

# Adapted Dynamic Cycling for Children and Young People with Cerebral Palsy: A Pilot Study

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# Outline

- Background
- Methods
- Results
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- Conclusions and Implications
- Acknowledgements
- Questions

# Participation: Ethical considerations

United Nations Convention on the Rights of the Child (United Nations, 1989)

*Article 12: 'children have a right to say what they think and have their opinions taken into account'*

*Article 31: 'children have a right to relax, play and join in a wide range of activities'*

*Article 23: 'children with a disability should have special care and support so they can lead full and independent lives'*

Regular moderate intensity physical activity e.g. walking and cycling have significant benefits for health

(WHO, 2007, NICE Walking and Cycling Guidelines, 2012)

CARDIFF  
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CAERDYDD



# Cycling as Participation

Cycling: a childhood milestone

Cycling with friends, family and carers

Appropriate cycles and adaptations

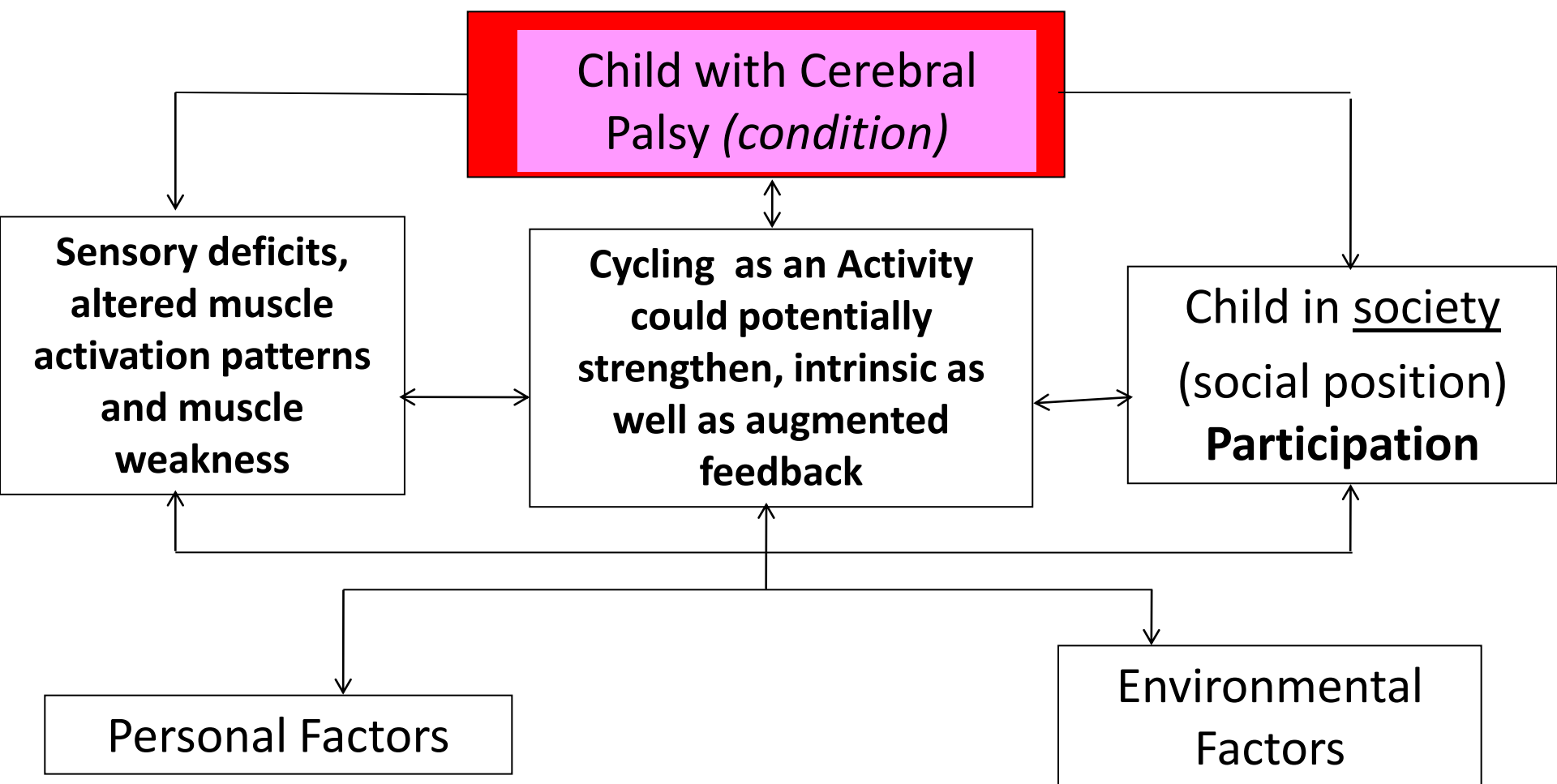
Suitable cycling Environment

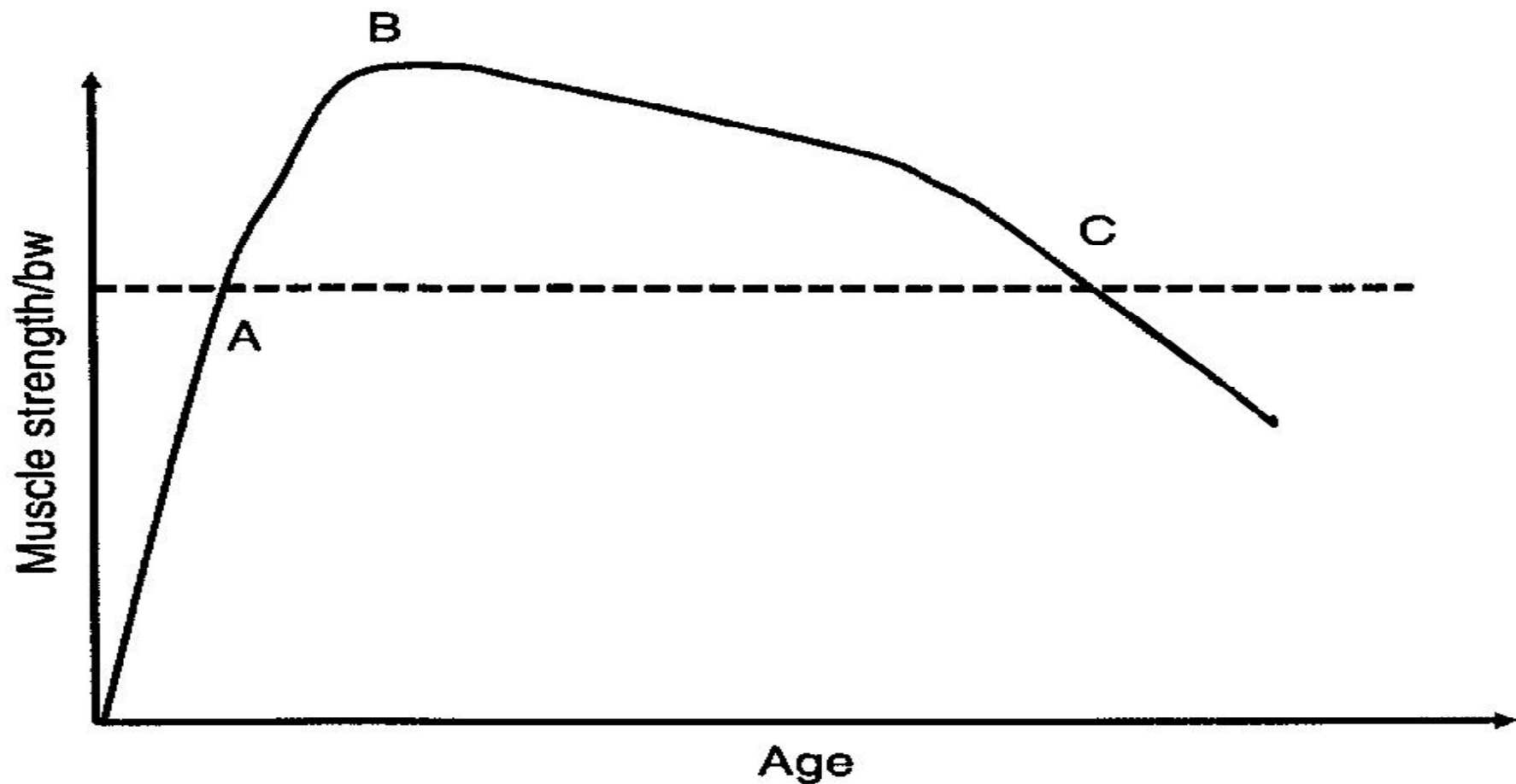
Assessment & on-going evaluation by suitable professional/s

