



## Interactive Technologies for Older Adults and People with Disabilities: Projects in Nutrition and Multisensory Museums

Presentation to

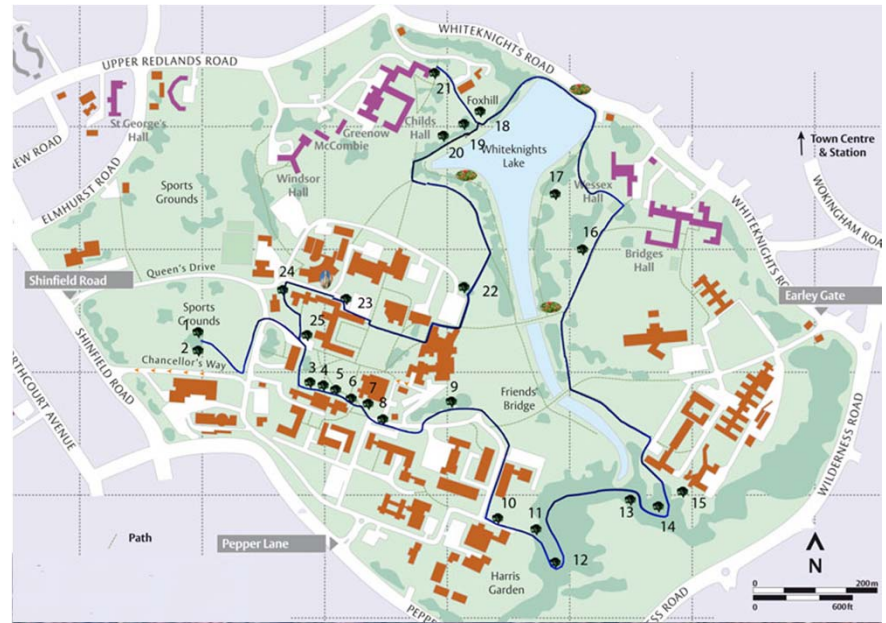
Phoenix Research Group, Inria Bordeaux Sud-Ouest, 23 June 2015

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# University of Reading



# School of Systems Engineering

Computer Science	Electronic Engineering	Cybernetics
Big Data	Energy harvesting	Control systems
Computer Vision	Wireless networks	Neuroscience
HCI	Smart grid	Infrared filters

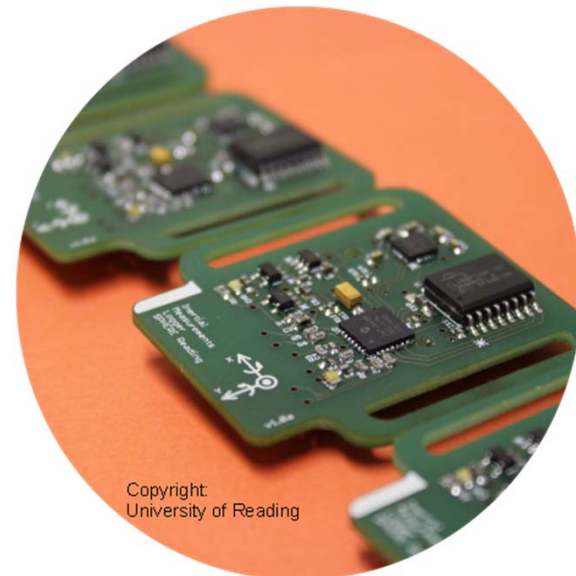
# SPHERE – A Sensor Platform for Healthcare in a Residential Environment

(Prof. William Harwin, [www.irc-sphere.ac.uk](http://www.irc-sphere.ac.uk))

“...employing data-fusion and pattern-recognition from a common platform of largely non-medical/environmental networked sensors in a **home environment.**”

In Reading:

- Low energy devices
- Sensor development
- Biomechanical modelling
- Data fusion



# Technology for older adults and people with disabilities

- Making “ordinary” technology easier to use
- Researching application areas for improved health, wellbeing, and/or independence

# Technology for older adults and people with disabilities

- **Making “ordinary” technology easier to use**
- Researching application areas for improved health, wellbeing, and/or independence

# The challenge with “ordinary” technology

Bjarne Stroustrup, creator and developer of the C++ programming language:

“I have always wished for my computer to be as easy to use as  
my telephone;

my wish has come true...

...because I can no longer figure out how to use my telephone.”



A framework to design for familiarity





Mid-air gestures for older adults



Making electronics accessible

# Technology for older adults and people with disabilities

- Making “ordinary” technology easier to use
- **Researching application areas for improved health, wellbeing, and/or independence**



Technology to address malnutrition in older adults



Using technology to promote physical activity  
in sedentary older adults



Tools to support prototyping of sensory substitution and sensory augmentation interfaces

## Two projects



NANA: Novel Assessment of Nutrition and Ageing



Interactive Sensory Objects for Enhancing Access  
in Museums for People with Learning Disabilities

# NANA: Novel Assessment of Nutrition and Ageing



A touchscreen-based system designed **for older adults to use at home** for assessing: dietary intake, physical function, mental health and cognitive function.



## Multidisciplinary research team

- Psychology  
Arlene Astell, University of St. Andrews
- Human Nutrition  
Liz Williams, University of Sheffield
- Human Computer Interaction  
Faustina Hwang, University of Reading
- Mechanical Engineering  
Tim Adlam, Designability

# Motivation

“Malnutrition is a significant, and neglected, public health problem. It affects over 10% of people over the age of 65.”

A significant proportion of this happens in the community.

European Nutrition for Health Alliance. 2006. Malnutrition among Older People in the Community: Policy Recommendations for Change ([http://www.european-nutrition.org/index.php/publications/details/malnutrition\\_among\\_older\\_people\\_in\\_the\\_community](http://www.european-nutrition.org/index.php/publications/details/malnutrition_among_older_people_in_the_community), last accessed 26 Nov 2014)

# Motivation

Challenge #1:

There is not currently a good way to screen for malnutrition routinely.

Regular monitoring of food intake could enable detection of changes, facilitate early intervention and prevent decline.

# Motivation

## Challenge #2:

Malnutrition is complex and the relationships between food intake, cognition, mental health and physical function are not well understood.

Integrated and extended assessment of these different domains could lead to a better understanding of malnutrition.

## Key objectives of NANA

To develop a tool that can conduct integrated and extended assessment of multiple domains, that overcomes some of the issues with traditional assessment methods.

To validate the system against current gold-standard methods.

# Challenges with current methods

## Dietary intake assessment example

### Food diary

(USE AS MANY PAGES AS YOU NEED)

Time	Food and Drink Include Brand Name (if applicable), Flavour and Packet Weight Enter each food item on a new line	Cooking Method Eg fried, grilled, poached etc.	Estimated Portion Eg cup, slice, portion of family meal or portion photo code
7:0	tea 112		
9:0	coffee		
9:0	tea Toast		
10:0	coffee		
11:0	orange Juice		
12:15	meat sandwich Tea		
3:0	Tea		
4:0	Banana		
5:0	Apple pie Tea		
6:30	coffee		
6:45	meat sandwich Tea		
7:30	Tea		

Have you taken any supplements or non prescribed medication eg Vitamin tablets, paracetamol etc. Please specify.

