

# Evaluation of the Validity of the Prosthetic Upper-Extremity Functional Index (the PUFI)

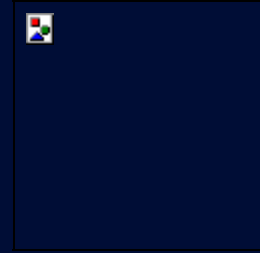
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# What is the PUFI?



- A 20 to 30 minute questionnaire completed by a parent or a child to tell us about use and value of a child's prosthesis
- Available now in a computer version (PUFI-PC) that can be used in clinic for easy completion by the parent or child
- Allows instant scoring by the clinician

# Uses of the PUFIs with an individual child

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- To investigate ways that a child performs bilateral activities
- To evaluate the success and value of prosthetic device use as compared with residual limb
- To identify difficulties and problem areas associated with device use
- To measure change in a child's abilities over a follow-up period (response to intervention)



# Design of the PUFI

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Two age-based versions are available:

**Young child** (ages 3 to 5 years)

**Older child** (ages 6 to 18 years)

- ⇒ Can do **parent-report** questionnaire for young and older child
- ⇒ Also can do **child self-report** questionnaire if child  $\geq 8$  years

# The PUFIs Items

- Questions (items) focus on “2-handed” activities:
  - 26 activities in young child version
  - 38 activities in older child version
- Items cover 4 areas of activity:
  - **Self-care** (e.g., tie up shoelaces)
  - **Domestic** (e.g., spread cheese/jam on a cracker)
  - **School** (e.g. draw a line with a ruler)
  - **Extra-curricular/sports** (e.g., swing a baseball bat)

# The PUFI Software

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- Designed by programmers at Bloorview MacMillan Children's Centre (2001 ...)
- Requires Microsoft Access 97, 2000, or 2002, Pentium (or faster processor), 64 MB RAM, 30 MB free hard drive space for the PUFI database, monitor that can display true colours, and CD-ROM drive
- Six different languages built into software: English, French, Spanish, Swedish, Dutch and Slovenian

# PUFI Part I: Introduction

- Overall evaluation of the usefulness of the prosthesis for 8 activity categories with a 3-point scale to rate usefulness
- Areas considered: Personal Care, Dressing Activities, at Home Relaxing, at School, at Work, at Social Events, Sports/ Recreation, at Play



Partie 1

# Est-ce que votre prothèse est utile pour cette activité?



## 1. Soins personnels

...Brosser ses dents, manger, hygiène,  
brosser ses cheveux...

- ☐ La prothèse est très utile
- ☒ La prothèse est plus ou moins utile
- ☐ La prothèse n'est pas utile



## 2. Tâche habillage / Déshabillage

...Mettre ses souliers, ses bas, un gilet,  
un manteau, des bijoux...

- ☐ La prothèse est très utile
- ☒ La prothèse est plus ou moins utile
- ☐ La prothèse n'est pas utile

☐ Avance automatique

Suivant >

# PUFI Part II

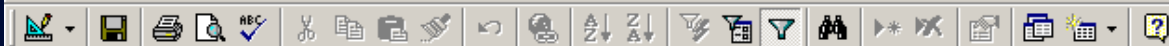
A detailed inventory of 2-handed activities.

Its 4 response scales evaluate:

- Method of performance
- Ease of performance with prosthesis
- Usefulness of prosthesis
- Ease of performance without prosthesis

# “Method of Performance”

- Uses prosthesis actively
- Uses prosthesis passively
- With residual limb
- Without prosthesis
- Needs someone's assistance
- Cannot do even with help

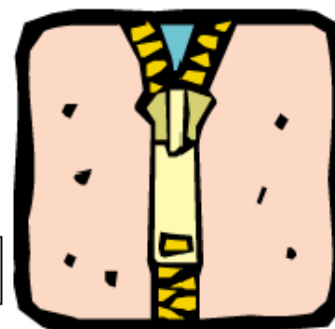


Activité: 1

Partie 2

**Monter la fermeture éclair d'un manteau****B. De quelle façon votre enfant réussit cette activité la plupart du temps:**

- ☐ Avec les deux mains, la prothèse étant utiliser activement
- ☐ Avec les deux mains, la prothèse étant utiliser passivement
- ☐ Avec l'aide du membre atteint
- ☐ En utilisant seulement la main non-atteinte
- ☐ Avec l'aide d'une autre personne
- ☐ Ne sait pas/ Pas certain

☒ Avance automatique

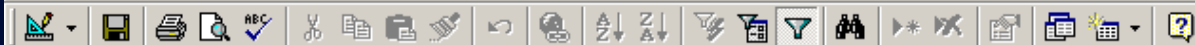
Commentaire

&lt; Précédent

Suivant &gt;

# "Ease of performance with the prosthesis"

- No difficulty
- Some difficulty
- Great difficulty
- With help from someone
- Cannot do with the prosthesis

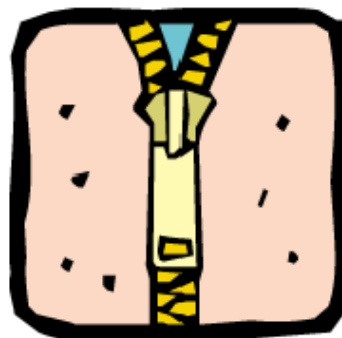


Activité: 1 ...Révision...

**Monter la fermeture éclair d'un manteau**

C. De quelle façon votre enfant fait-il cette activité lorsqu'il porte sa prothèse?

- ☐ Sans difficulté
- ☐ Avec un peu de difficulté
- ☒ Avec beaucoup de difficulté
- ☐ Avec l'aide d'une autre personne
- ☐ Ne peux pas faire l'activité avec sa prothèse

☐ Avance automatique

Commentaire

&lt; Précédent

Suivant &gt;



# “Usefulness of the prosthesis”

- Very useful
- Somewhat useful
- Not useful

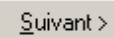
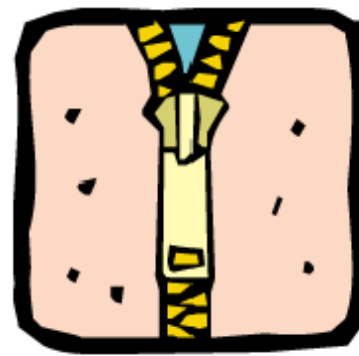


## Monter la fermeture éclair d'un manteau

☐ Très utile

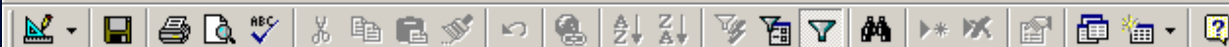
☒ Plus ou moins utile

☐ N'est pas utile



# "Ease of performance without the prosthesis"

- No difficulty
- Some difficulty
- Great difficulty
- With help from someone
- Cannot do with the prosthesis

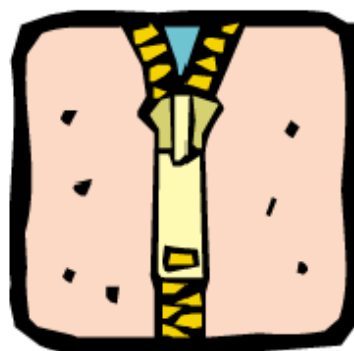


Activité: 1

**Monter la fermeture éclair d'un manteau**

E. De quelle façon votre enfant fait-il cette activité lorsqu'il ne porte sa prothèse?

- ☐ Sans difficulté
- ☒ Avec un peu de difficulté
- ☐ Avec beaucoup de difficulté
- ☐ Avec l'aide d'une autre personne
- ☐ Ne peux pas faire l'activité sans sa prothèse



