment will significantly correlate with performance in AWD
  - test of impairment will not correlate with performance in non-disabled people

Valid tests of impairment for runners with ataxia, athetosis and hypertonia

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

- Runners with health conditions such as CP and acquired brain injury have eligible impairments:
  - Hypertonia
  - Ataxia
  - Athetosis
  - Impaired range of movement (ROM)
  - Impaired strength

- Impaired coordination due to hypertonia, ataxia and athetosis

- Motor coordination is the ability to execute fluid, accurate and controlled movements rapidly.

Aim

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

Evaluate the validity of objective tests of coordination and range of movement in runners with ataxia, athetosis and hypertonia.

- Compare coordination and ROM in AWD and non-disabled
- Strength of association between coordination and ROM and running performance in AWD and non-disabled

Methods - participants

Group	Sample size (n)	Age (yrs)	Height (cm)	Body Mass (kg)
AWD	13	24.3 (9.4)	176.3 (8.8)	69.1 (9.6)
Non-disabled (ND)	28	23.1 (4.1)	180.5 (6.8)	76.7 (9.5)

- Males
- AWD sample comprised participants with CP (n=11), TBI (n=1) and stroke (n=1)
- One testing session (approximately 2 hours)

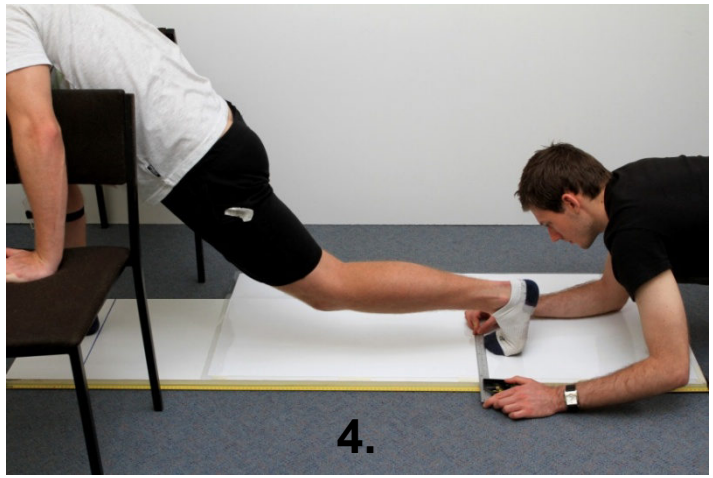
Methods - tests of ROM

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

4 lower limb tests of ROM

1. Supine leg flexion
   a. Thigh angle
   b. Heel pull distance
2. Standing hip extension
3. Dorsiflexion lunge angle
4. Backward stepping lunge

- Most and least affected sides were tested.
- 10 outcome measures.