### Analysis



## Challenges with current methods

- Resource intensive
- Burdensome for the participant
- Trade-off in terms of participant burden and scalability vs. quality of the data
- Some (e.g. cognitive assessments) are intended to provide a snapshot of function

## NANA – a tool that would...



... be easy for older adults to use by themselves at home

...facilitate regular and frequent assessment in order to detect changes early

...provide high-quality data without high participant burden



# The NANA System

Touchscreen  
desktop all-in-one

Webcam

NANA software  
(launch on start up)

Mic for  
voice  
recordings



Digital hand  
dynamometer

# Software

Touch the screen to start



nana

## Select meal

Select your meal:


Breakfast

Lunch

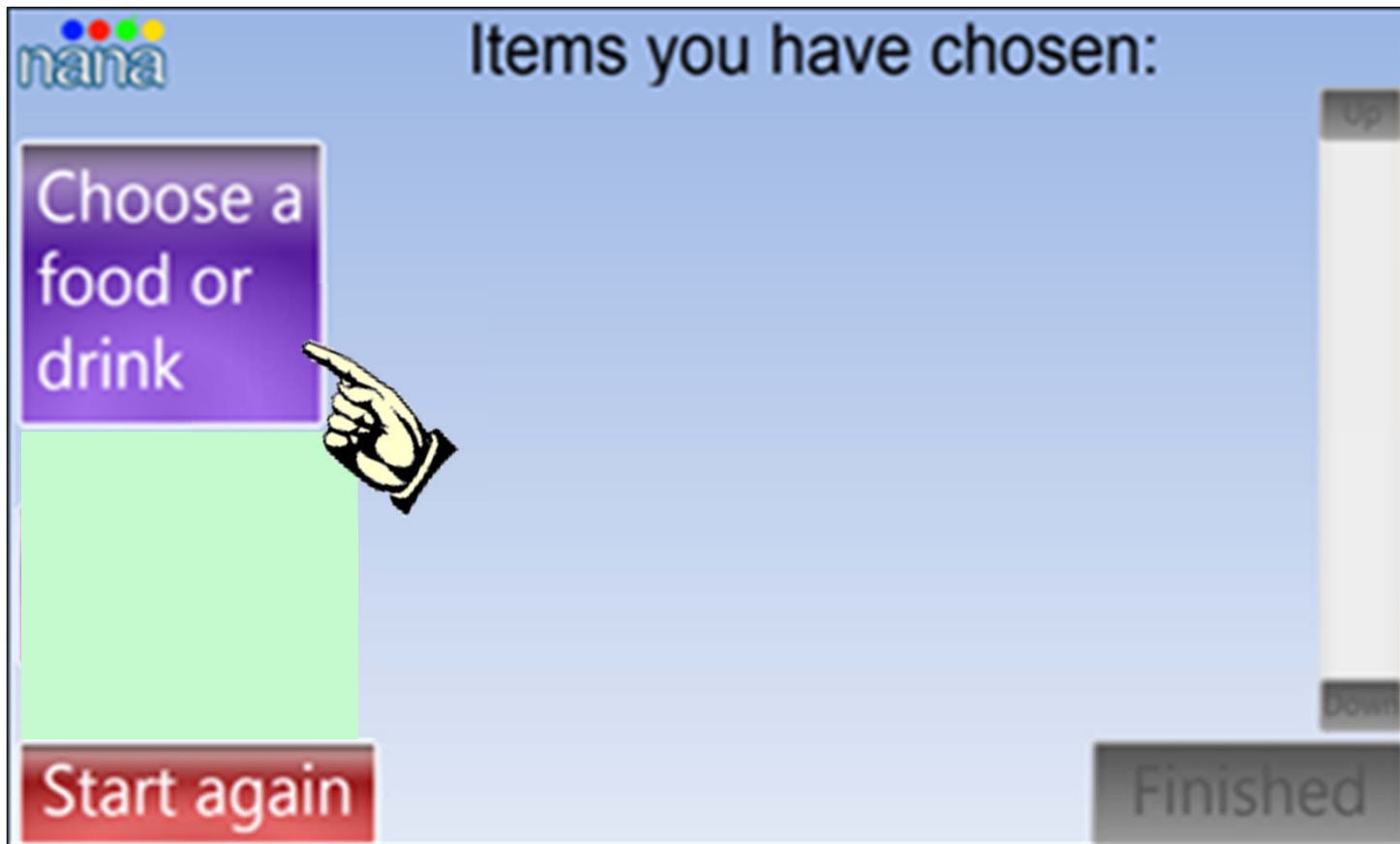
Dinner/Tea

Snacks & Drinks

Out of Home or Forgotten



# Select choose a food or drink



# Select food/ drink category
















<p>Drinks</p> 	<p>Bread, cereal, pasta, rice</p> 	<p>Dairy</p> 	<p>Meat, poultry &amp; eggs</p> 	<p>Fish and seafood</p> 	<p>Convenience, sandwiches, fast food</p> 
<p>Fruit</p> 	<p>Vegetables</p> 	<p>Desserts, cakes &amp; biscuits</p> 	<p>Sweets &amp; chocolate</p> 	<p>Savoury snacks, crisps &amp; nuts</p> 	<p>Sauces, spreads, condiments &amp; other</p> 



[Cancel this item](#)

# Select food/ drink item

 Back

<p>Apples</p> 	<p>Banana</p> 	<p>Citrus</p> 	<p>Grapes (red &amp; white)</p> 	<p>Juices</p> 	<p>Pears</p> 
<p>Tomatoes</p> 	<p>Dried</p> 	<p>Berries &amp; Currants</p> 	<p>Canned</p> 	<p>Fruit salad, homemade</p> 	<p>Other</p> 