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☒ Avance automatique

Commentaire

&lt; Précédent

Prochaine tâche &gt;



# Example of a Child's Response Pattern

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Put on a loose pair of socks

- METHOD: Non-prosthetic hand alone
- WITH PROSTHESIS: Great difficulty
- PROSTHESIS: Not useful
- WITHOUT PROSTHESIS: Some difficulty





# Example of a Child's Response Pattern

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## Insert a straw into a juice box

- METHOD: Both arms together, with the prosthetic hand used actively to grasp the box or straw
- WITH PROSTHESIS: No difficulty
- PROSTHESIS: Very useful
- WITHOUT PROSTHESIS: with great difficulty

# PUFI-PC Reports for a Child



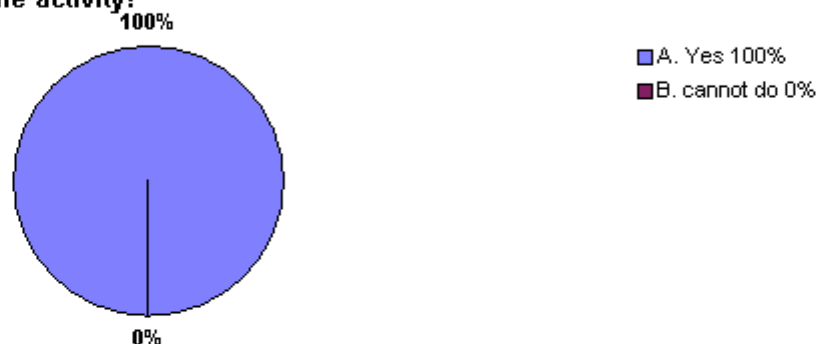
## Frequency and % Scores

Client: Clinic 1, ChartID 00-83-79

Client Number: 00-83-79

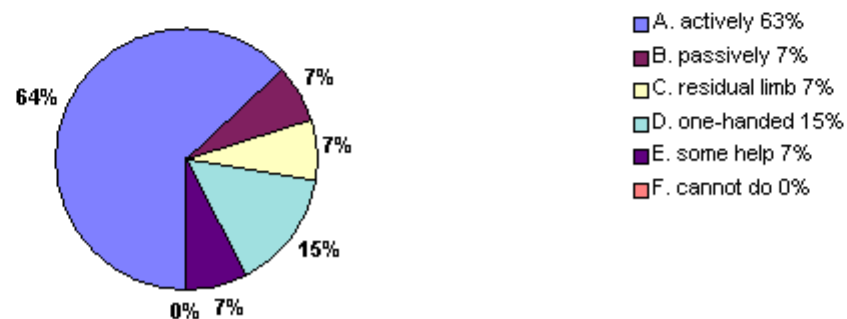
Assessment Date: Jan-7-2003

### Does the client do the activity?



Number of N/A's: 11

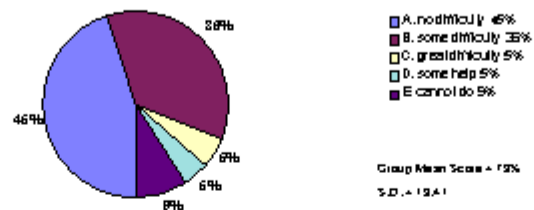
### How does the client usually do the activity?



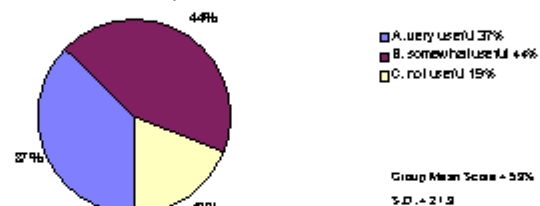
Multiple Choice: Young Child (Parents)

21 - A x 04

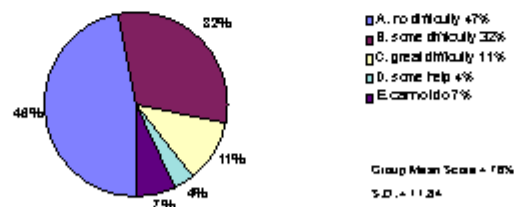
How well does the client do the activity using the prosthesis?



How useful is the prosthesis for the activity?



How well does the client do the activity without the prosthesis?



Use the Close button (top) to close the report.

Frequency and % Score

Use the Page buttons (bottom-left) to go to the next or previous page.

Page 1 of 2

## Raw Scores

Client: Clinic 1, ChartID 00-83-79

Client Number: 00-83-79

Assessment Date: Jan-7-2003

	Activity	Is the activity done?	Usage	Ease of Use	Usefulness	Without Prosthesis
1	Zipper	yes	prosthetic (active)	some difficulty	very useful	great difficulty
2	Shoelaces	yes	prosthetic (active)	no difficulty	very useful	cannot do
3	Tights	N/A	-	-	-	-
4	Socks	N/A	-	-	-	-
5	Mittens	yes	prosthetic (active)	no difficulty	very useful	no difficulty
6	Buttons	yes	residual limb	no difficulty	somewhat useful	no difficulty
7	Pants	yes	prosthetic (active)	no difficulty	somewhat useful	some difficulty
8	Belt	yes	with help	cannot do	somewhat useful	some difficulty
9	Toothpaste	yes	non-prosthetic	no difficulty	somewhat useful	no difficulty
10	Toothbrush	yes	non-prosthetic	no difficulty	not useful	no difficulty
11	Necklace	N/A	-	-	-	-
12	Fingernails	yes	with help	great difficulty	not useful	cannot do
13	Cut meat	yes	prosthetic (active)	no difficulty	very useful	some difficulty
14	Unwrap sandwich	yes	prosthetic (active)	no difficulty	very useful	some difficulty
15	Peanut butter	yes	prosthetic (passive)	some difficulty	somewhat useful	some difficulty
16	Chop fruit	yes	prosthetic (passive)	some difficulty	somewhat useful	some difficulty
17	Juice box straw	N/A	-	-	-	-



## How well does the client do the activity using the prosthesis?

Client: Clinic 1, ChartID 00-83-79

Client Number: 00-83-79

Assessment Date: Jan-7-2003

### These activities never need to be performed:

- 3 Put on tights or pantyhose
- 4 Put on a loose pair of socks
- 11 Put on a necklace or chain around the neck
- 17 Remove straw from a juice box and insert it
- 19 Use a can opener
- 23 Pull small building blocks apart (e.g., LEGO, Meccano)
- 25 Thread a string of beads to make a piece of jewellery
- 29 Open a zippered pencil case and take a pencil out
- 30 Use a small hand-held pencil sharpener
- 32 Play with a Game Boy
- 33 Skip with a skipping rope

### These activities cannot be performed with the prosthesis:

- 8 Do up the buckle on a belt around the waist

### These activities can be performed with great difficulty:

- 12 Groom fingernails (clip, file or polish)

### These activities can be performed with some difficulty:

- 1 Do up the zipper of a coat or jacket
- 15 Spread cheese, jam or peanut butter on a cracker
- 16 Chop vegetables or fruit

# PUFI Publication 1

## Development and Reliability Testing of a New Functional Status Questionnaire for Children Who Use Upper Extremity Prostheses

Wright V, Hubbard S, Jutai J, Naumann S

J Hand Ther 2001;14:91-104

## PUFI Publication 2

Evaluation of the validity of the Prosthetic  
Upper extremity Functional Index (PUFI)  
for children.

