Spinal cord injury and training status impact the differentiated RPE response to incremental wheelchair propulsion

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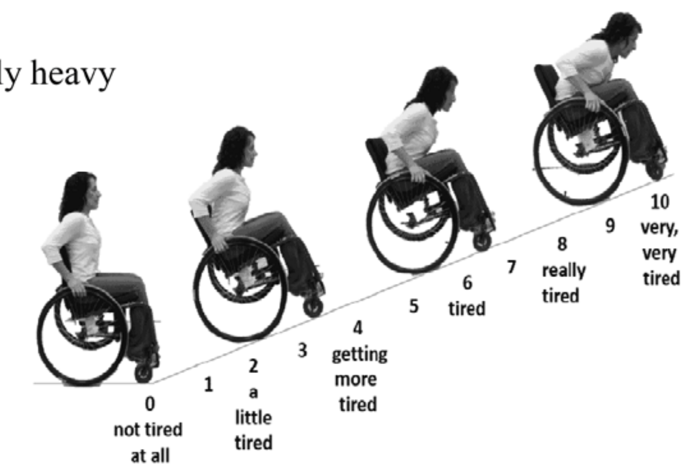
BACKGROUND

- Subjective measure of exercise intensity.
- Uses:
  - Exercise prescription.
  - Monitor training load.
- Whole-body, overall RPE (RPE_O)
- Differentiated RPE:
  - Peripheral (RPE_P)
  - Central (RPE_C)

0	Nothing at all
0.5	Extremely weak
1	Very weak
2	Weak (light)
3	Moderate
4	
5	Heavy
6	
7	
8	
9	
10	Extremely heavy
•	

6	No exertion at all
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard (heavy)
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

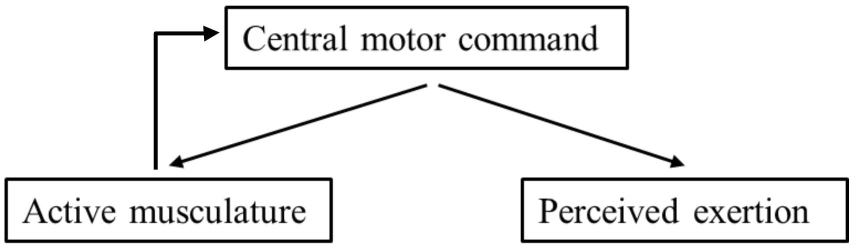


DIFFERENTIATED RPE

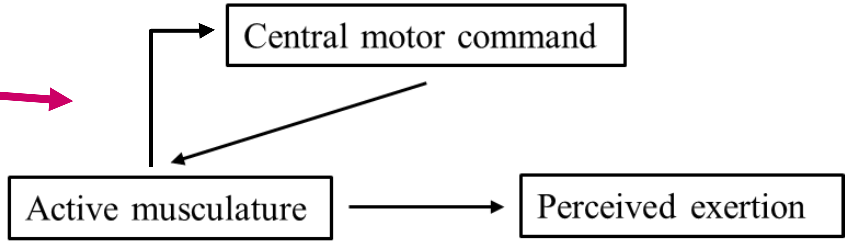
- Used in able-bodied (AB) team sports to monitor different types of training session (McLaren et al., 2017).
- No effect of training status on differentiated RPE at equal relative intensity (%VO_{2max}) in AB performing lower body exercise (Bolgar et al., 2010).
- What about during upper body exercise?
  - **Increased RPE_P** in untrained AB vs. trained wheelchair sports people at 60% VO_{2peak} (Lenton et al., 2008).
  - **No difference** in peak RPE_P and RPE_C in active men with paraplegia (Al-Rahamneh & Eston, 2011).
  - **No difference** in relationship of differentiated RPE with VO_2 in trained men with tetraplegia (Paulson et al., 2013).
  - **Increased RPE_P vs RPE_C** during incremental exercise in low-active people **with tetraplegia, but not paraplegia** (Au et al., 2017).