Storing and transporting cycles and adaptations

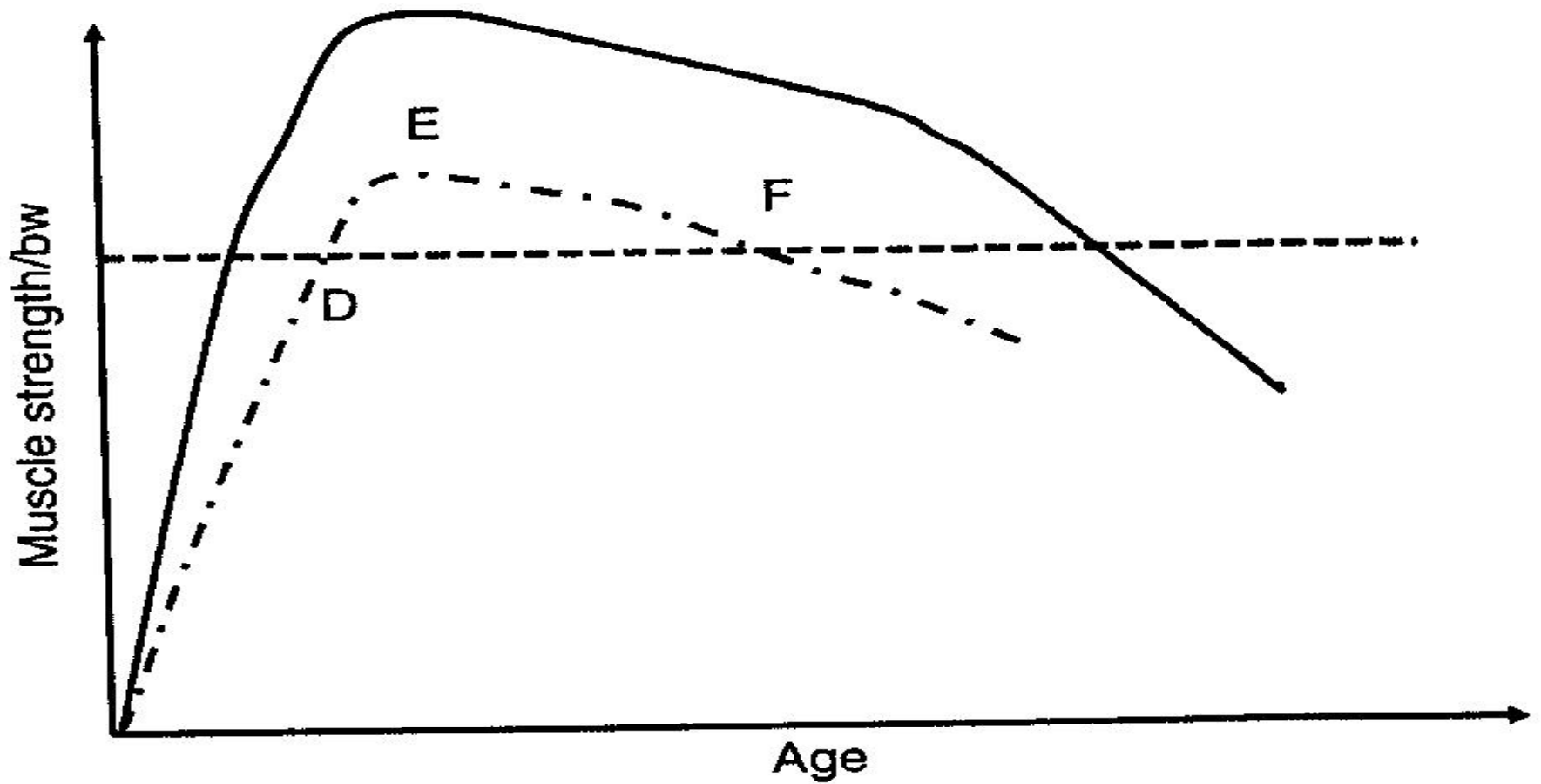
Medical Model: Disability is inherent in the person

Social Model: Disability is an interaction between individuals and their environment (ICF: WHO, 2001)