Wright V, Hubbard S, Jutai J, Naumann S.  
Arch Phys Med Rehabil\_2003;84:518-527.

# The PUF<sub>I</sub> validity study

Does the PUF<sub>I</sub> differentiate between children and abilities on different tasks (as a function of age, nature of amputation, type of prosthesis, etc.)?

- Do the PUF<sub>I</sub> item response patterns make sense clinically?

- Do PUFIs scores correlate significantly with observed skill with the prosthesis and with scores on a recognized observational test (*University of New Brunswick [UNB] Test of Prosthetic Function*)?
- Is the PUFIs a feasible tool for clinical use?

# Validity Study: Participants

- Glenrose Rehabilitation Hospital, Edmonton, Alberta, Canada
- Institute of Biomedical Engineering, Fredericton, New Brunswick, Canada
- Area Child Amputee Center, Mary Free Bed Hospital and Rehabilitation Center, Grand Rapids, Michigan, USA
- Variety Myoelectric Center, Detroit, Michigan, USA



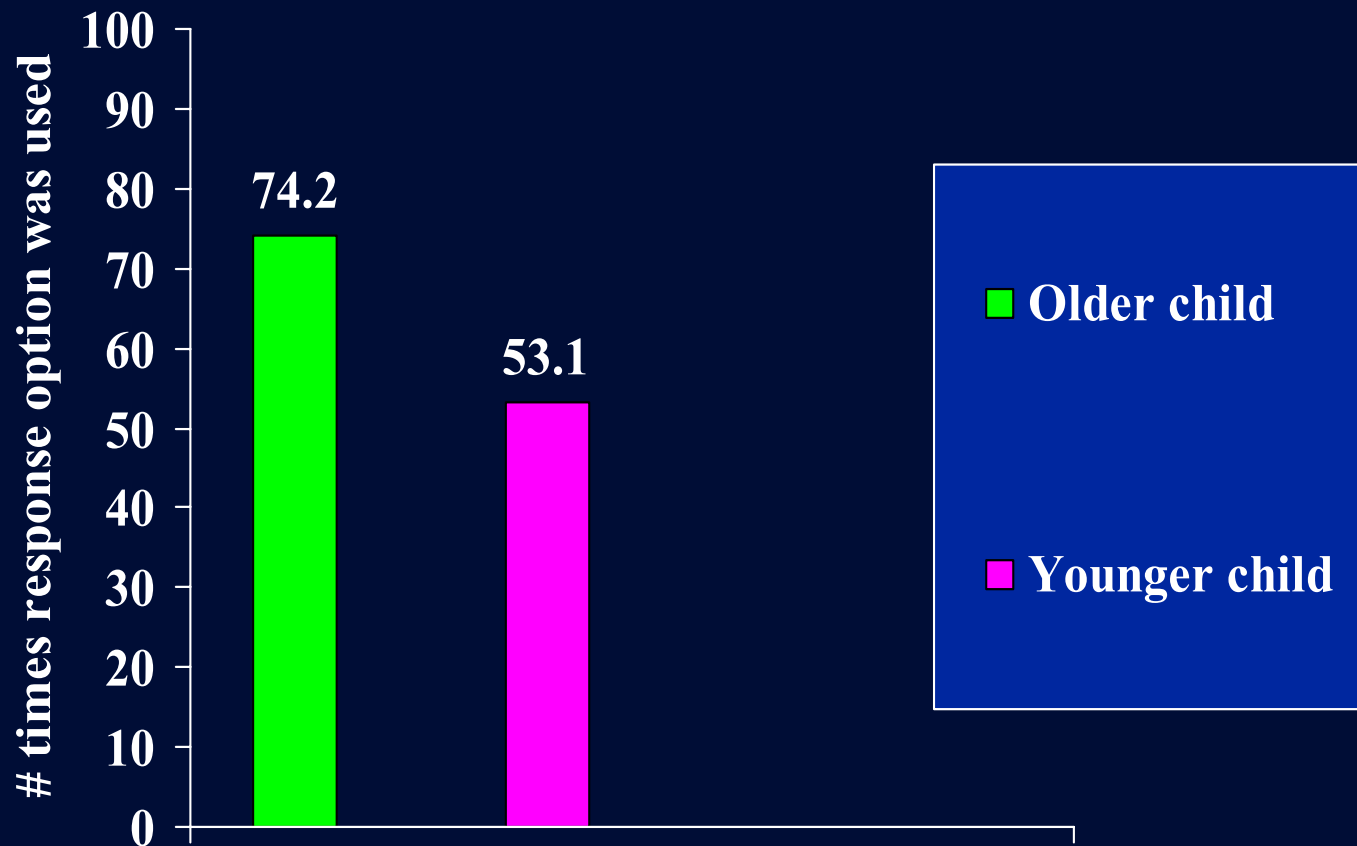
# Demographic characteristics of older child sample (n=29)

- 20 females, 9 males
- Mean age = 10.1 yrs (7 to 18 yrs)
- 27 congenital, 2 acquired
- 5 body-powered hook, 4 body-powered adept, 17 myoelectric, 3 passive
- Wearing pattern: 1 occasional, 18 majority of day, 10 all waking hours