Item not found Cancel this item

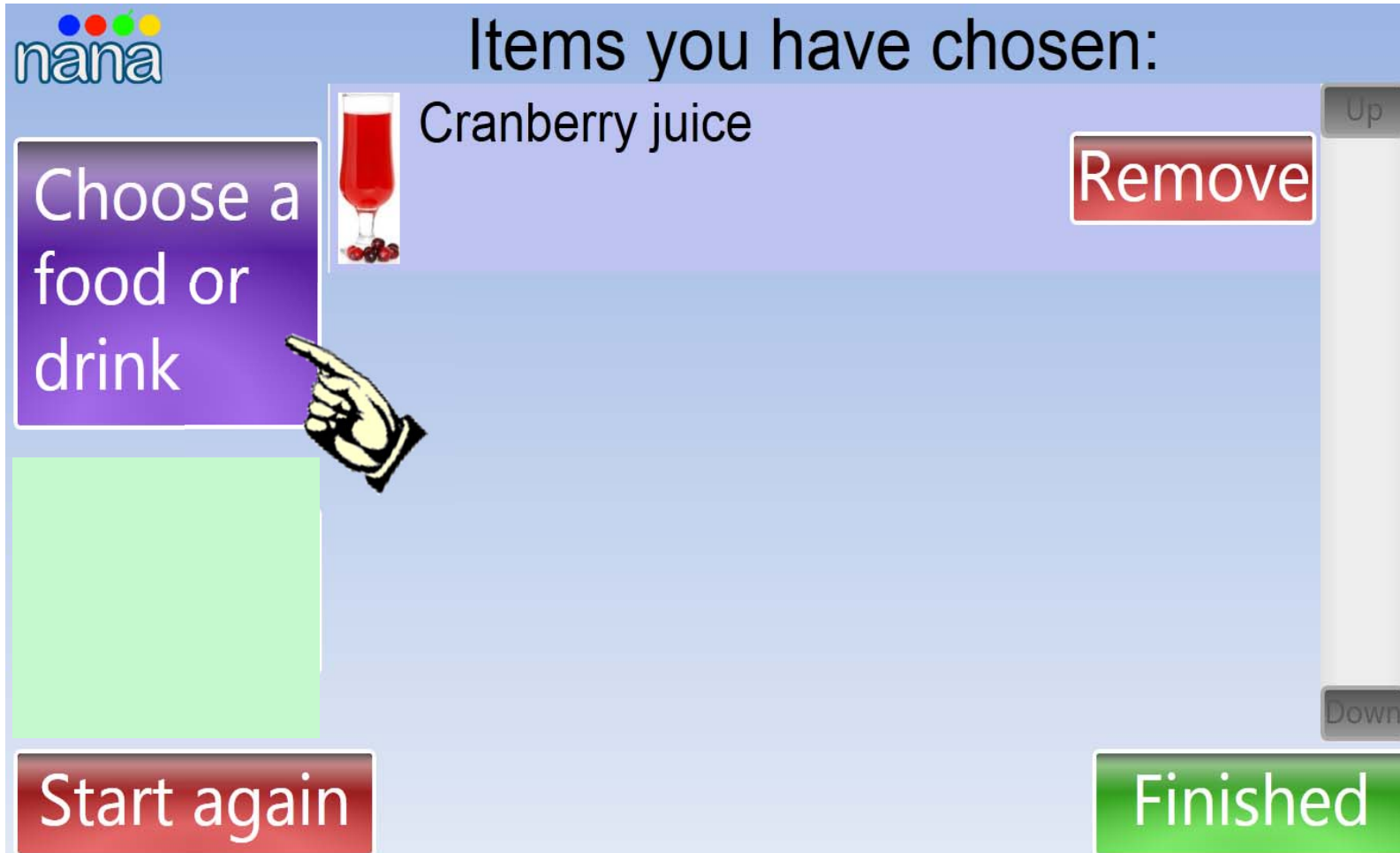
# Cranberry juice

 Back

<p>Orange juice, freshly squeezed</p> 	<p>Orange juice, standard</p> 	<p>Apple juice</p> 	<p>Cranberry juice</p> 	<p>Pineapple juice</p> 	<p>Pomegranate juice</p> 
<p>Grapefruit juice</p> 	<p>Prune juice</p> 	<p>Grape juice</p> 			

Item not found Cancel this item

## Add another item



The screenshot shows a user interface for a shopping list application. At the top left is the 'nana' logo. The main title is 'Items you have chosen:'. Below this, a list item 'Cranberry juice' is displayed with a small image of a glass of red juice and a hand icon pointing to it. To the right of the list item is a red 'Remove' button. On the far right, there is a vertical scrollbar with 'Up' and 'Down' buttons. At the bottom left is a red 'Start again' button, and at the bottom right is a green 'Finished' button. A purple box on the left contains the text 'Choose a food or drink' and a green box is positioned below it.

nana

Items you have chosen:

Cranberry juice

Remove

Up

Down

Choose a food or drink

Start again

Finished



# Select another category










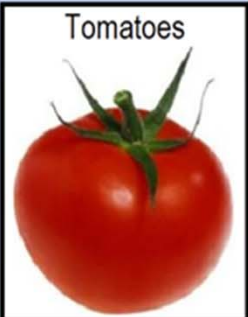





<p>Drinks</p> 	<p>Bread, cereal, pasta, rice</p> 	<p>Dairy</p> 	<p>Meat, poultry &amp; eggs</p> 	<p>Fish and seafood</p> 	<p>Convenience, sandwiches, fast food</p> 
<p>Fruit</p> 	<p>Vegetables</p> 	<p>Desserts, cakes &amp; biscuits</p> 	<p>Sweets &amp; chocolate</p> 	<p>Savoury snacks, crisps &amp; nuts</p> 	<p>Sauces, spreads, condiments &amp; other</p> 



Cancel this item

# Select another food/ drink item

 Back

Apples 	Banana 	Citrus 	Grapes (red & white) 	Juices 	Pears 
Tomatoes 	Dried 	Berries & Currants 	Canned 	Fruit salad, homemade 	Other 

Item not found Cancel this item

# Selected items



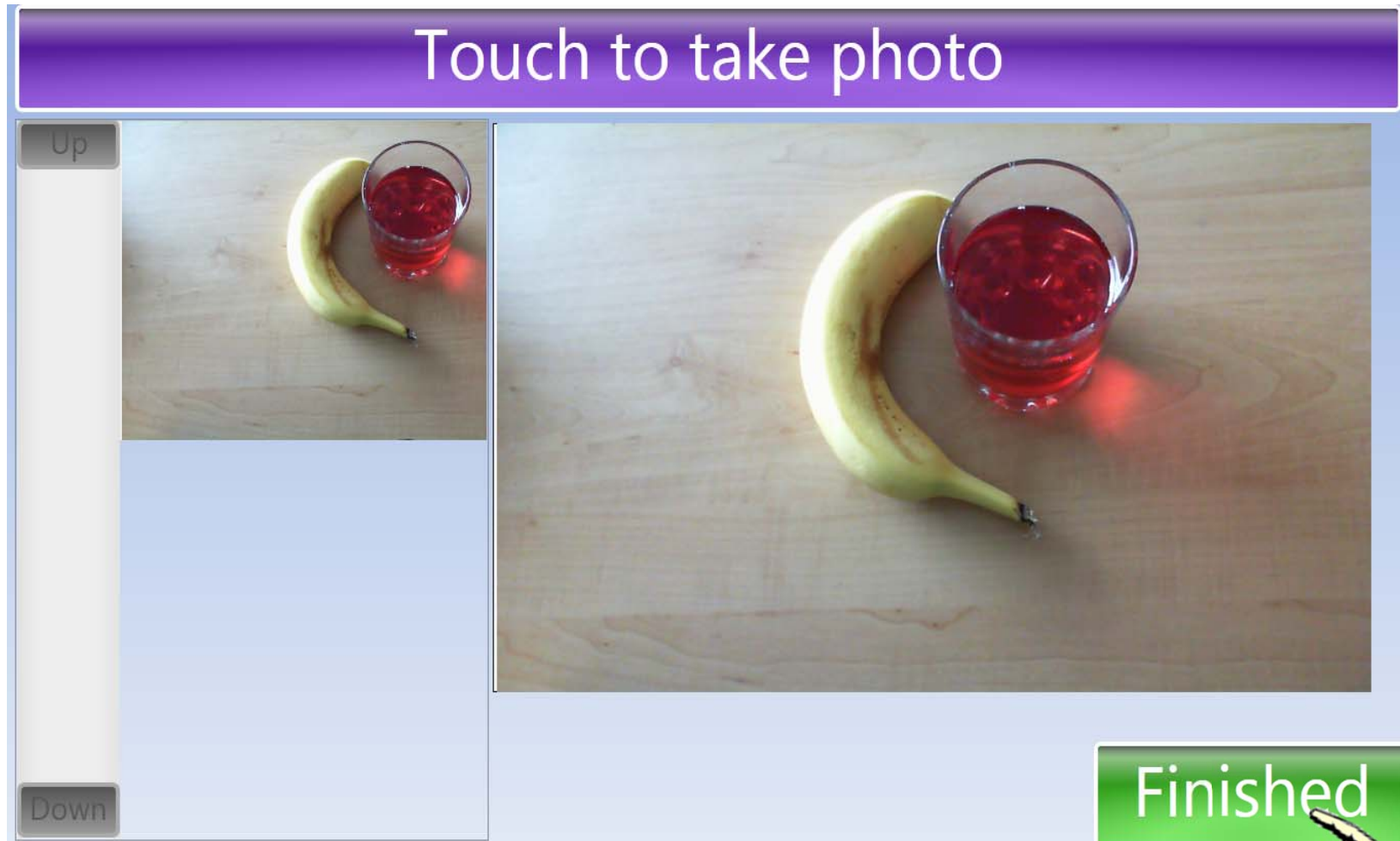
The screenshot shows a user interface for 'nana' with the following elements:

- Logo:** 'nana' with four colored dots (blue, red, green, yellow) above the letters.
- Section Header:** 'Items you have chosen:'
- Item 1:** 'Cranberry juice' with a glass of red juice icon, a 'Remove' button, and an 'Up' arrow.
- Item 2:** 'Banana' with a banana icon, a 'Remove' button, and a 'Down' arrow.
- Navigation Buttons:** 'Choose a food or drink' (purple), 'Favourites' (purple), 'Start again' (red), and 'Finished' (green).
- Interaction:** A hand icon is pointing at the 'Finished' button.

