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# The difference in biomechanics and physiology between synchronous and asynchronous handcycling in dependence of practice in able-bodied men

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# Handcycling for commuting



Adapted from <https://pxhere.com/nl/photo/276131>



Adapted from [https://c1.staticflickr.com/9/8472/8387438416\\_73088026be\\_b.jpg](https://c1.staticflickr.com/9/8472/8387438416_73088026be_b.jpg)

- More efficient than hand-rim wheelchair

Dallmeijer 2004; Arnet 2013



Adapted from <https://www.zerohedge.com/sites/default/files/2018-08/wheelchair%20guy.jpg>

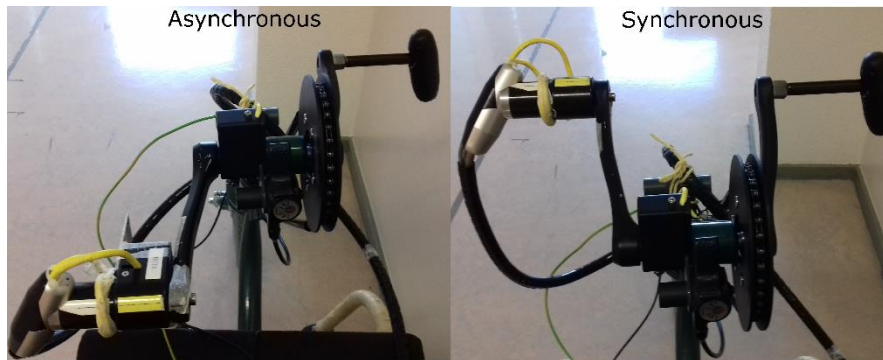


[https://upload.wikimedia.org/wikipedia/commons/0/0e/Kompaktes\\_Handbike.jpg](https://upload.wikimedia.org/wikipedia/commons/0/0e/Kompaktes_Handbike.jpg)

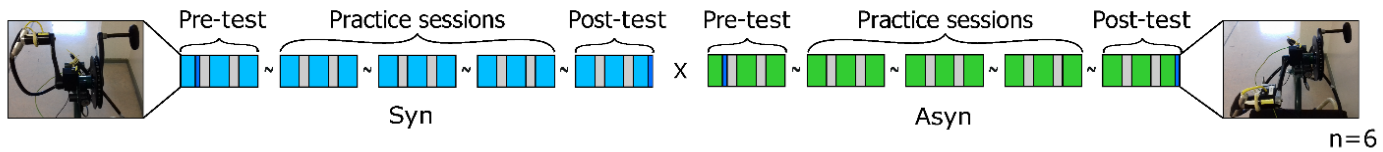
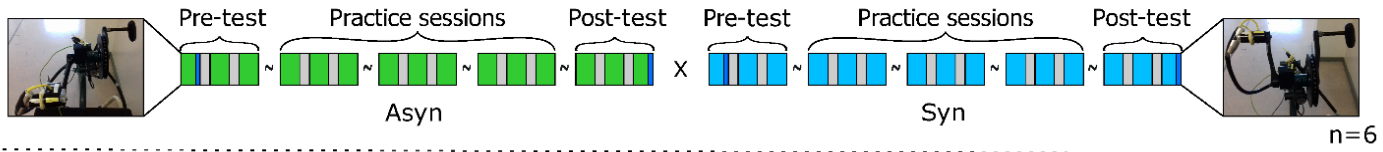
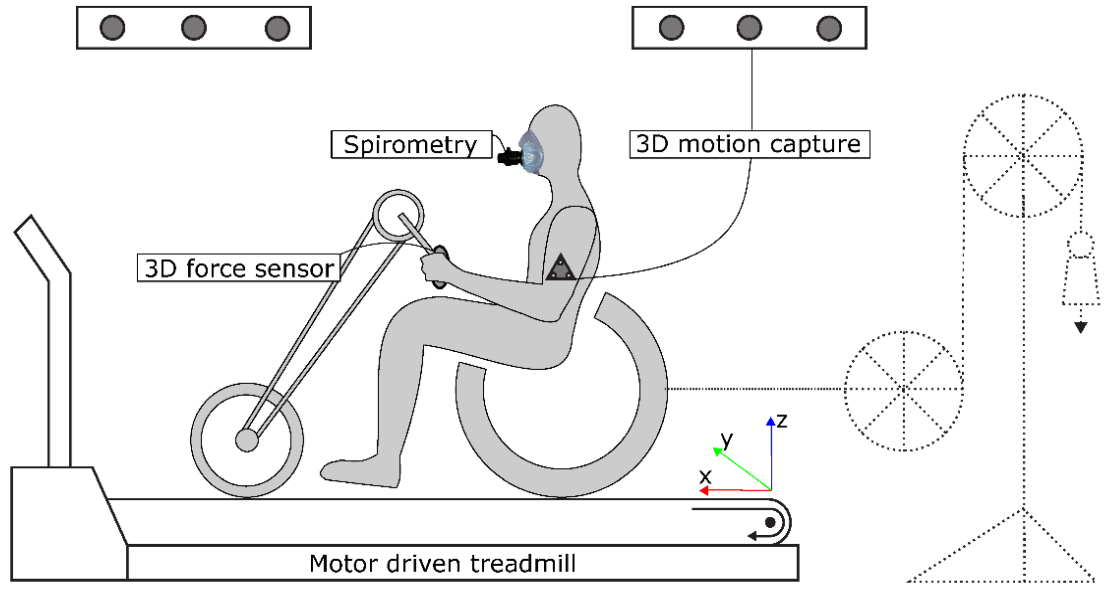
- Participation in society
- Stay active and independent ICF, WHO 2001