# Demographic characteristics of younger child sample (n=12)

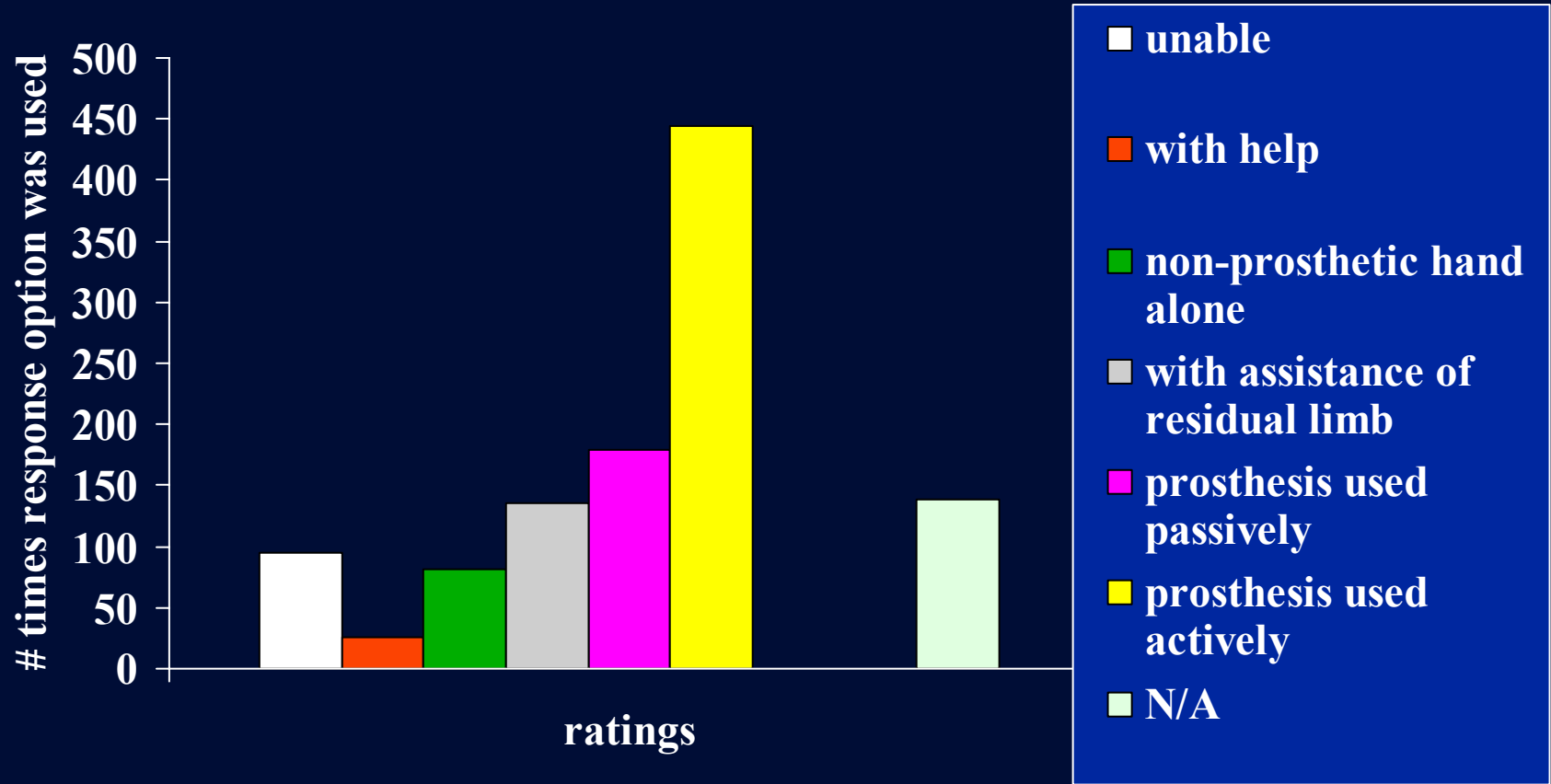
- 6 females, 6 males
- Mean age = 4.2 yrs (3.1 to 5.7 yrs)
- 10 congenital, 2 acquired
- 3 body-powered hook, 3 body-powered adept, 6 myoelectric
- Wearing pattern: 3 occasional, 2 regular part-day, 4 majority of day, 3 all waking hours

# PUFI Part I mean scores (%): Usefulness of the prosthesis



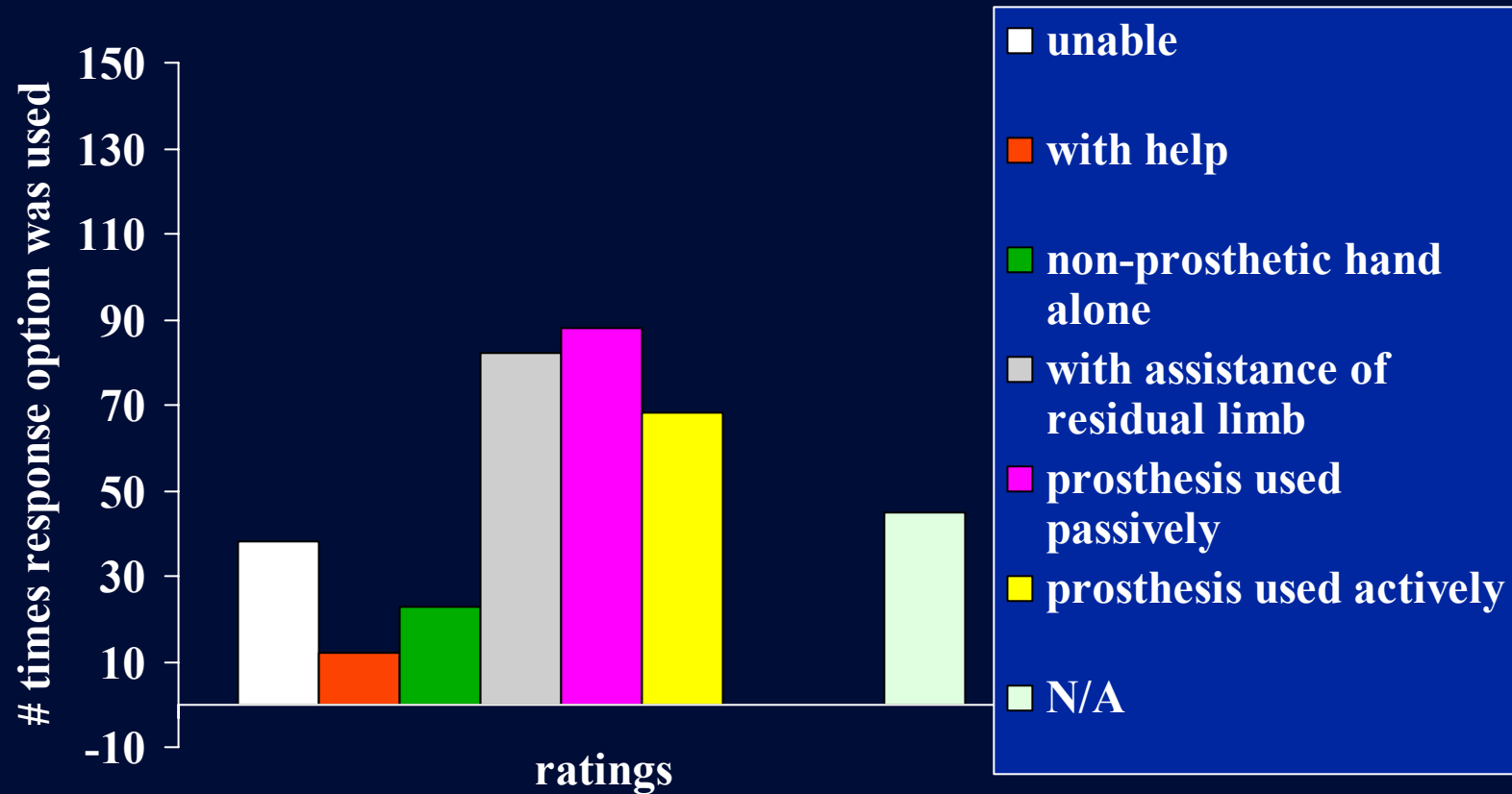
# Usual method of performance

Older child PUF1, 38 items, (n=29)