MECHANISM OF RPE

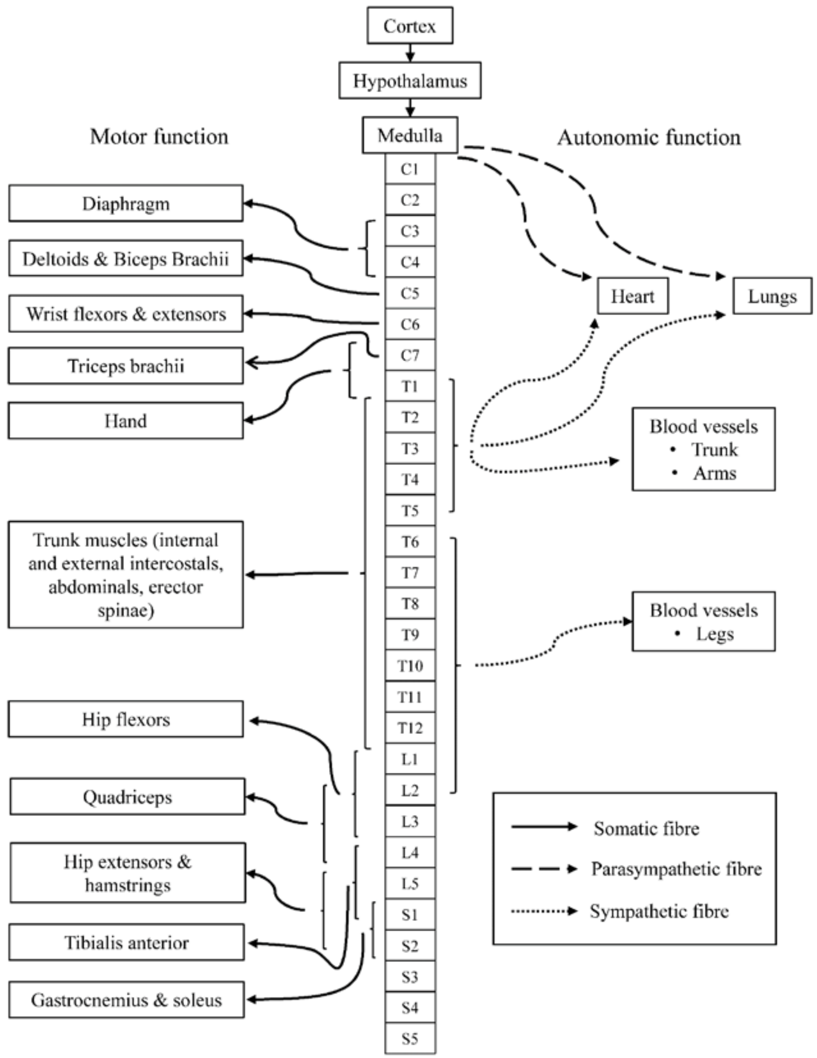
- Contention over the origin of the RPE response and the role of the exercising muscle (Pageaux, 2016).
- Corollary discharge (Marcora, 2009).



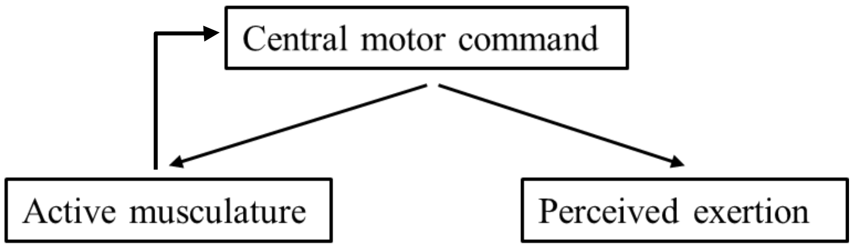
- Afferent feedback (Noakes et al., 2004; Amann et al., 2011).



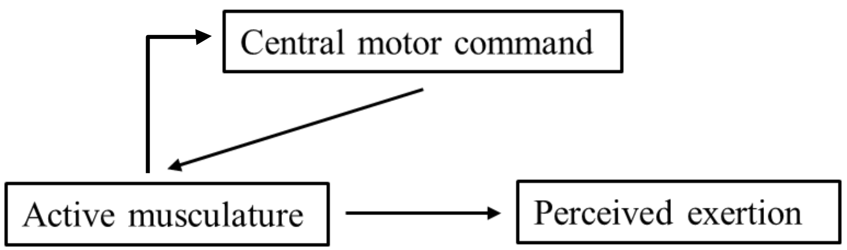
SCI & RPE



Cortex
Hypothalamus
Medulla
Motor function
Autonomic function
C1
C2
C3
C4
C5
C6
C7
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
L1
L2
L3
L4
L5
S1
S2
S3
S4
S5
Diaphragm
Deltoids & Biceps Brachii
Wrist flexors & extensors
Triceps brachii
Hand
Trunk muscles (internal and external intercostals, abdominals, erector spinae)
Hip flexors
Quadriceps
Hip extensors & hamstrings
Tibialis anterior
Gastrocnemius & soleus
Heart
Lungs
Blood vessels
• Trunk
• Arms
Blood vessels
• Legs
Somatic fibre
Parasympathetic fibre
Sympathetic fibre