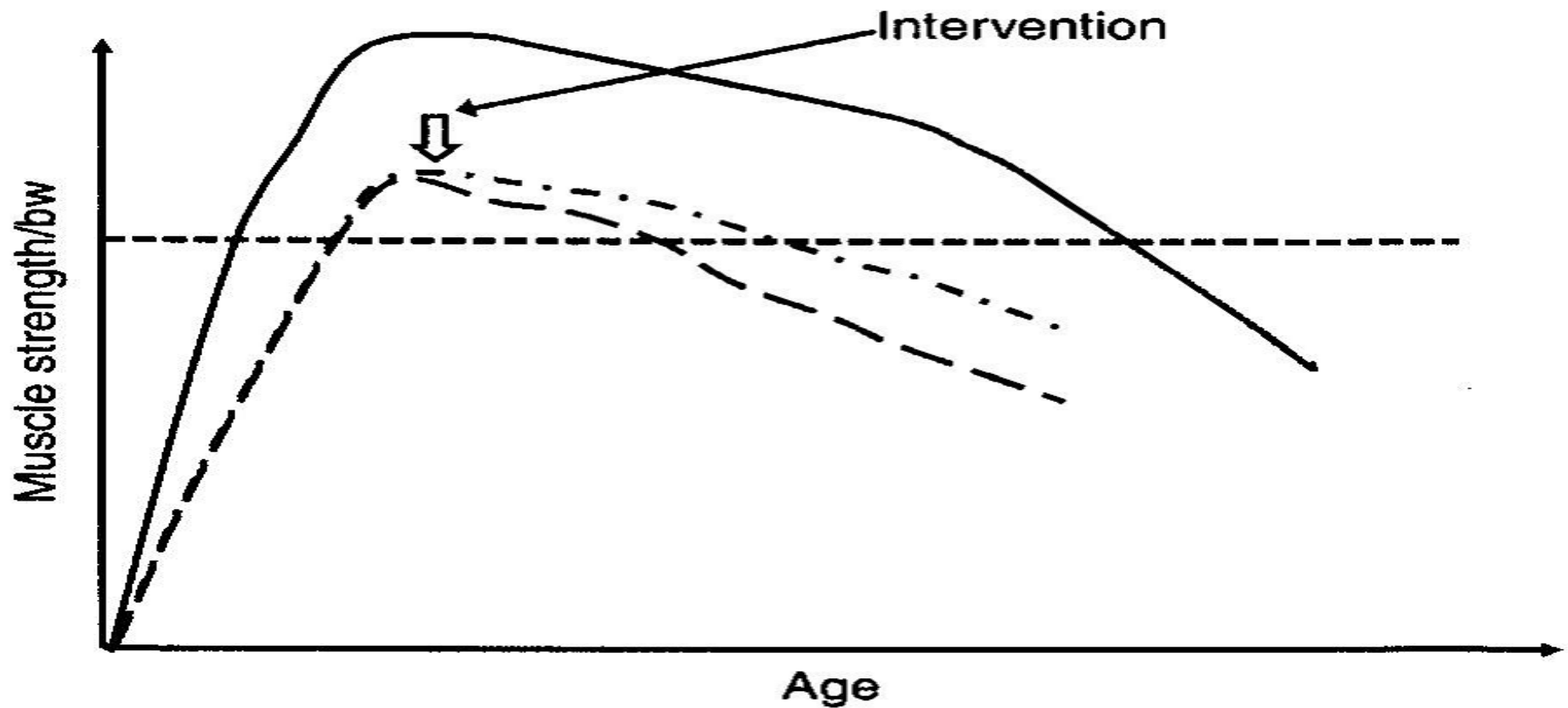




**Figure 1:** The trajectory of muscle strength with age in a typically developing individual. The dotted line indicates the threshold muscular strength required to perform a particular task (e.g. sit-to-stand).



**Figure 3:** The trajectory of muscle strength in individuals with cerebral palsy (dash-dot line) and in typically developing individuals (solid line).



**Figure 4:** The potential impact of an intervention on the trajectory of muscular strength in an individual with cerebral palsy (dashed line). The trajectory of muscular strength without the intervention is also illustrated (dash-dot line), as is the trajectory for a typically developing adult (solid line).



# Effects of Adapted Dynamic Cycling

Quantitative Measures: Hamstring length (PA) and Hamstring and Quadriceps Strength

Qualitative: Cycling and Physical Activity participation- interviews and diaries

Phase 1 – included children and young people with CP attending Pedal Power (17 children)