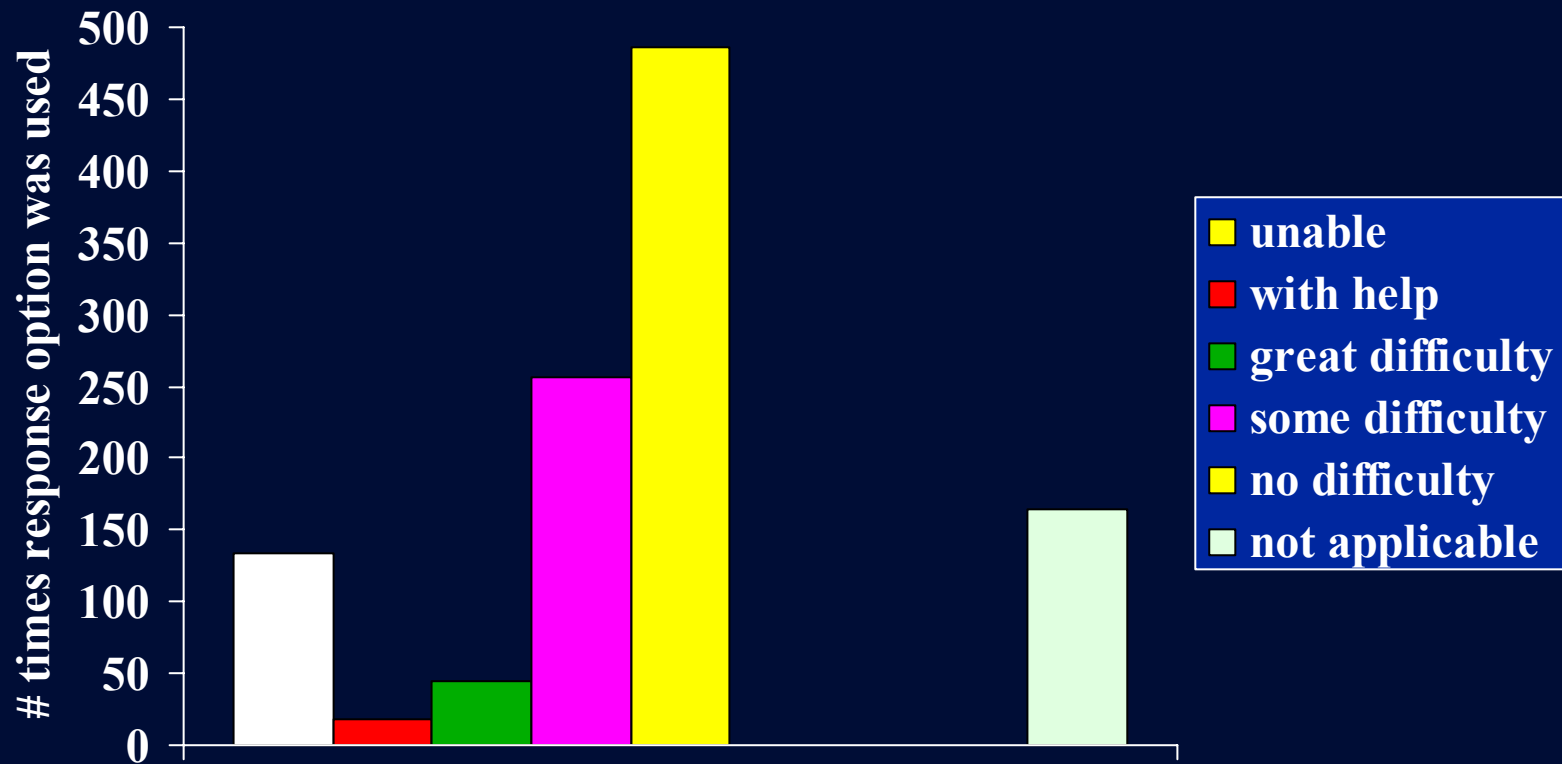
# Usual method of performance

Younger child PUFI, 26 items (n=12)



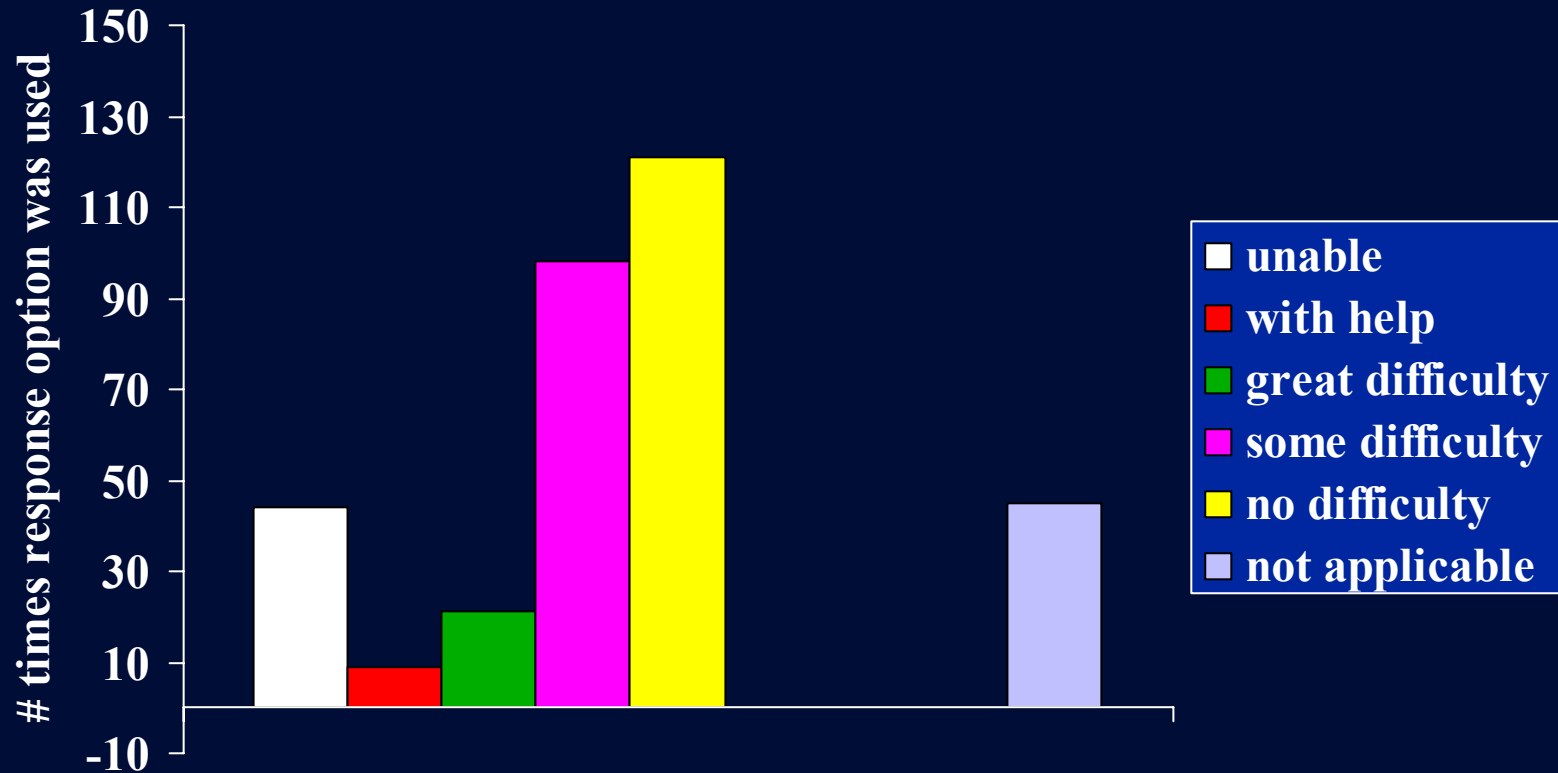
# Ability with the prosthesis

Older child PUFI, 38 items, (n=29)