# Take a photograph



# Take more photos if required



# Enjoy your meal



Enjoy your meal! After you have finished eating, answer the following.

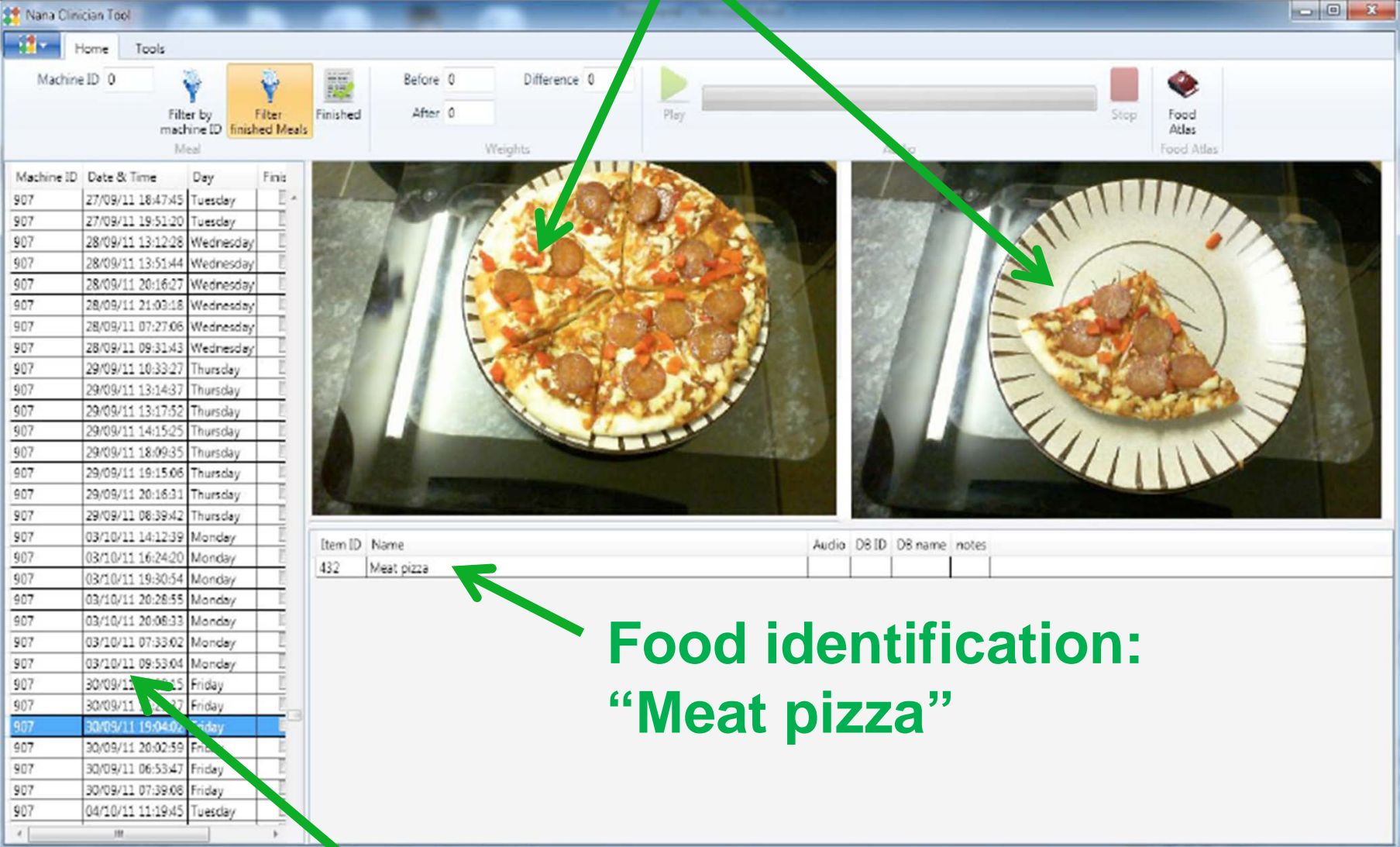
Have you eaten all the food in your meal, or do you have leftovers?

I have leftover food

I ate everything



# Portion size



The screenshot displays the Nana Clinician Tool interface. At the top, there are controls for Machine ID (0), filters for meals, and a play button. Below this is a table of meal entries. To the right of the table are two images: a whole pizza and a single slice on a plate. Below the images is a table for food identification.

Machine ID	Date & Time	Day	Finish
907	27/09/11 18:47:45	Tuesday	
907	27/09/11 19:51:20	Tuesday	
907	28/09/11 13:12:28	Wednesday	
907	28/09/11 13:51:44	Wednesday	
907	28/09/11 20:16:27	Wednesday	
907	28/09/11 21:09:18	Wednesday	
907	28/09/11 07:27:06	Wednesday	
907	28/09/11 09:31:43	Wednesday	
907	29/09/11 10:33:27	Thursday	
907	29/09/11 13:14:37	Thursday	
907	29/09/11 13:17:52	Thursday	
907	29/09/11 14:15:25	Thursday	
907	29/09/11 18:09:35	Thursday	
907	29/09/11 19:15:06	Thursday	
907	29/09/11 20:16:31	Thursday	
907	29/09/11 08:39:42	Thursday	
907	03/10/11 14:12:39	Monday	
907	03/10/11 16:24:20	Monday	
907	03/10/11 19:30:54	Monday	
907	03/10/11 20:28:55	Monday	
907	03/10/11 20:06:33	Monday	
907	03/10/11 07:33:02	Monday	
907	03/10/11 09:53:04	Monday	
907	30/09/11 19:02:55	Friday	
907	30/09/11 19:02:55	Friday	
907	30/09/11 19:04:02	Friday	
907	30/09/11 20:02:59	Friday	
907	30/09/11 06:53:47	Friday	
907	30/09/11 07:39:08	Friday	
907	04/10/11 11:19:45	Tuesday	

Item ID	Name	Audio	D8 ID	D8 name	notes
432	Meat pizza				

Food identification:  
"Meat pizza"

One entry for every meal

## Non-diet assessments

Touch the screen to start

There are readings or exercises  
overdue. Do you want to do them  
now?

Yes

No



9



9



nana



## Non-diet assessments

Administered by the system according to a set schedule:

- Novel cognitive assessment tasks
- Mood and appetite questions
- Physical activity questions
- Self-administered grip strength measurement



## Three deployments

- 1<sup>st</sup> validation – diet only (40 older adults)
- 2<sup>nd</sup> validation – diet & cognition (20 older adults)
- 3<sup>rd</sup> validation – diet, cognition, mood & physical function (40 older adults)

## 3<sup>rd</sup> validation

- 40 older adults (16 men), 65 - 89 years of age (mean 72.39)
- living independently in the community
- 20 from Sheffield, 20 from St. Andrews
- Deployed **in the home** for 3 one-week periods over 3 months
- Comparison of the NANA system against traditional methods for dietary intake, cognition, mood, and grip strength
- Analysis was done off-line

**OPEN ACCESS:** A.J. Astell, F. Hwang, L.J.E. Brown, C. Timon, L.M. Maclean, T. Smith, T. Adlam, H. Khadra, E.A. Williams, Validation of the NANA (Novel Assessment of Nutrition and Ageing) touch screen system for use at home by older adults, *Experimental Gerontology*, Volume 60, December 2014, Pages 100-107, ISSN 0531-5565, <http://dx.doi.org/10.1016/j.exger.2014.10.008>.