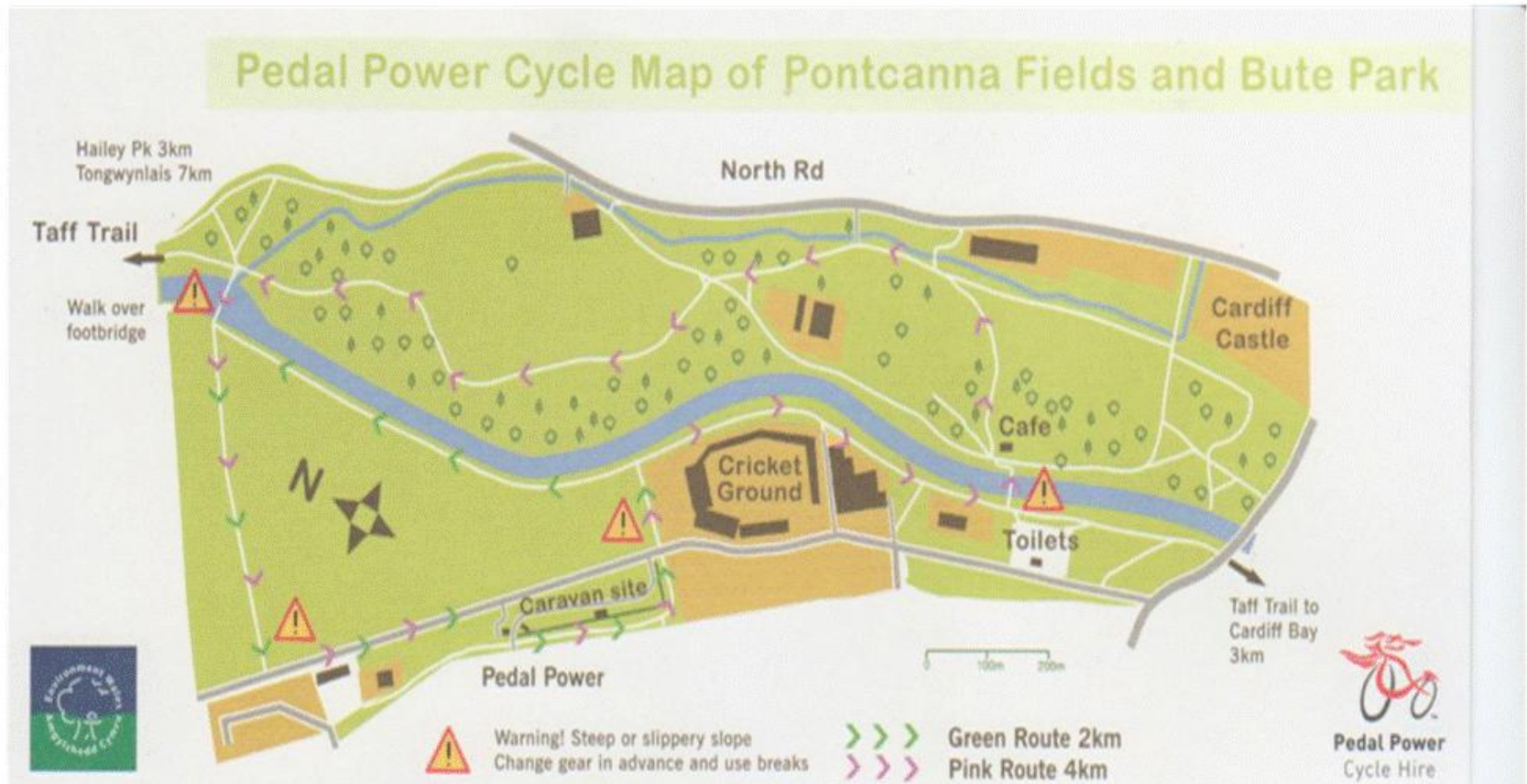
Phase 2- included children and young people with CP not / not yet cycling (18 children)

# Methods

- Mixed Methods: Different Subject Experimental Design
- Pre- & Post Intervention assessment
- Ethical Approval: School of Healthcare Studies Research Ethics Committee, Cardiff University, IRAS



# Intervention: Cycle Path





# Results- Demographics

- Aged 2-17 years
- Cycling Group: n= 17 (7 males, 10 females)
- 8 Quadriplegia, 8 Diplegia, 1 Hemiplegia
- Non cycling group: n=18 (13 males, 4 females)
- 7 Quadriplegia, 4 Diplegia, 7 Hemiplegia

<b>GMFCS Palisano et al (1997)</b>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>
<b>Cycling Group</b>	4	4	2	7	0
<b>Non cycling group</b>	3	8	4	3	0

# Results - Quantitative

Groups	R Quads	L Quads	R Hams	L Hams
Cycling Group	+ 12.4 N ± 6.5	+ 15.56 N ± 13.87	+ 5.19 N ± 3.5	+ 4.23 N ± 5.94
Control Group	-3.62 N ± 4.73	-0.14 N ± 1.4	-1.03 N ± 0.06	-1.05 N ± 3.05

Cycling Group – Within Group: Wilcoxon Ranks Sign Test

Significant Quadriceps changes: (R)  $p=0.018$ ; (L)  $p=0.021$

Non-significant Hamstring changes: (R)  $p=0.065$ ; (L)  $p=0.069$

# Results: Inferential Comparisons

Repeated Measures ANOVA & ANCOVA  
No statistical significance between groups

R Quads	$p = 0.76$
L Quads	$p = 0.79$
R Hams	$p = 0.83$
L Hams	$p = 0.83$

# Discussion

- Children with CP changing body mass: strength ratio
- Physical activity participation may be an enjoyable way of maintaining or increasing strength- what are the opportunities for CP?
- Strength gains through neural changes via internal feedback, augmented by external feedback and goal directed strategies

