

## The Peter Harrison Centre for Disability Sport at Loughborough University: Supporting the wheelchair athlete

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### How areas of wheelchair set-up effect performance: an athlete's perspective

#### **Introduction**

Configuring a sports wheelchair is a vital yet complex decision for wheelchair athletes. Scientific testing is important to establish how different configurations affect performance. However, athlete's opinions also need to be considered in order to establish which areas of configuration they need help with.

#### **What we did**

Nine experienced wheelchair athletes were interviewed to document which areas of performance were most important to successful mobility performance in their sport and how different wheelchair configurations affected these performance indicators.



*Photograph 1: A wheelchair athlete discussing aspects of his wheelchair set-up with a sports scientist*

#### **Main findings and applications**

- Athletes appeared to give greater consideration to how aspects of ball handling or stroke production were affected by their wheelchair set-up as opposed to mobility performance.
- Stability was deemed the most important parameter when configuring a new chair.
- Initial acceleration was viewed as the most important performance indicator by wheelchair basketball and rugby players although wheelchair tennis players often favoured improved manoeuvrability.
- Athletes demonstrated similar views as to how they felt manipulating the majority of areas of configuration affected their mobility performance.

- However these were often vague statements i.e. sitting higher does this, whereas sitting low does this. These type of statements do not assist the identification of optimal set-ups
- Rear-wheel camber was identified as the area of configuration most in need of future scientific research as athlete's responses to how this area affected mobility performance were mixed.

### Reference

Mason B.S., Porcellato L., van der Woude L.H.V., & Goosey-Tolfrey V.L. A qualitative examination of wheelchair configuration for optimal mobility performance in wheelchair sports: a pilot study. *J. Rehab. Med.* 2010; 42: 141-149.

If you take a look at the chairs at the Games you will see an array of chairs and one of the most notable changes evident was with the moulded seat of Esther Vergeer's sports wheelchair. A sports wheelchair is an integral part of the wheelchair-user interface and our research has assisted British athletes with making a much better decision about their chair set-up. Please refer to the following two studies:



Photograph 2: Chair used in 2008 vs. 2012

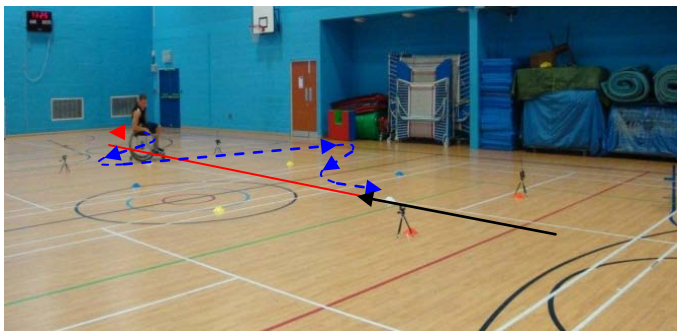
# The effect of rear-wheel camber during on-court mobility performance

## Introduction

Wheelchair athletes have often associated an increase in the degree of camber with an improvement in manoeuvrability performance. However, the effect of greater camber on aspects of linear performance is not well documented.

## What we did

Fourteen wheelchair athletes performed three sports specific on-court field tests in 4 different camber settings (15°, 18°, 20° & 24°). Timing gates were used to assess the times taken to perform a 20m sprint and a manoeuvrability drill. A velocometer (a device measuring speed) was attached to athlete's wheelchairs during the 20m sprint to assess initial acceleration performance and peak speeds.



Photograph 3: A participant performing the manoeuvrability drill in a camber setting.

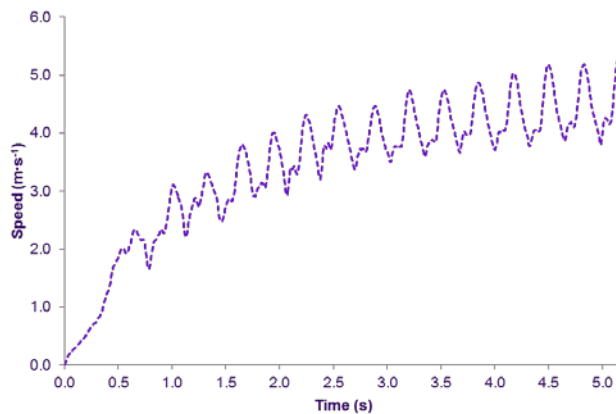


Figure 1: A typical speed trace derived during the 20m sprint, which was analysed for acceleration and sprinting performance.