# Explore the handcycle settings: Crank mode

- Handcycle mechanics from bicycle technology → asynchronous
- Nowadays, western world → synchronous



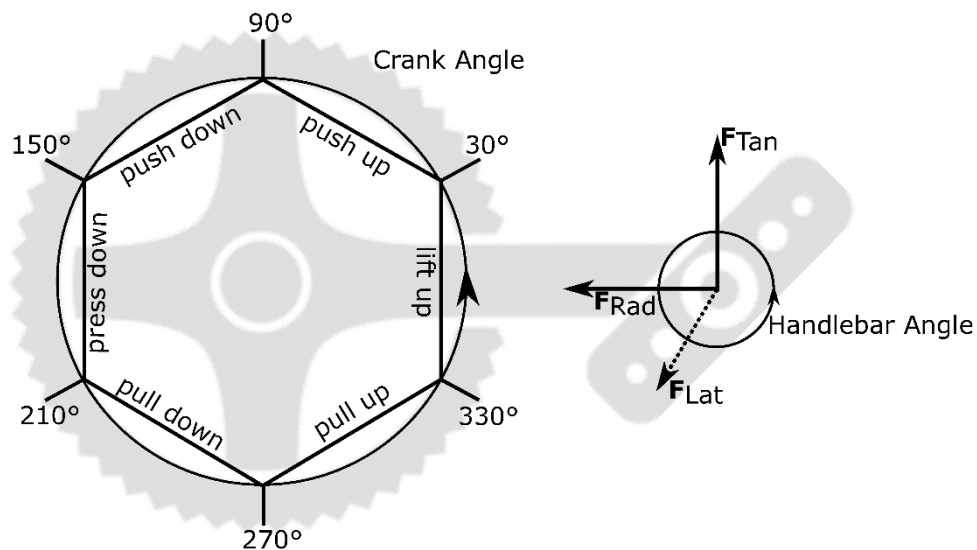
- Synchronous is more efficient as asynchronous van der Woude 2008;Dallmeijer 2004;van der Woude 2000;Bafghi 2008