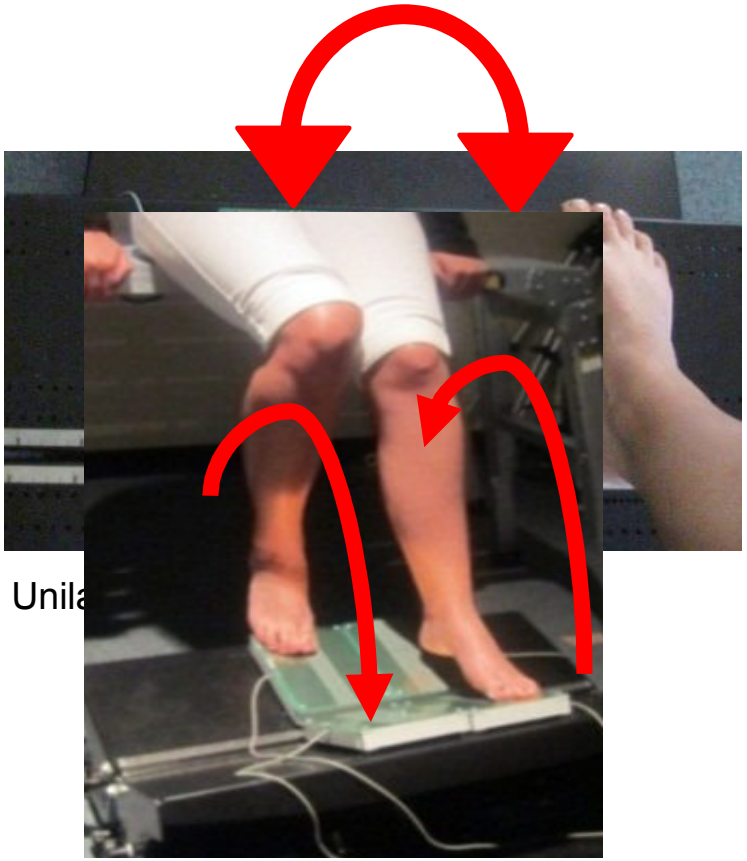
Methods - tests of coordination

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

3 lower limb tests of coordination

1. Reciprocal Unilateral With Target
2. Reciprocal Unilateral No Target
3. Reciprocal Bilateral No Target

- Most and least affected sides were tested for unilateral.
- 5 outcome measures.



Unila

Bilateral

Methods - tests of performance

- 60m maximal sprint
  - 0-15m acceleration phase
  - 30m-60m maximal velocity phase

Methods – statistical analyses

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

- Independent t-tests
  - AWD vs. non-disabled
- Pearson's correlation
  - Coordination and ROM vs. acceleration in AWD and non-disabled
  - Coordination and ROM vs. maximal velocity in AWD and non-disabled

Results - tests of coordination

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

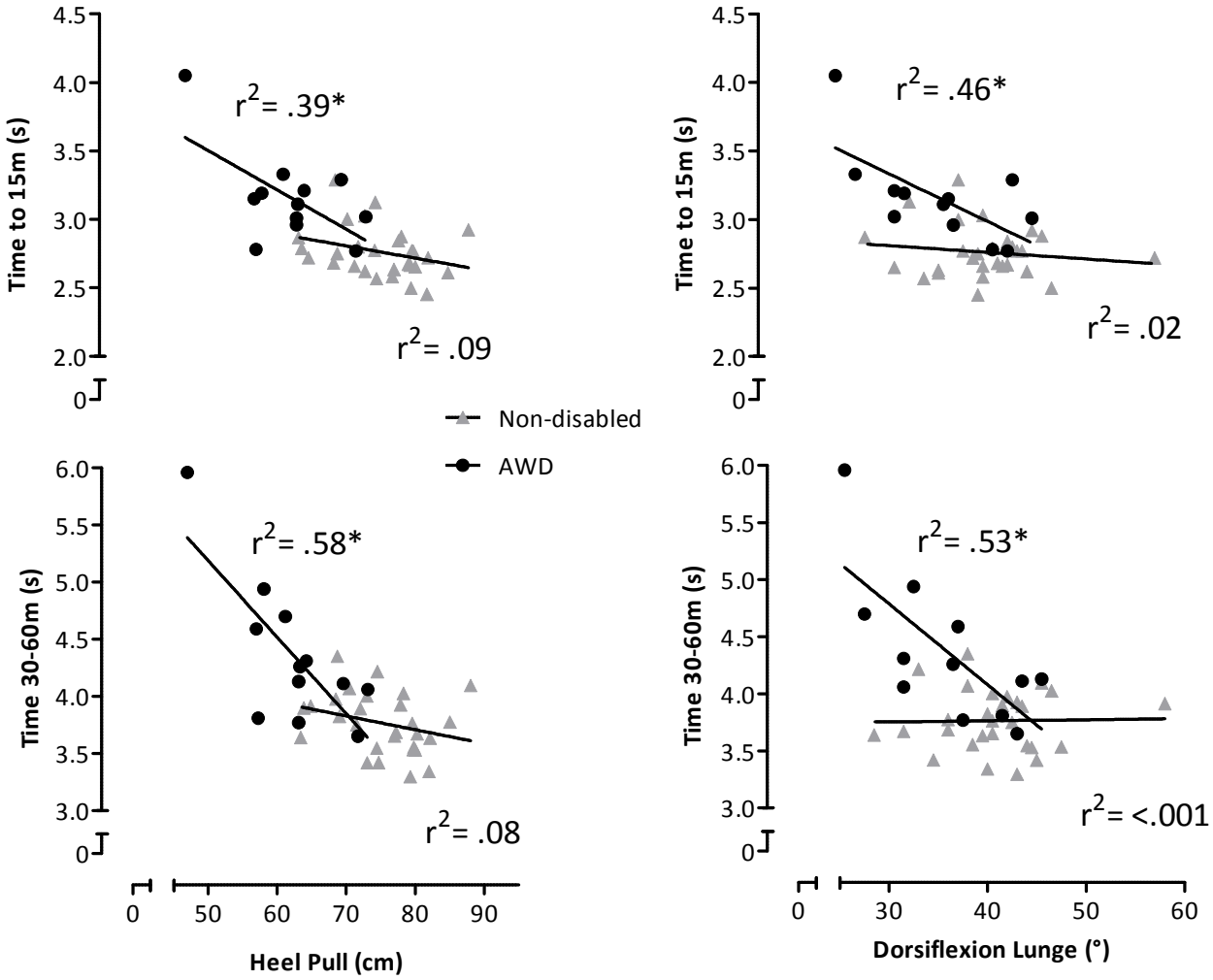
Test	Limb	Group	Pearson correlation with acceleration (r)	Pearson correlation with maximal velocity (r)	Mean (S.D)	p-value (ND vs. AWD)
Reciprocal Unilateral tapping With Target (s)	Least Impaired	ND	.306	.213	.30 (.04)	<0.001*
		AWD	.124	-.018	.47 (.10)	
	Most Impaired	ND	.175	.167	.34 (.05)	<0.001*
		AWD	.121	.061	.54 (.12)	
Reciprocal Unilateral Tapping No Target (s)	Least Impaired	ND	.020	.090	.25 (.03)	<0.001*
		AWD	.217	.110	.35 (.07)	
	Most Impaired	ND	-.043	.059	.29 (.03)	<0.001*
		AWD	.159	.040	.40 (.08)	
Reciprocal Bilateral No Target (s)		ND	.001	.017	.30 (.05)	<0.001*
		AWD	.212	.131	.63 (.26)	