# Ability with the prosthesis

Younger child PUF1, 26 items, (n=12)



# Ability with the prosthesis

Older child PUF1 (n=29)

## • MOST DIFFICULT ITEMS

- groom fingernails
- put on necklace
- play with Game Boy
- cut meat
- chop veggies
- hammer nail into board

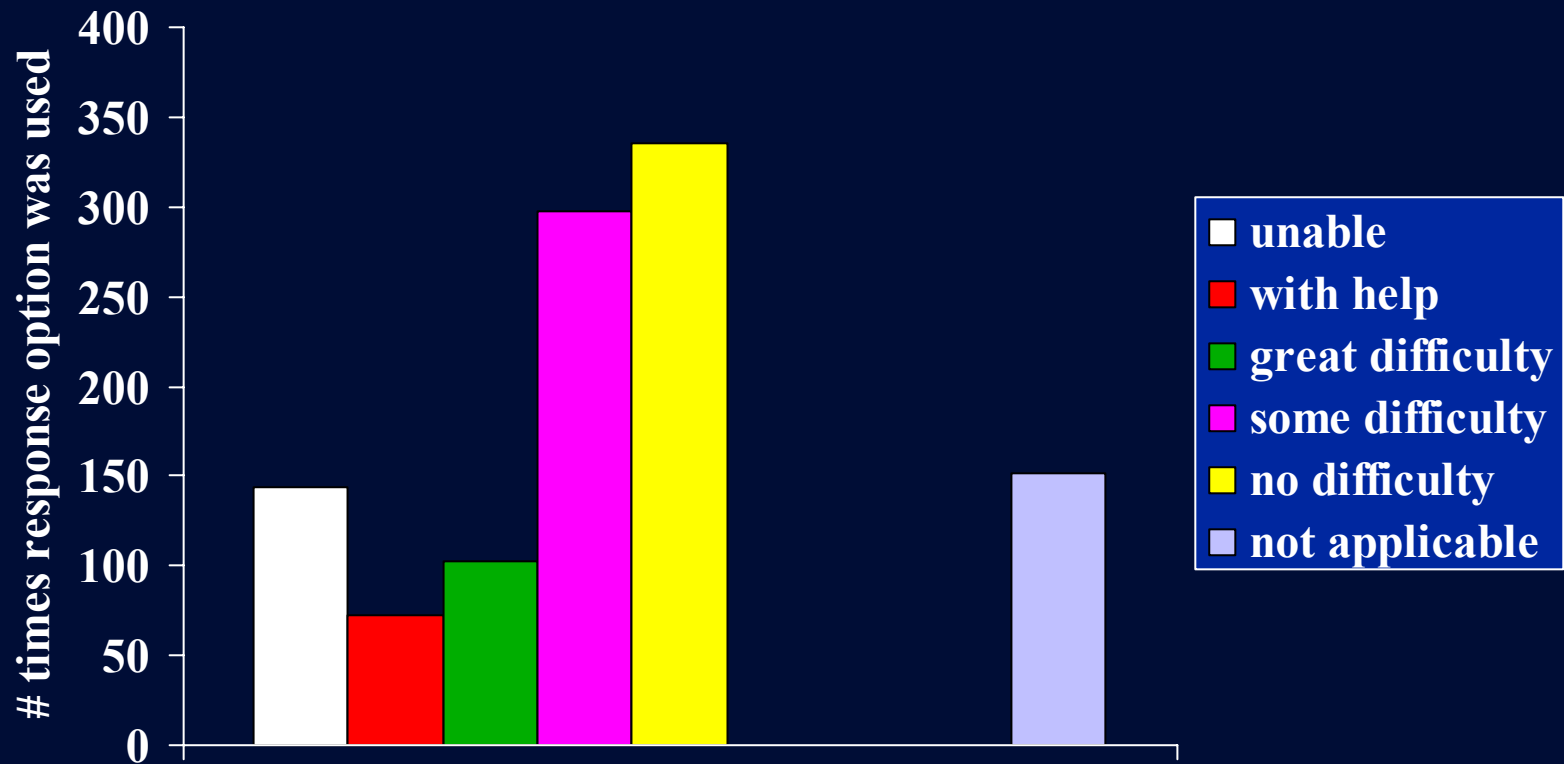
## • EASIEST ITEMS

- cut out picture
- take cap off marker
- open pencil case
- pull blocks apart
- unwrap cookies/sandwich
- remove a straw from juice box and insert