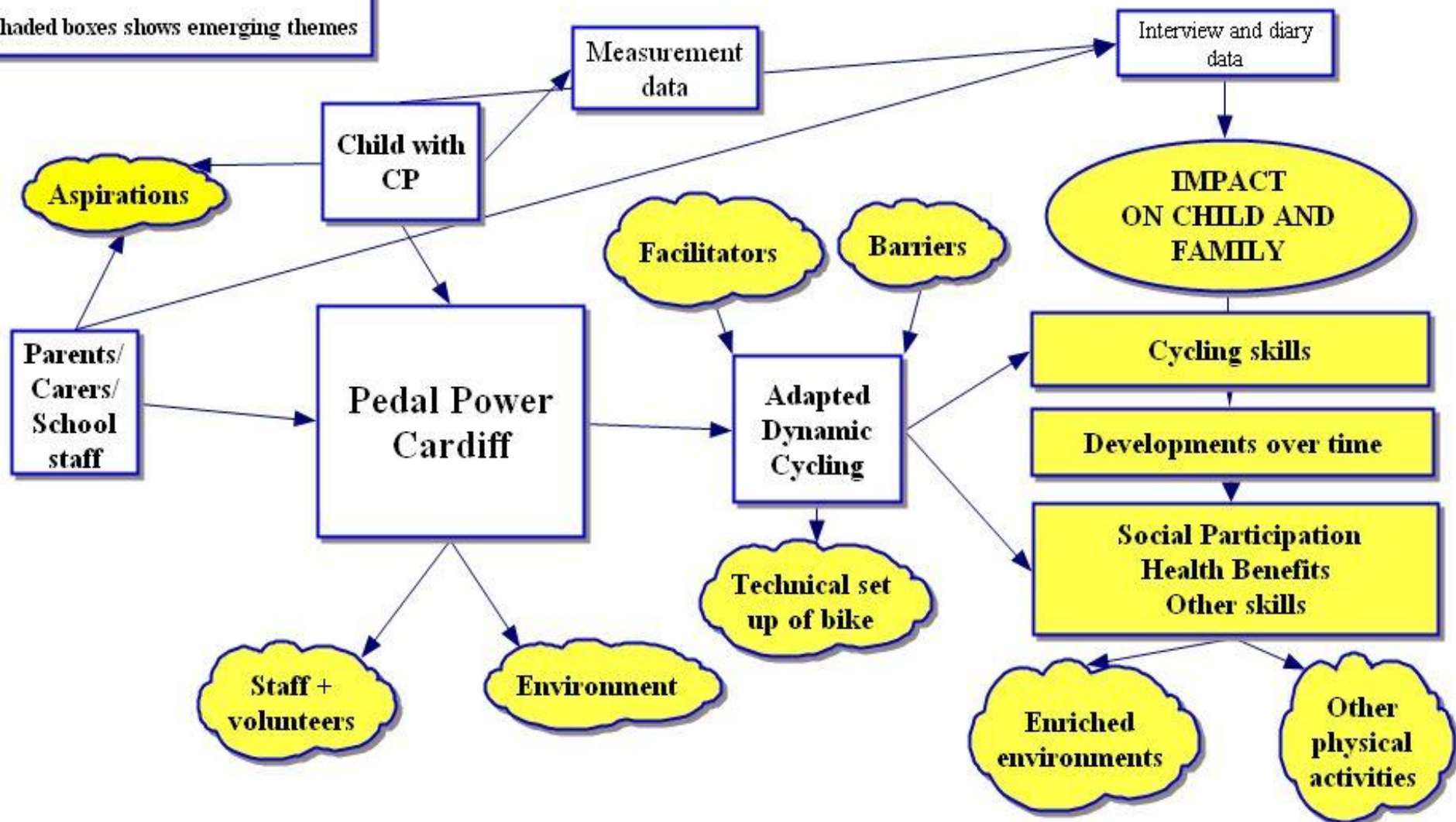
# Thematic analysis Pickering et al, 2012

Figure 2 Themes

Key:

Clear boxes are topics being explored

Shaded boxes shows emerging themes





# Aspirations

Peter's Mum: "*Gabriela put him on the Tom Cat trike, strapped his feet in and **it was the first time ever he pedalled and he couldn't stop it. Everybody got so emotional, fantastic. It just shows if you've got the tools for the job, the right equipment, you can do it... This year we cycled from Bristol towards Windsor because we could hire the special trike.... I think completely independently he cycled not far off 40 miles...***"