# Example

- 79 year old female

# Morning





# Morning



## Mid-day/afternoon



## Mid-Day/afternoon



# Afternoon



# Evening



## Example

- BMI= 21
- **Average intake/day**
- Energy: 6617kJ (1580calories)
- Fat: 81g
- Protein: 61g
- Carbohydrate: 161g
- Alcohol: 0g
- Vitamin C: 74mg

## Example

- MMSE 22/30
- Weekly average response speed to mood questions = 14.43 secs
- Group average = 10.61
- Weekly average response speed to cognitive questions = 5.26 secs
- Group average = 3.35 secs

## Example

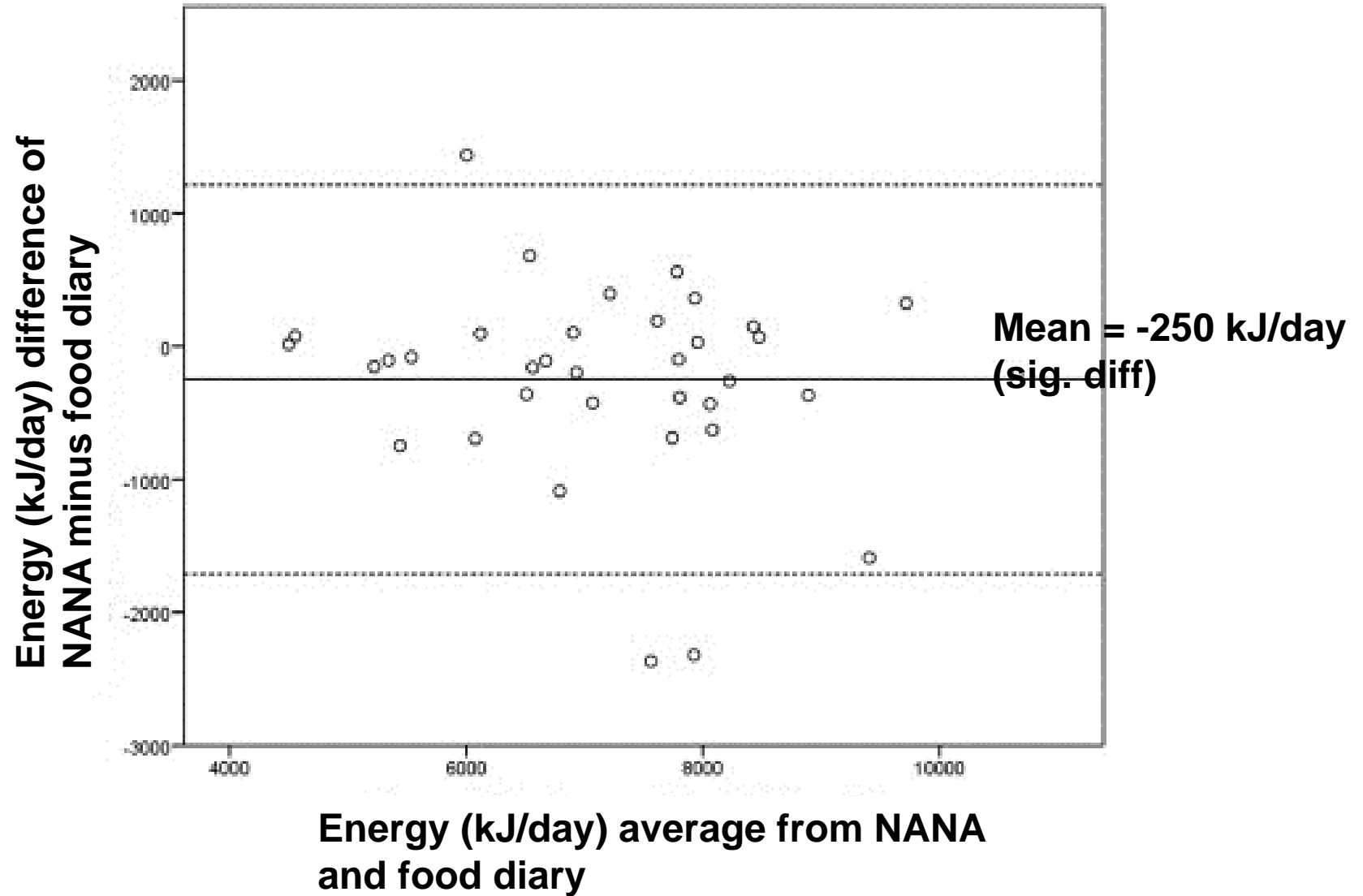
- Total expended kilocalories = 373
- Total expended activity hours per week = 2.8
- Exhaustion = yes
- Walking speed 15m = 6.74s; within norms = yes
- Grip strength = 11.2; within norms = no
- Frailty risk = yes





of  
69

# Results – Energy (kJ/day)



**OPEN ACCESS:** A.J. Astell, F. Hwang, L.J.E. Brown, C. Timon, L.M. Maclean, T. Smith, T. Adlam, H. Khadra, E.A. Williams, Validation of the NANA (Novel Assessment of Nutrition and Ageing) touch screen system for use at home by older adults, *Experimental Gerontology*, Volume 60, December 2014, Pages 100-107, ISSN 0531-5565,

## Discussion

Proof-of-principle established:

- Usable by and acceptable to older adults
- Allows for regular assessment via computer
- Good validity

Ongoing work:

- Diversity of user groups
- Automate the analysis
- Opportunities to provide treatment and intervention



# Acknowledgements



All Participants

Funders

The NANA team

Laura Brown

Tom Smith

Rebecca Rowland-Jones

Sarah Forster

Claire Timon

Lin Maclean

Daynor Spurr

Hassane Khadra

Simon Halsey

Alan Godfrey

Bridey Monger

NANA Advisory Panel





## Interactive Sensory Objects for Enhancing Access in Museums for People with Learning Disabilities



# Interactive sensory objects developed for and by people with learning disabilities

Kate Allen, Nic Hollinworth, Faustina Hwang  
Gosia Kwiatkowska, Andy Minnion

[www.sensoryobjects.com](http://www.sensoryobjects.com) & [extrasensoryobjects.wordpress.com](http://extrasensoryobjects.wordpress.com)

## Aim

- To improve access to museum and heritage collections for people with learning disabilities through hands-on, multisensory experiences

## A multidisciplinary team

- Sculptural arts
- Human-computer interaction
- Multimedia advocacy
- People with learning disabilities
- Museums and heritage sites

# Three-years, three sites (2012-2015)

Year 1: Speke Hall (National Trust) with the Access to Heritage Forum (Mencap Liverpool)





## Three-years, three sites (2012-2015)

Year 2: Museum of English Rural Life (University of Reading) with Reading College LLD/D\* programme and Mencap Reading



*\*LLD/D – Learners with Learning Disabilities and/or Difficulties*

## Three-years, three sites (2012-2015)

Year 3: British Museum Enlightenment Gallery with  
the Tower Group from East London



# Workshops

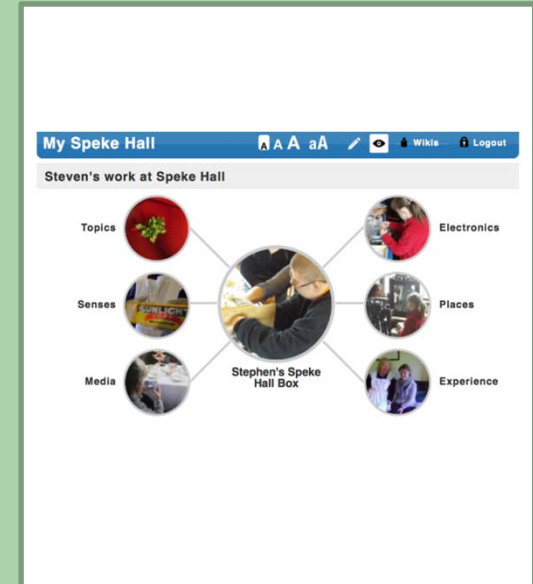
Central to the project is a series of workshops engaging people with LD as co-researchers