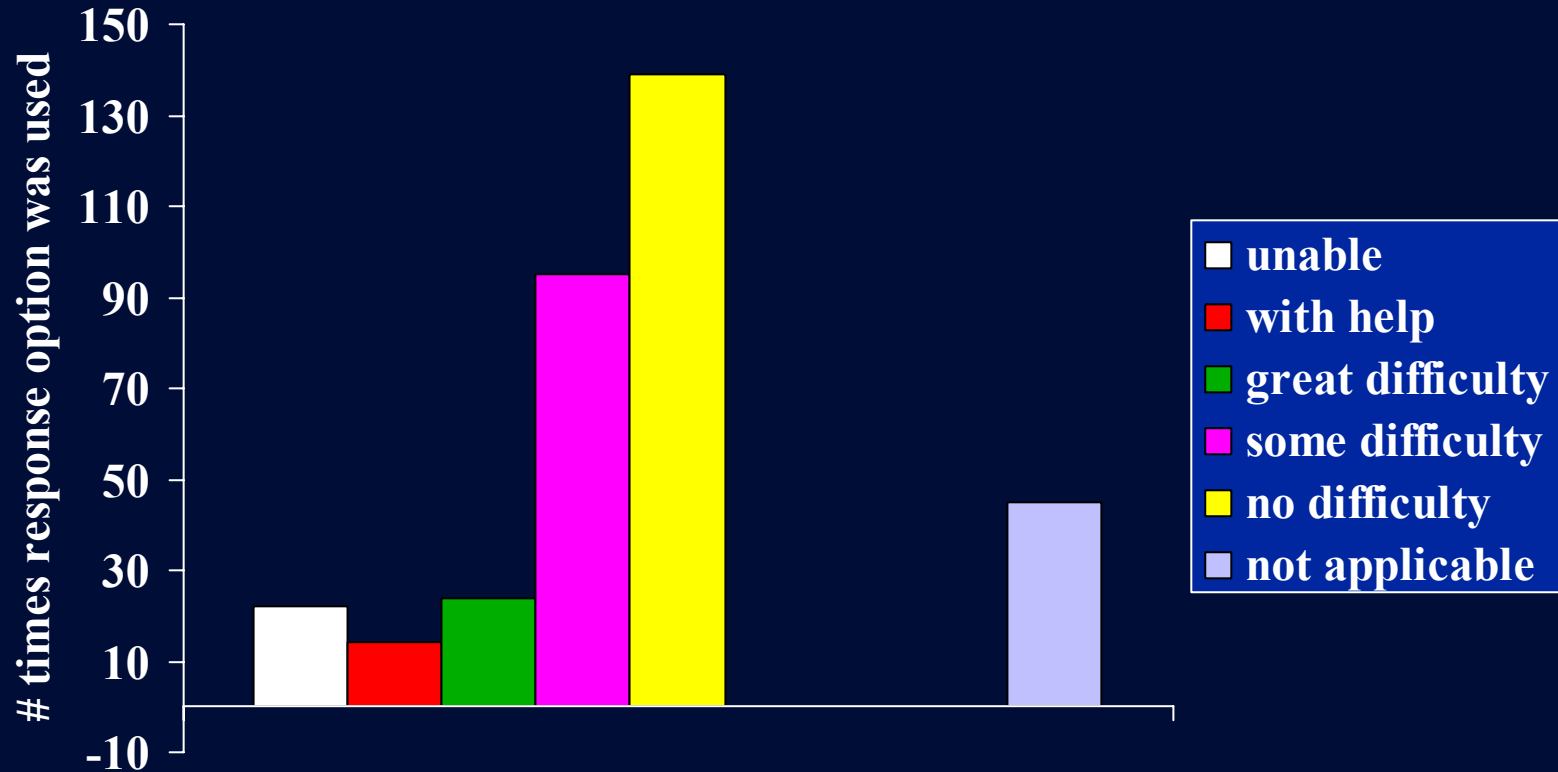
# Ability without the prosthesis

Older child PUF1, 38 items, (n=29)



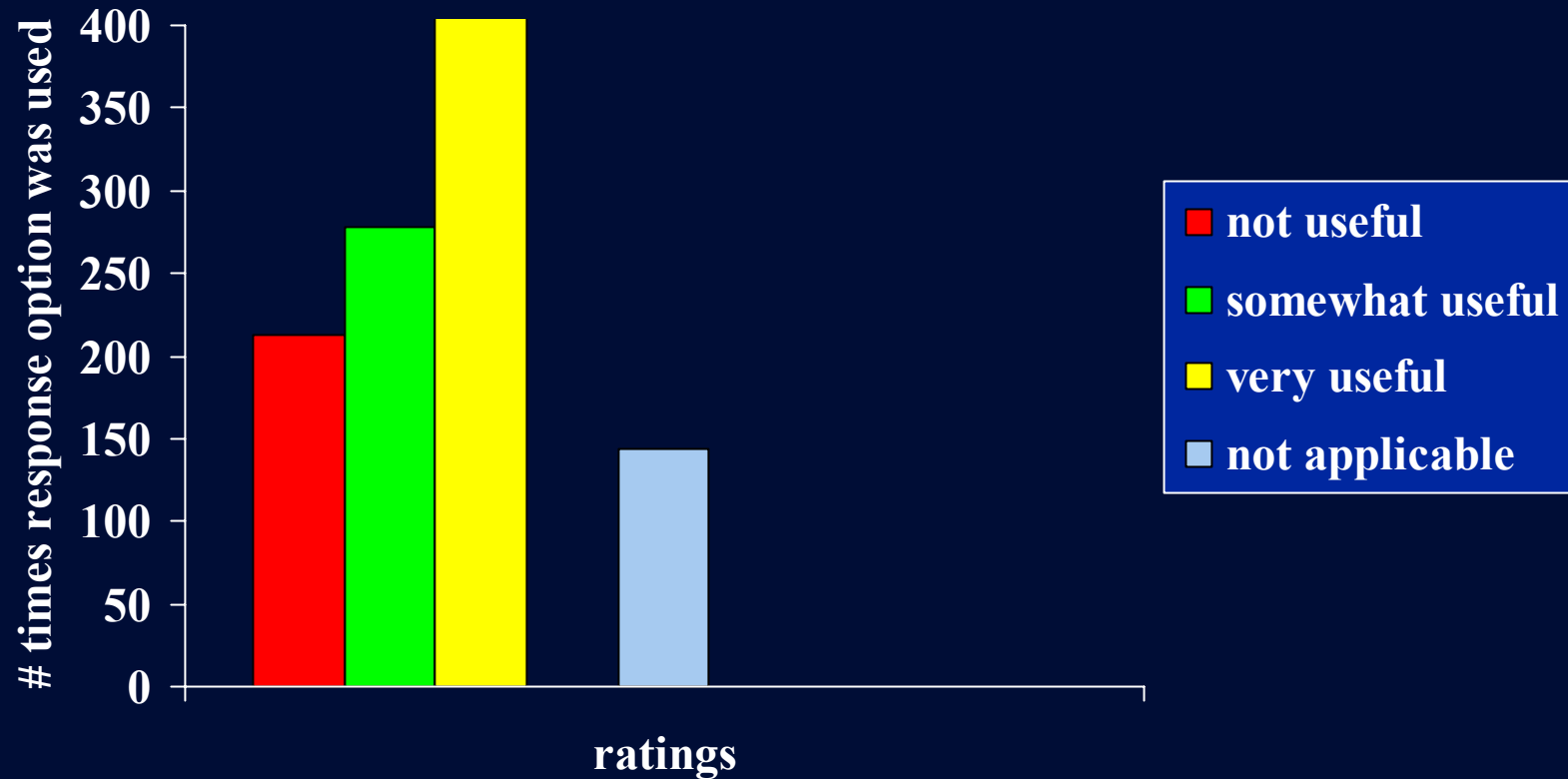
# Ability without the prosthesis

Younger child PUFI, 26 items, (n=12)