*I did cycling and it was wicked!*

Peter aged 7 years Diplegia, High tone. GMFCS I

# Social Participation Publication pending, 2013

- Interview

*“..at the caravan park it was much easier than walking ...I cycled quickly with my friend and we chased each other on bikes and went To buy sweets at the village **shop...we cycled on our own without Mum and Dad to the ‘lagoon’[see drawing]...when I don’t have my bike I tag along with others for a while..ponder my thoughts... get bored... In the city there aren’t enough safe places to cycle but at the caravan its easier to get around- it’s a clever ,clever invention whoever invented it I want to thank them.....”***

- Diary drawing



*Diane was 10, GMFCS II and has Diplegia*

# Andrew's cycling skills

Recumbent Trike steered from side



Andrew 17 years and GMFCS level II with diplegia, athetosis and autism

Andrew was able to describe his cycling experiences: '*...when I pedal it's like I'm there and I am enjoying it...we cycle in the park and I go down the slope...and then I change it.... you know... **I put into 3 (gears) and it makes me fast...***'

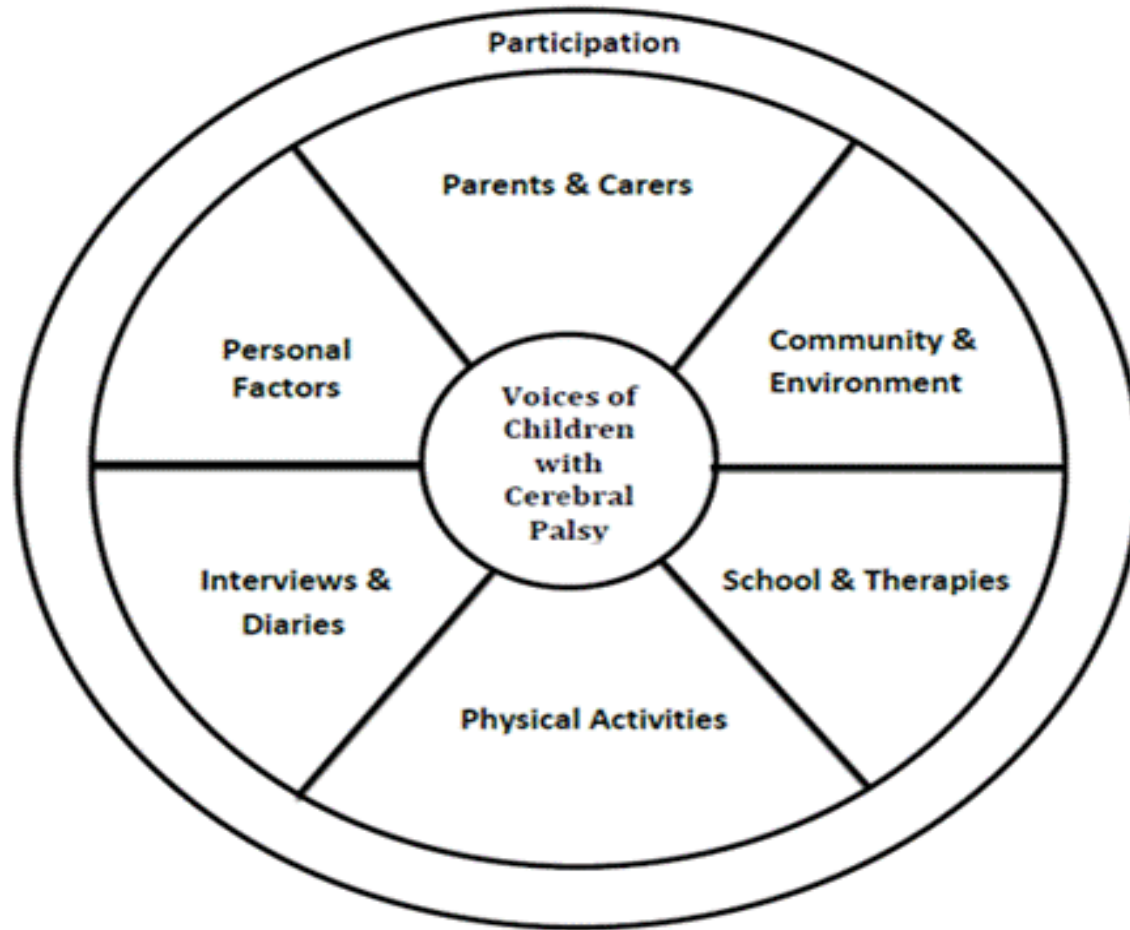
Dad describes his progress '*...he loves biking, **obviously it gives him that independence**...they've taken the footplates away..*'