Central motor command
Active musculature
Perceived exertion



Central motor command
Active musculature
Perceived exertion

AIM

- To investigate the role of **i) training status** and **ii) cervical SCI (CSCI)** on differentiated RPE responses to incremental wheelchair propulsion.

- 3 groups:
  - Non upper-body trained **AB** (n = 20).
  - Highly-trained wheelchair rugby players:
    - With **CSCI** (n = 9; C5-7; motor and sensory complete).
    - **Non-SCI** (n = 9; amputation = 4; arthrogryposis, cerebral palsy, osteogenesis imperfecta, polyneuropathy, Roberts Syndrome = 1).

METHODS

- AB performed 2 familiarisation sessions.
- Incremental wheelchair propulsion (1.2-3.2 + 0.1 $m \cdot s^{-1} \cdot min^{-1}$).
- RPE_P and RPE_C on CR-10.
- RPE fit against VO_2 using a quadratic function (Au et al., 2017).
- Data extraction from 50-100% VO_{2peak}.

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•	

	AB	CSCI	Non-SCI
Age (years)	22 ± 2	29 ± 7	28 ± 5
Body mass (kg)	86.7 ± 11.4*†	68.9 ± 12.4	60.1 ± 12.8
VO_{2peak} ($L \cdot min^{-1}$)	3.1 ± 0.5*†	1.5 ± 0.5	2.4 ± 0.7†
VO_{2peak} ($ml \cdot kg^{-1} \cdot min^{-1}$)	35.7 ± 6.0†	21.3 ± 5.9	40.1 ± 5.3†
Peak speed ($m \cdot s^{-1}$)	2.7 ± 0.4	2.4 ± 0.5	3.5 ± 0.5†‡

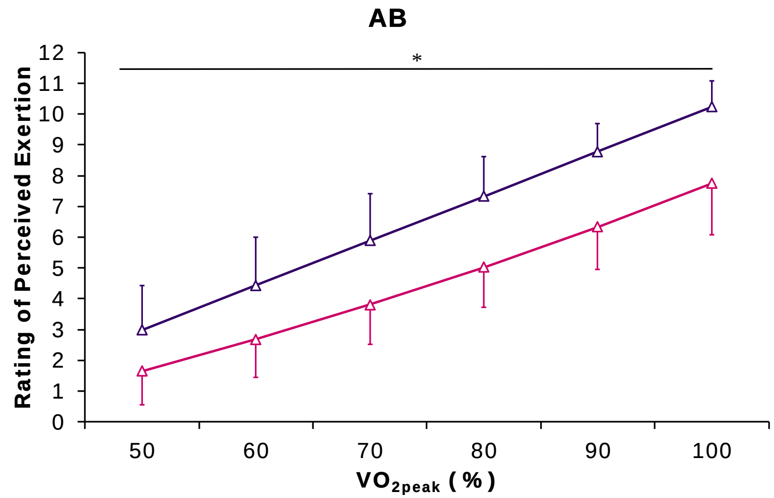
*: significantly greater than Non-SCI, †: significantly greater than CSCI, ‡: significantly greater than AB.