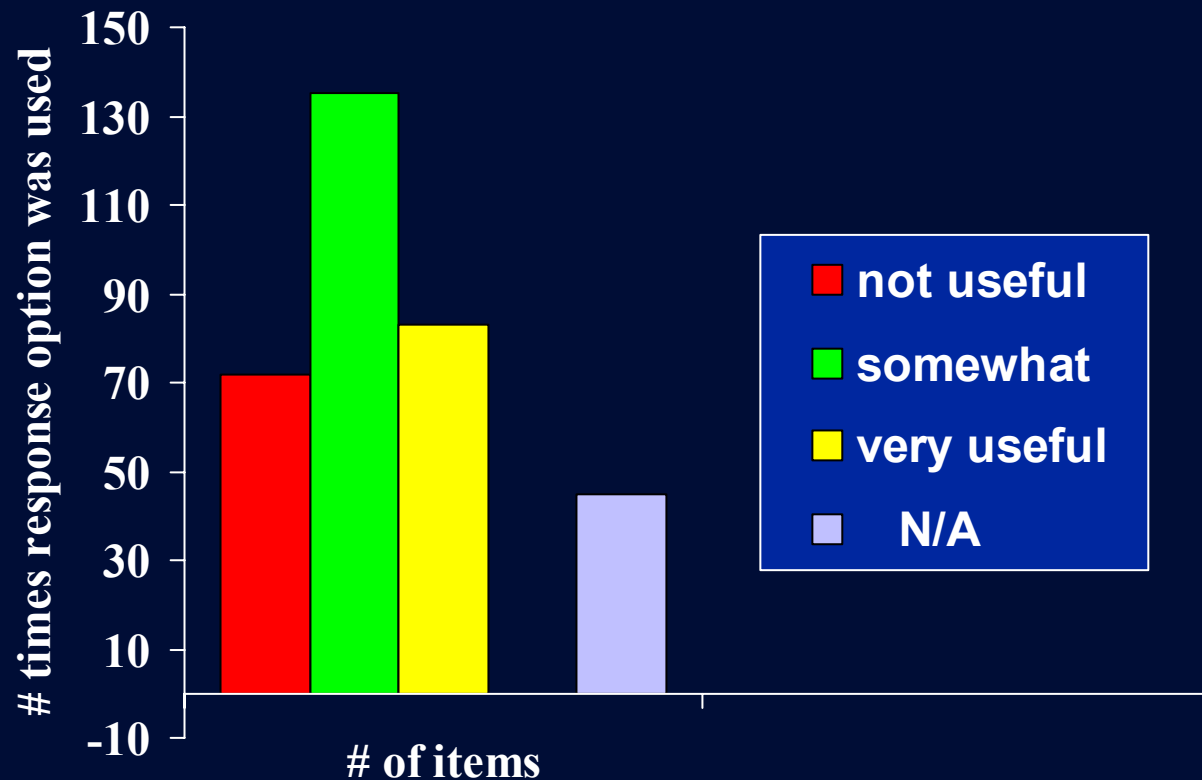
# Usefulness of the prosthesis

Older child PUF1, 38 items (n=29)



# Usefulness of the prosthesis

Younger child PUF1, 26 items (n=12)



# Agreement between parent-report of ability and therapist's observation of PUFIs items - total sample (n=33)

For 186 observation-item pairs:

- method of performance: **Kappa=0.54**
- ability with prosthesis: **K=0.59**
- usefulness of prosthesis: **K=0.46**
- ability without prosthesis: **K=0.55**

Tendency for higher ratings from therapist observation than from parent-report

# Correlations between PUFI and UNB-A

- PUFI usefulness of prosthesis and UNB-A (spontaneity)

Older child (n=29):  **$r = 0.16$**

Younger child (n=13):  **$r = 0.55$**

Total sample (n=42):  **$r = 0.44, P < 0.01$**

# Correlations between PUFI and UNB-B

- PUFI usefulness of prosthesis and UNB-B (performance)

Older child (n=29):  **$r = 0.57$**

Younger child (n=13):  **$r = 0.46$**

Total sample (n=42):  **$r = 0.63, P < 0.02$**

# Parents' Feedback About the PUFI

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- Completion of the PUFI made them think about use of the myoelectric prosthesis for everyday tasks
- Gave them ideas for increased use of the prosthesis and activities to practice
- Often requested a copy of videotape for use by local therapist or school staff
- Paper forms were long and tedious





# Study Conclusions

- Both older child and young child PUFIs were able to differentiate between children and abilities on different tasks
- Evidence that the ability to perform the activity was higher with the prosthesis than without
- Prostheses rated as “very useful” for about 50% of activities

- PUF1 mean scores for self-report and observation were quite high (perhaps due to volunteer sample, i.e., “good” prosthetic users)
- Indication of a pattern of highest skill for school activities and lowest for self-care activities
- Response patterns were logical within items (i.e., method of use, ability with prosthesis and usefulness of prosthesis fit together into logical picture)

- PUFI scores showed moderate levels of agreement with scores from observation of actual performance
- There was fair to good correlation between PUFI prosthetic ability and usefulness scores and UNB-skill of prosthetic use
- Sample is too small to make any conclusion about impact of type of prosthesis on function or about factors predictive of good use

# Future Directions

- Building of version 2.0 of PUFi software in progress
- Development of new versions with our partners:
  - i) teen/adult
  - ii) non-wearers
  - iii) children with hemiplegic cerebral palsy
- Refinements and validation testing with various language versions

# Future Directions

- Development of an international database for longitudinal tracking and evaluation of issues such as: developmental pattern of prosthetic use (young child through teen), factors predicting success with use , differences in abilities with different types of prostheses
- Rasch analysis of PUFIs with larger sample

# Our Partnerships

- “*Free-trade*” agreements which included free use of the PUFi and provision of clinic summary reports in exchange for data
- Development of PUFi-PC language versions in exchange for translation services.

# Our Partners

CANADA:

Institute of BioMedical Engineering at the University of  
New Brunswick, NB

Centre de readaptation Marie Enfant de L'hôpital Ste  
Justine, Montreal, PQ

Ottawa Children's Treatment Centre, Ottawa, ON

Children's Developmental Rehabilitation program,  
Hamilton, ON

Glenrose Rehabilitation Hospital, Edmonton ,AB



# Our Partners

USA:

Shriners Hospital for Children: funded research project evaluating outcomes of children with congenital below elbow deficiencies (James and Bagley) - includes Montreal Shriners

Children's Healthcare of Atlanta

# Our International Partners

## OVERSEAS:

The Children's Hospital at Westmead,  
Australia

West Midlands Rehabilitation Centre.  
Birmingham, UK

King's College Hospital, London, UK

Nottingham City Hospital, Nottingham, UK

# Our International Partners ...

## OVERSEAS:

Erasmus University Medical Centre,  
Rotterdam, Holland

Institut Republike Slovenije za  
rehabilitacijo, Ljubljana, Slovenia

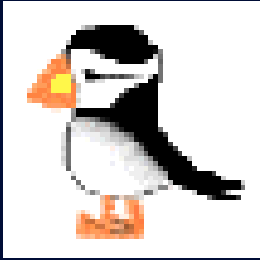
Orebro University Hospital, Orebro,  
Sweden

# Acknowledgements

- Funding from: Bloorview MacMillan Childrens Hospital Foundation, Bloorview MacMillan Children's Foundation, Ontario Ministry of Health and Long-Term Care (through the Ontario Rehabilitation Technology Consortium)
- The clients and their caregivers and family members
- Our international partners

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Merci!



# Older Child PUF1 Mean Scores

(n=29)

- Ease of performance with prosthesis:  
**72.3%** (sd = 23.7, min = 8.8, max = 98.4)
- Ease of performance without prosthesis  
**65.2%** (sd = 19.4, min = 17.7, max = 94.5)
- Usefulness of prosthesis  
**61.5%** (sd=23.7, min = 1.5, max = 93.2)

# Older Child PUF1 Mean Scores for Myoelectric users only (n=33 reliability and validity sample)

- Ease of performance with prosthesis:  
**72.6%** (sd = 23.8, min = 0.0, max = 98.4)
- Ease of performance without prosthesis  
**67.1%** (sd=19.9, min = 22.7, max = 95.0)
- Usefulness of prosthesis  
**57.4%** (sd = 24.8, min = 0.0, max= 93.7)



# Younger Child PUF1 Mean Scores (n=13)

- Ease of performance with prosthesis:  
**70.9%** (sd=24.2, min = 0.0, max= 95.0)
- Ease of performance without prosthesis  
**76.0%** (sd=21.4, min = 0.0, max=76.9)
- Usefulness of prosthesis  
**52.1%** (sd=15.4, min = 34.1, max=76.9)

# Younger Child PUF1 Mean Scores for Myoelectric users only (n=14, reliability and validity sample)

- Ease of performance with prosthesis:  
80.6 (sd=11.7, min = 57.1, max= 95.6)
- Ease of performance without prosthesis  
74.9 (sd=13.7, min = 46.6, max=95.8)

Usefulness of prosthesis

66.1 (sd=16.7, min = 34.1, max=93.4)

# PUFI Part II mean scores for ability to perform activities with and without Prosthesis