## Main findings and applications

- 20 m sprint times were lower in 18° and 20° camber compared with 24° camber.
- Although no significant differences were identified, strong trends suggested that manoeuvrability performance was improved in the 18° and 20° settings compared with 15°.
- In summary, 24° would not be an advisable camber setting for a wheelchair athlete, given the negative impact it had on linear performance, without any positive impact on manoeuvrability performance.

**Reference**

Mason B.S., van der Woude L.H.V., Tolfrey K., & Goosey-Tolfrey V.L. The effects of rear-wheel camber on maximal effort mobility performance in wheelchair athletes. *Int. J. Sports Med.* 2012; 33: 199-204.

# The effect of rear-wheel camber on physiological & biomechanical parameters

## Introduction

The camber angle of the main wheels is an area of configuration that has increased gradually in court sport wheelchairs over the years. However, the effects of this area of configuration on athlete's mobility performance have been somewhat limited and varied.

## What we did

Fourteen wheelchair athletes performed a 4-minute sub-maximal exercise bout on a motorised wheelchair treadmill in 4 different camber settings (15°, 18°, 20° & 24°). During each camber setting, physiological demand was assessed by the oxygen being consumed and athletes' heart rates, whilst propulsion technique was monitored using high-speed video analysis.



*Photograph 4: A typical court sport wheelchair with rear-wheel camber*



*Photograph 5: A participant performing a trial on the treadmill with joint markers on for video analysis.*





*Photograph 6: An athlete being testing for pushing economy*

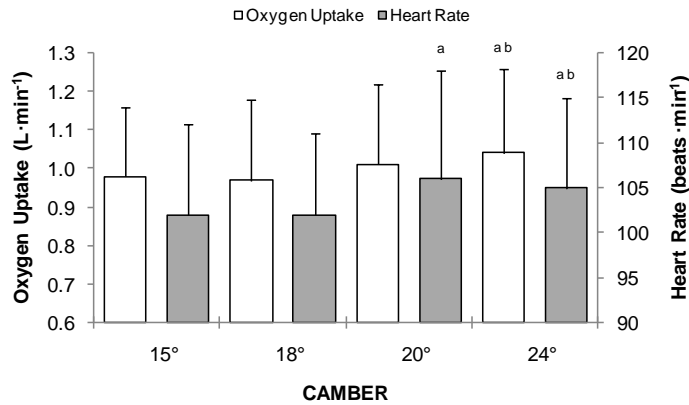


Figure 2: Due to increases in rolling resistance in higher camber settings, physiological demand was elevated in the larger two settings (20° & 24°).

### Main findings and applications

- Larger camber increased the surface area of the tyre in contact with the treadmill, hence greater rolling resistance.
- A consequence of this was an increased physiological demand in larger camber settings.
- An increase in the active elbow and shoulder range of motion was observed during the largest 24° camber setting.
- Larger camber settings may exacerbate the onset of fatigue during prolonged sporting activity.

### Reference

Mason B.S., van der Woude L.H.V., de Groot S., & Goosey-Tolfrey V.L. The effects of camber on the ergonomics of propulsion in wheelchair athletes. *Med. Sci. Sports Exerc.* 2010; 43: 319-26.



'The studies we've taken part in with the PHC team have proved invaluable over the years. The world class staff and facilities have enabled us to gather accurate data as well as conducting in-depth monitoring/analysis to perfect our training regimes. Without the help of the PHC, we simply wouldn't be able to play and train at the professional levels that we do.'

Photograph 7: Andy Barrow (GB wheelchair rugby player, former captain).