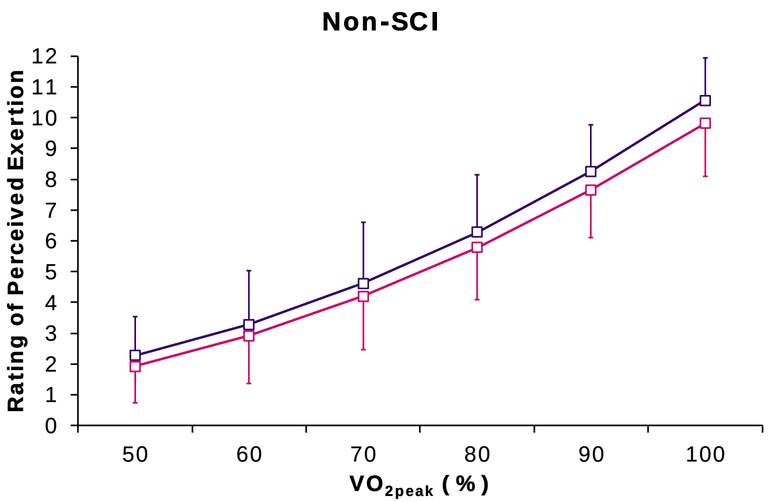
RESULTS: Training status

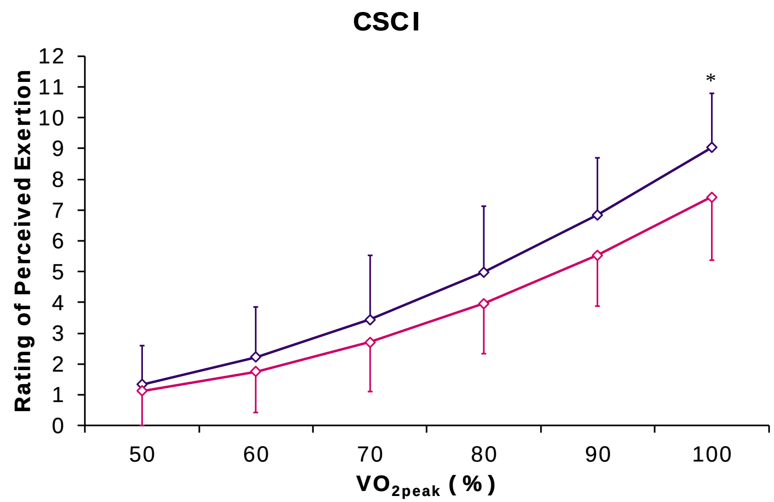
RPE_P

RPE_C

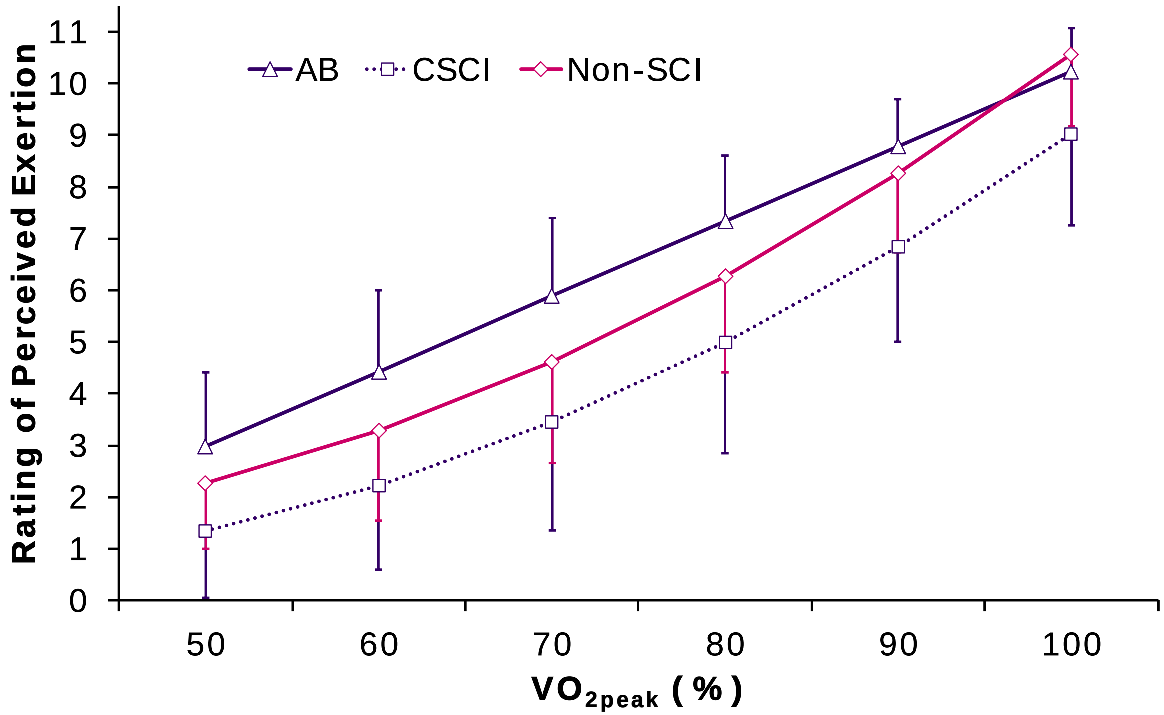
- In AB:
  - $RPE_P > RPE_C$ (6.6 ± 2.8 vs 4.5 ± 2.5, P < 0.005).
  - RPE_P developed faster than RPE_C (P = 0.01).
- In Non-SCI and CSCI:
  - No difference between RPE_P and RPE_C.