4 min handcycling
  2 min rest
  1 min analysis
 ~ 2 days
X switch crank mode

# Outcomes

## Handcycle kinetics



Krämer 2009

## Kinematics and Physiology

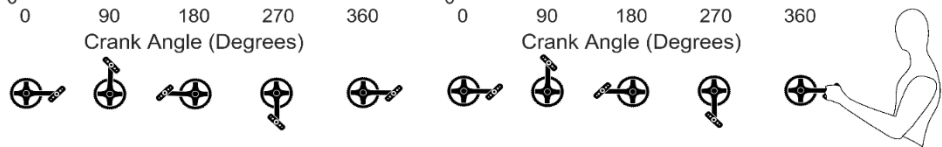
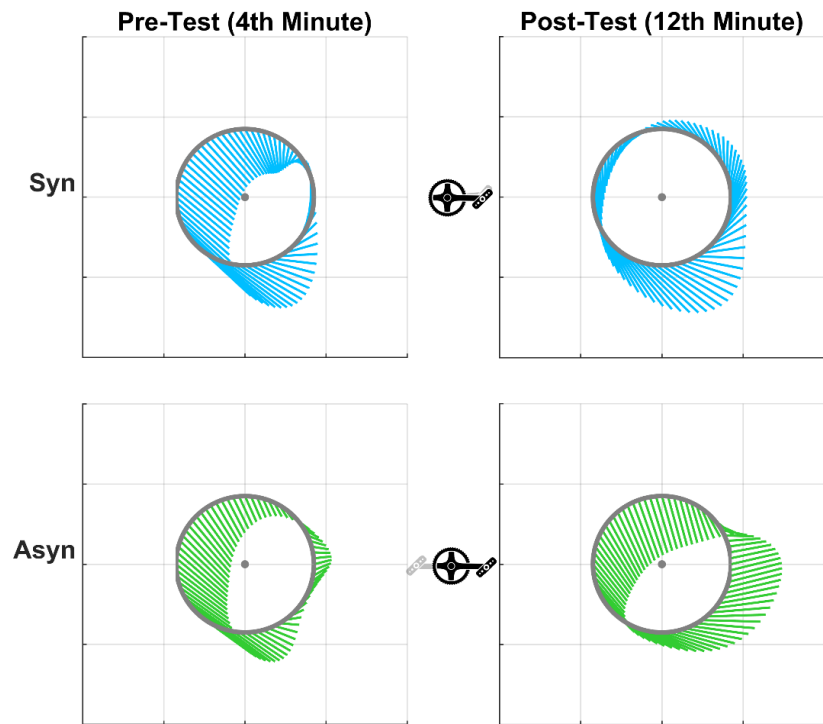
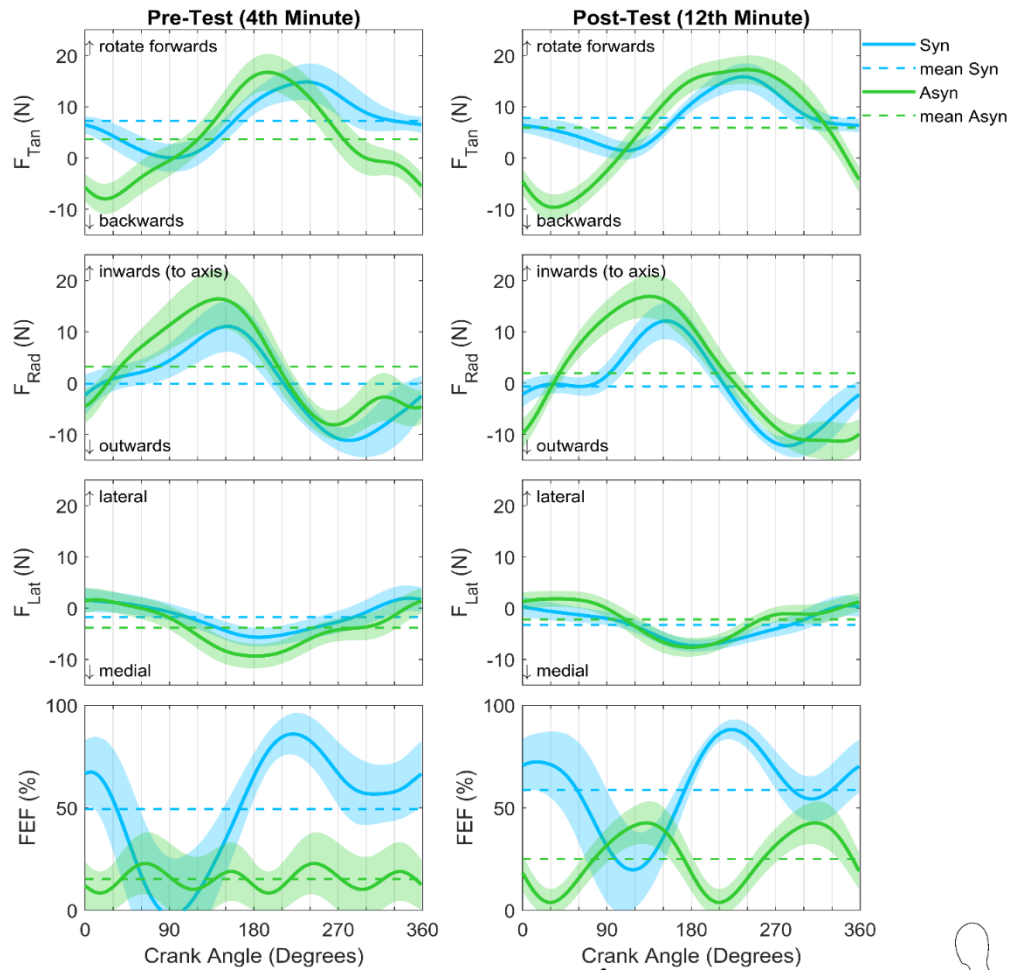
- Distance on treadmill
  - Front to Back
  - Left to Right
- Energy Expenditure (internal work) Garby 1987
- Ventilation
- Breathing Frequency
- Heart rate