Multisensory  
expeditions



Making interactive  
artwork



Reflecting and sharing

# Workshops - Multisensory Expeditions

Designing activities for engaging with the site through the senses



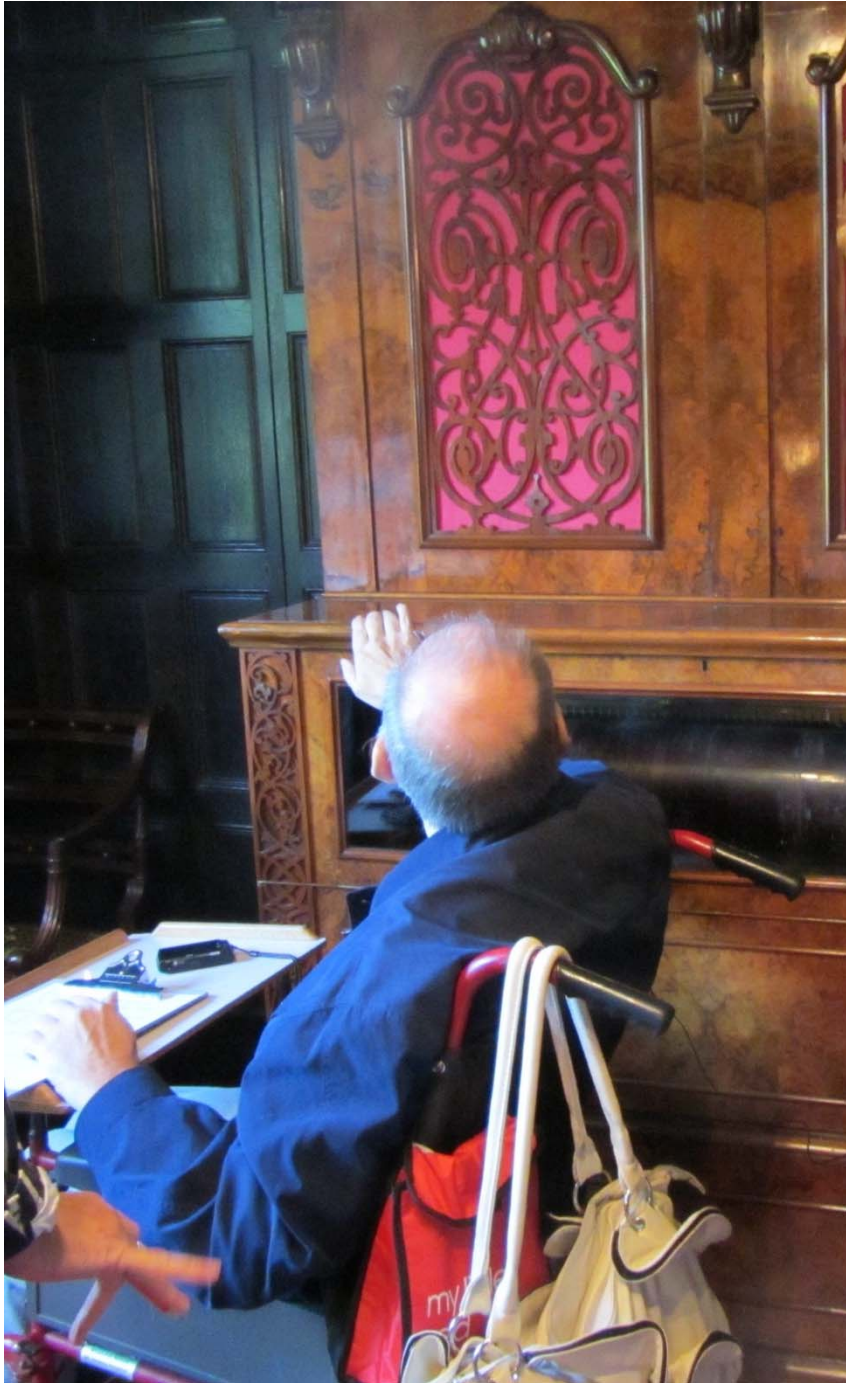






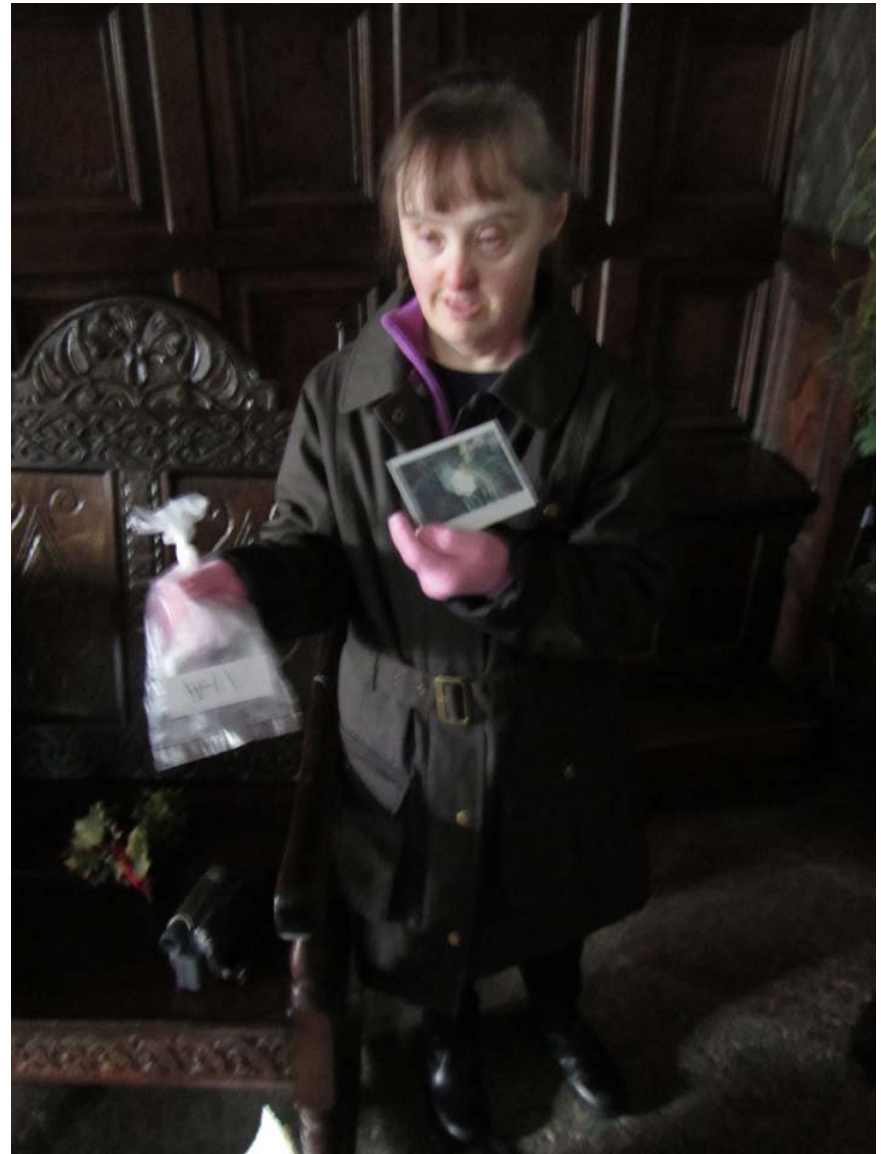








# WORKSHOP Collecting the smells of Speke Hall















### Local ingredients

How much of your food is grown locally?