Results – tests of ROM

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

Test	Limb	Group	Pearson correlation with acceleration (r)	Pearson correlation with maximal velocity (r)	Mean (S.D)	p-value (ND vs AWD)
Supine Hip Flexion (°)	Least Impaired	ND	-.363	-.174	88.9 (13.5)	.112
		AWD	-.473	-.674*	82.2 (6.7)	
	Most Impaired	ND	-.413*	-.302	84.1 (13.1)	.060
		AWD	-.294	-.513	76.4 (6.0)	
Heel Pull (cm)	Least Impaired	ND	-.301	-.284	75.3 (6.3)	<.0001*
		AWD	-.622*	-.762**	62.4 (7.2)	
	Most Impaired	ND	-.308	-.308	72.5 (5.6)	<.0001*
		AWD	-.575	-.672*	58.1 (7.3)	
Standing Hip Extension (°)	Least Impaired	ND	.061	-.042	32.0 (7.3)	.122
		AWD	-.622*	-.579*	28.0 (7.7)	
	Most Impaired	ND	.099	.028	28.1 (7.5)	.034*
		AWD	-.541	-.496	22.3 (7.7)	
Dorsiflexion Lunge (°)	Least Impaired	ND	-.146	.020	40.8 (5.7)	.027*
		AWD	-.675*	-.725**	36.1 (6.5)	
	Most Impaired	ND	.027	.178	37.0 (6.0)	<.0001*
		AWD	-.220	-.140	25.9 (5.4)	
Backward Stepping Lunge	Least Impaired	ND	.040	.083	2.16 (0.45)	.130
		AWD	-.357	-.268	2.11 (0.41)	
	Most Impaired	ND	-.064	.003	2.03 (0.39)	.140
		AWD	-.354	-.267	1.88 (0.28)	

Results – valid tests



Discussion

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

- This study provides a framework for evaluating the validity of tests of coordination and ROM for classification of runners with ataxia, athetosis and hypertonia
- Heel pull and dorsiflexion lunge tests will potentially facilitate classification
- These two tests have a good biomechanical basis.
- Coordination tests were not validated in this sample
- Larger sample and people with greater impairments of coordination and range of motion are required

CRICOS Provider No 00025B

Conclusions

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

This study describes a framework for evaluating validity of tests of impairment for the purposes of classification. In runners with ataxia, athetosis and hypertonia, the results provides an early indication that the heel pull and dorsiflexion lunge tests are valid tests of impairment for the purposes of classification

Future direction: a larger sample of runners with more severe ataxia, athetosis and hypertonia is required

Thank You!

Comments and questions?