Andrew progressed to going cycling with a carer (Bethan)

Dad: '*...Bethan actually cycles with Andrew and **they now do four circuits rather than the one or two he did before....***'

# Non cycling group analysis- physical activities + cycling

## Wheel of Participation



# May's Cycling Ambitions

## May 's own Diary entry (aged 10 years)

*Today I had a 20 mins bike ride with my sister and brother to RK secondary school car park there are loads of bends, curbs, bays and car spaces. **I have come on really well considering me and my family all thought I wouldn't be able to achieve such a brilliant opportunity**, we also thought I am going to be doing a bike proficiency test after easter so we have been practising weaving in and out and signalling left and right the right is really easy for me but the left is what I find tricky. and I am also learning that I have to ride on the left on the road.*

*May*

## Interview:

*Int: ... So assuming you pass your cycling proficiency test, what do you hope to do with your cycling?*

*M: ...**to get better and better at it.***

*Int: Where would you like to go with your bike?*

*M: H Forest*

*Int: Have you been there already?*

*M: Yeah but I had to go on a '**stupid tandem**' because my teacher kind of forced me...another Dad pedalled..*

*Mum: ...It was sort of an ice cream basket on the back..*

*Int: So you didn't do any pedalling at all?*

*M: No which was **really, really, really disappointing...cos all my other friends were like riding a bike and I was lonely....***

# Ghost's interview (GMFCS III)

*'I walk most of the time  
but its just like those  
Few days when I'm  
not very active and I  
need the wheelchair..the  
kids in school say '**why  
Are you in a pram**'?'*

*'We tried to go on the  
bumper cars... I've  
been on them  
before...but the man  
asked my mum if I  
was disabled and he  
said **we don't really  
have people with  
disabilities on  
here....**'*

# Change in cycling activity 'Ghost'

**“Didn't think he  
would ever be able  
to ride a bike”**

To/ Mrs D. Pickering,  
thank-you for the feed back of [redacted]  
every think looks o.k on the sheets,  
I've got really good news [redacted] has  
learnt to ride a bike only a little way  
down hill or flat roads,  
can't ride up hill yet. But we are  
all really excited didn't think he  
would ever be-able to ride a bike,  
so he's got one for christmas as a  
special surprize.  
He has also learnt to swim a little  
But not gone too take him now its  
winter cause his legs plays him up  
too long in cold water.  
And also just to say thank-you for all  
the work you've done with [redacted]  
and merry christmas and happy new year  
from  
Debbie and [redacted]

# Lack of physical activity 'Murray' aged 4 years, Diplegia GMFCS III

- 19/4 - no physical activity ★
- 20/4 - some walking @t nursery.
- 21/4 - no real physical activity. ★
- 22/4 some walking @t nursery.
- 23/4 some walking @t nursery
- 24/4 short walk to local shops.
- 25/4 no physical activity ★
- 26/4 Swimming in am  
soft play in pm.  
lots of walking @ school
- 27/4 lots of walking @ school.
- 28/4 very little physical activity ★



# Fatigue

**Rugby 11 years  
GMFCS IV: “After  
trying the trike my  
legs feel aching”**

**Wayne 7 years  
GMFCS II**

**“Legs get too  
tired after  
riding a bike  
so don’t do it  
very often”**

**Ghost 10 years  
GMFCS III**

**“My legs was  
killing me  
after 15  
minutes of  
lazer tag”**

**Suarez 8 years  
GMFCS III**

**“My legs hurt  
for 3 days  
after riding  
the trike”**

# Change in behaviour

- 11 of the 18 children started cycling during or after the study was completed

# Limitations:

- Small sample size
- Convenience volunteer sample
- Wide age ranges and GMFCS abilities
- Insufficient intervention period (6/52) & intervention frequency (x1 per week)
- Difficult to standardise and monitor intervention – participant specific
- Availability for hiring adapted bikes limited
- Weather

# Conclusions and Implications

- Adapted dynamic cycling has potential social and physical health benefits
- Observed improvements in cycling skills and strength trends deserve further investigation with larger sample sizes
- Therapists, educators and policy makers should consider adapted dynamic cycling opportunities for children and young people with disabilities

# Acknowledgements



- Nancie Finnie Charitable Trust
- Children, families and carers who took part
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- BBC Children in Need
- Jenx Ltd
- Polar
- NHS physiotherapists in England and Wales who helped us recruit to control group, as well as Contact a Family, Cerebra and Scope.

# THANK YOU FOR LISTENING

ANY  
QUESTIONS ?