Today food can be frozen and flown around the world. This means that it is still fresh when it gets to you. But it hasn't got over long distances. People don't buy things they are what they eat. They buy what they can produce locally. This means that they can get the best quality ingredients for their food.

### Food, glorious food!

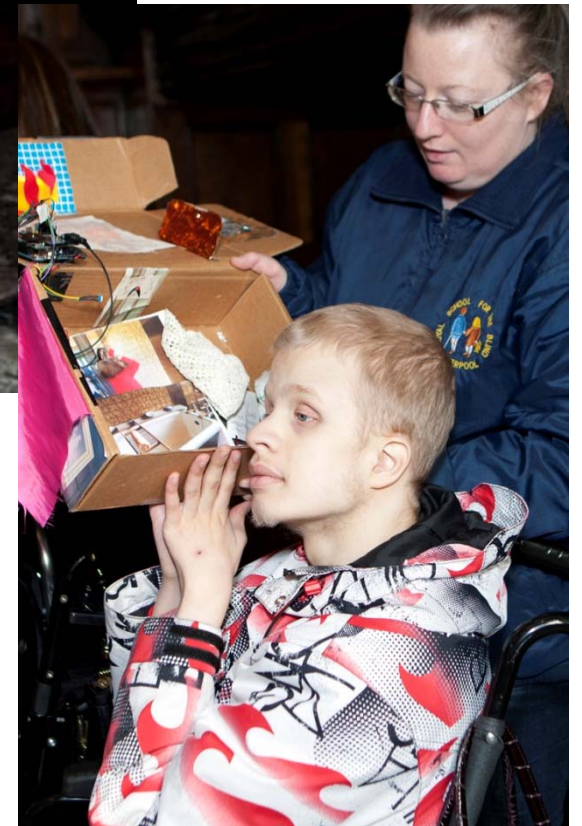
What went into your last meal?

Did you bake or cook it in the oven? Did you buy the ingredients and mix them yourself? Did you grow the vegetables, rear the animals and grind the flour for the bread? Food is a basic human need. Knowing how to grow, preserve and cook your own food was once a matter of survival. Today these food skills are less about survival than about lifestyle choice. Supermarkets, with their wide range of ready meals and processed foods, together with a culture of eating out and buying takeaway, have reduced our reliance on the traditional food skills that previous generations took for granted.

This exhibition is all about food in the home. Using the Museum's historical objects and archive material it looks at the ingredients, food skills and equipment that were once a part of everyday domestic life in the countryside.

# Workshops - Making interactive artwork

Create an interactive artwork that represents your own personal creative interpretation of the site









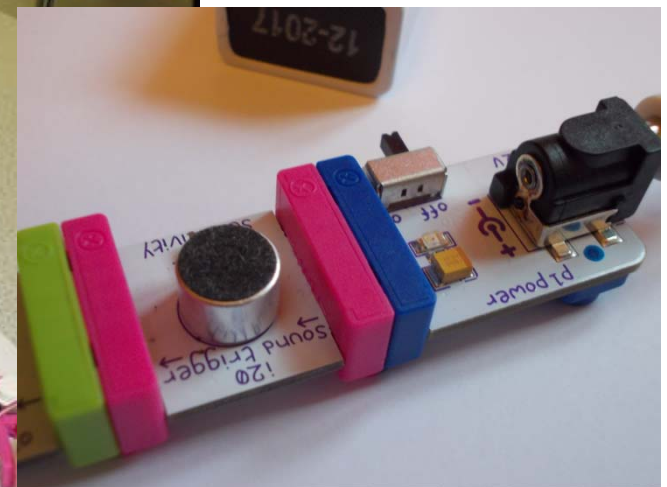
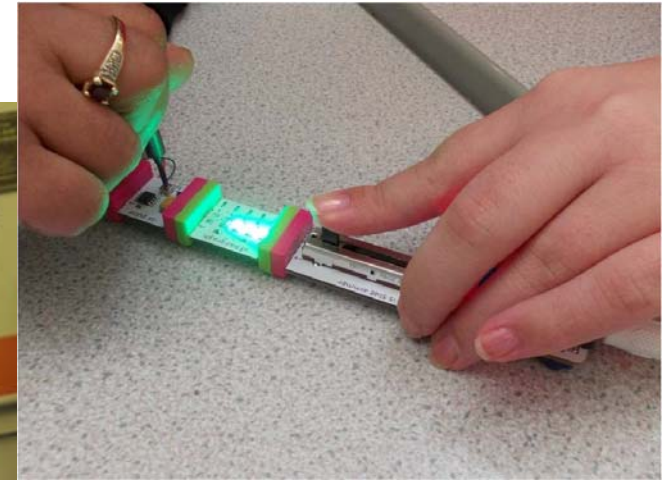
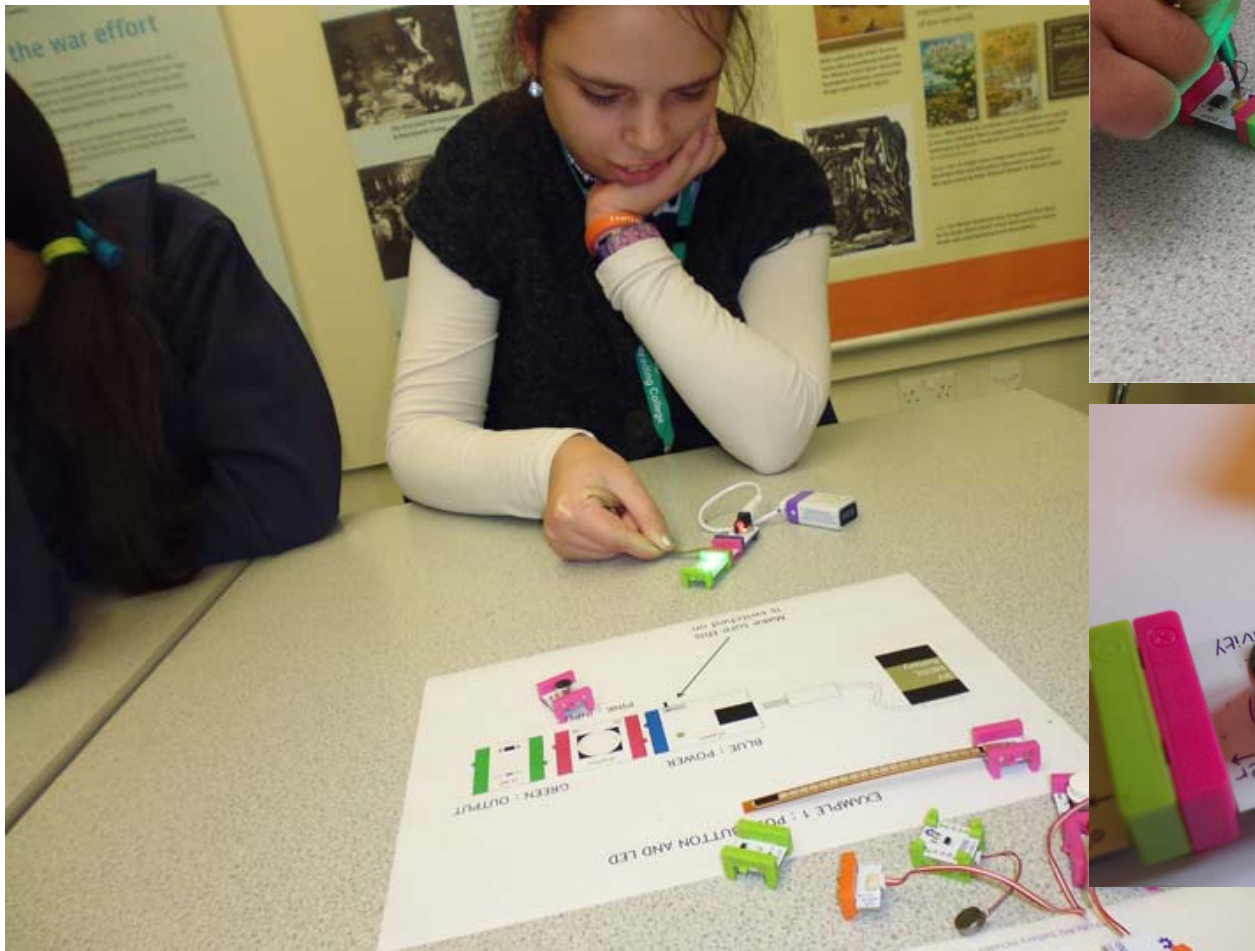
# Working with interactive technology