# Pre test 4th min. asynchronous vs. synchronous

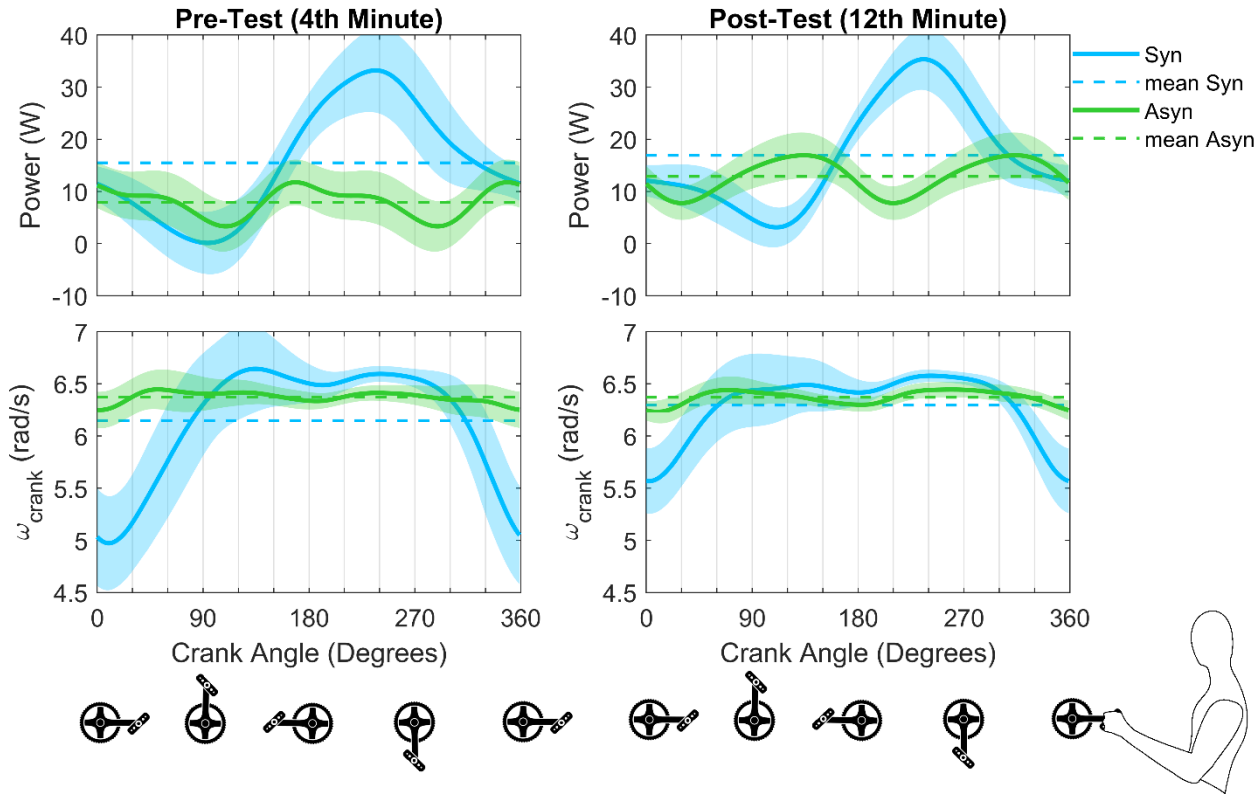


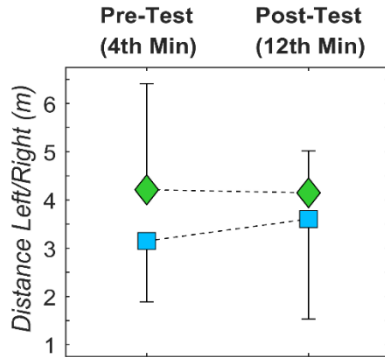
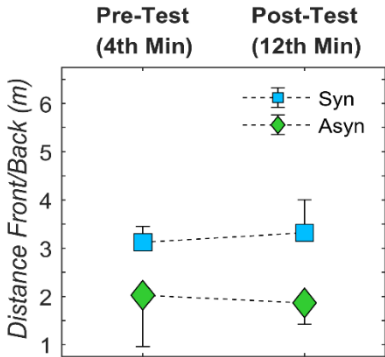
# Post test 12th min. asynchronous vs. synchronous











# Conclusions

	Without practice	Practice	After practice
<b>Force effectiveness</b>	ASYN < SYN	ASYN ↑ / SYN ↑	ASYN < SYN
<b>Power production</b>	ASYN < SYN	ASYN ↑ / SYN =	ASYN < SYN
<b>Crank rotation velocity</b>	ASYN > SYN	ASYN = / SYN ↑	ASYN > SYN
<b>Movement on treadmill</b>	ASYN < SYN	ASYN = / SYN =	ASYN < SYN
<b>Physiological strain</b>	ASYN > SYN	ASYN ↓ / SYN =	ASYN = SYN

# Take home message

- For research
  - Improvements with practice > have a practice period before comparing both modes
- For handcycle users
  - Use a synchronous set-up for daily use
  - Speed fluctuations → solutions needed

# Thank for your attention

The difference in biomechanics and physiology between synchronous and asynchronous handcycling in dependence of practice in able-bodied men (Under Review)

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