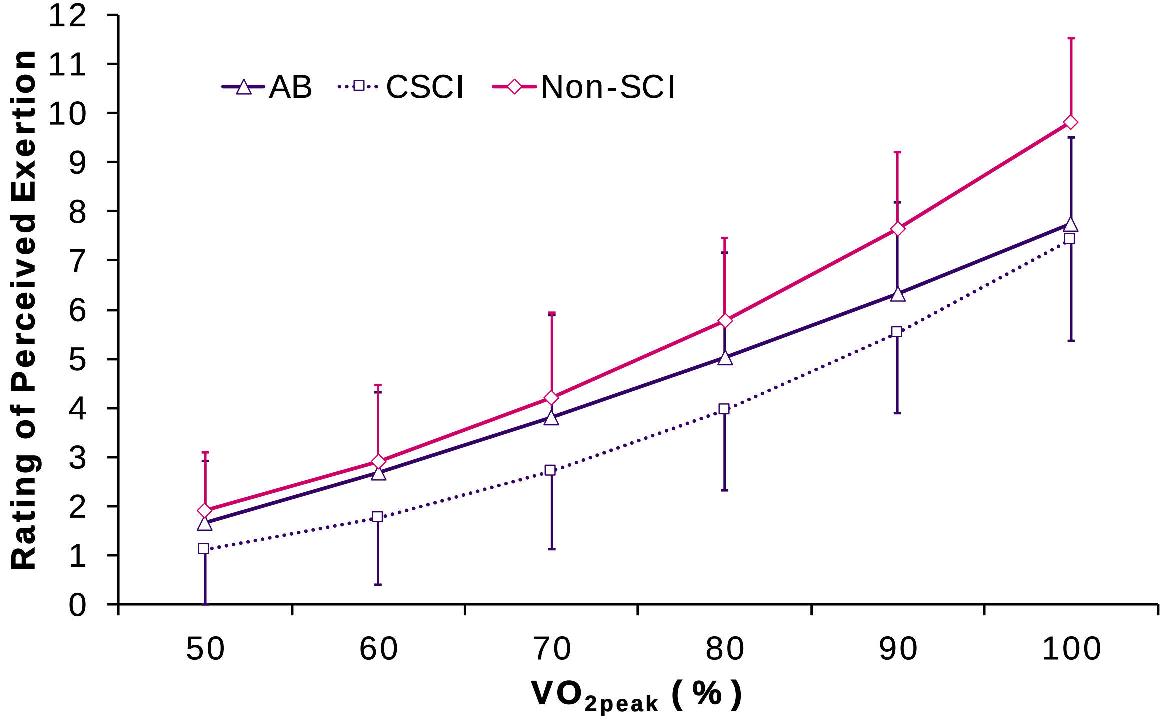


RESULTS: RPE_P



- ↑ **respiratory exchange ratio** in AB (1.02 ± 0.10) versus CSCI (0.82 ± 0.11).
- ↑ **blood lactate** in AB (7.98 ± 2.53) versus CSCI (4.66 ± 1.57 mmol·L^{-1}).
  - ↑ metabolism-derived afferent feedback leading to ↑ RPE_P in AB?

RESULTS: RPE_C



- ↑ **heart rate** in AB (146 ± 24) and Non-SCI (166 ± 20) versus CSCI (104 ± 15 beats·min^{-1}).
- ↑ **ventilation** in AB (75.0 ± 26.0) and Non-SCI (59.2 ± 28.8) versus CSCI (35.1 ± 16.6 L·min^{-1}).
  - ↑ active musculature, or feedback from the muscles leading to ↑ RPE_C?

PRACTICAL IMPLICATIONS

- Training status impacts relationship between RPE_P and RPE_C during upper body exercise:
  - Young / newer athletes.

- CSCI significantly impacts on differentiated RPE:
  - Findings from AB cannot be applied to CSCI population.
  - Implications for practitioners working in Paralympic team sports.

- Mechanistic basis of RPE response:
  - Support for the role of afferent feedback.
  - Further research into the area needed.

Thank you

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