## Squishy circuits



# Working with interactive technology

littleBits and littleBits go LARGER





# Working with interactive technology

littleBits and littleBits go LARGER



# Workshops – Reflecting and sharing

Multimedia advocacy and public engagement

## Steven's work at Speke Hall



Easy-build wikis



# BUCKETS, BASKETS AND BOOTS

Monday 9th June, 12.30–3pm  
Museum of English Rural Life (MERL)  
Redlands Road, Reading RG1 5EX  
[www.reading.ac.uk/merl](http://www.reading.ac.uk/merl)

**RESEARCH IN ACTION:** Reading College Learners with Learning Difficulties in collaboration with researchers from the University of Reading and the Rix Centre from the University of East London present their research into interactive sensory objects: creating alternative forms of museum interpretation.

## Explore MERL through your senses using Interactive Sensory Objects

- Hear and activate the sounds of sensory buckets, listen for a "Hole in One"
- Touch the interactive pig's nose, then stroke a mooing boot
- Smell herbs and flowers growing in baskets and boots
- Taste some specially made smoothies
- See an LED light up as you try accessible littleBits electronics kits

**FREE ADMISSION**  
Find out more at  
[www.sensoryobjects.com](http://www.sensoryobjects.com)



**WINNER 2014**  
Awarded to Sensory Objects for Making Electronics Accessible to People with Learning Disabilities



# 'SENSORY OBJECTS IN PROGRESS' SEMINAR 2014



**WINNER 2014**  
Awarded to Sensory Objects for Making Electronics Accessible to People with Learning Disabilities

Tuesday 10th June, 10.15am–3pm  
University of Reading, Institute of Education, Building 22,  
Drama and Teaching (G03 and G04), London Road Campus,  
4 Redlands Road, Reading RG1 5EX

**RESEARCH IN ACTION:** In this three-year (2012-15) Arts and Humanities Research Council funded project, people with learning disabilities work with artists and technologists as co-researchers to develop ideas for museum interpretation. Through a series of art workshops they explore the five senses and experiment with electronics to create interactive sensory objects.

The 'Sensory Objects in Progress' seminar will explore the project in greater detail, with presentations from guest speakers and from the Sensory Objects research team. Guest speakers include: Kate Arnold-Forster, Director of MERL; members of Liverpool Mencap Access to Heritage Group; and Dr. Nicola Grove, a skilled storyteller and leading specialist in narrative intervention.

There will be hands-on demonstrations of interactive sensory objects created by the research team, and opportunities to experience first-hand some of the project's workshop activities.

Attendees will learn about the challenges of developing tools to empower people with learning disabilities to develop a creative sensory experience of heritage sites and museums, and some approaches to addressing these challenges.

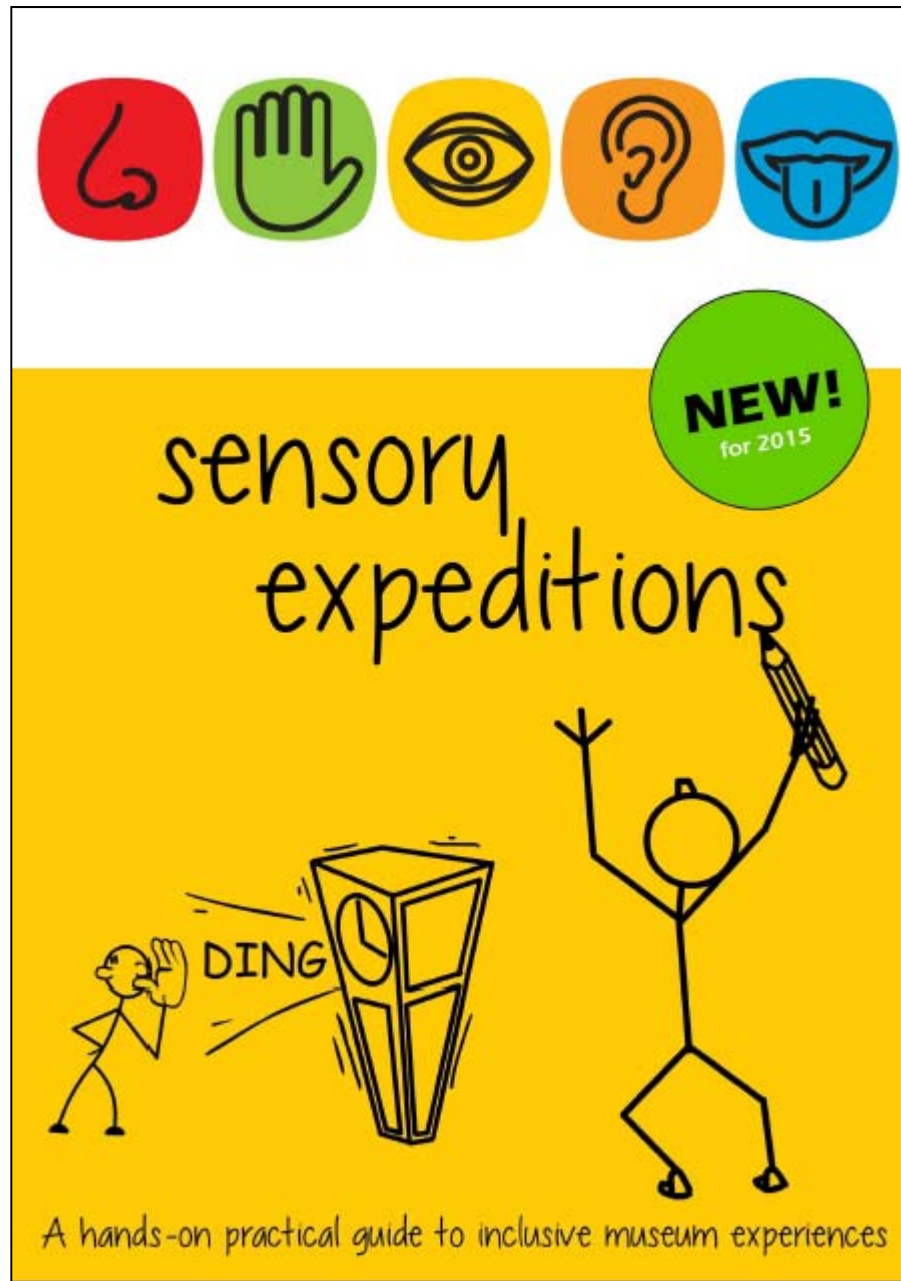
Lunch will be provided. Please forward to others who may be interested.

**The event is free, but places are limited. Please book by May 31st**  
e: [k.allen@reading.ac.uk](mailto:k.allen@reading.ac.uk) t: 0118 378 8050

Find out more at [www.sensoryobjects.com](http://www.sensoryobjects.com)









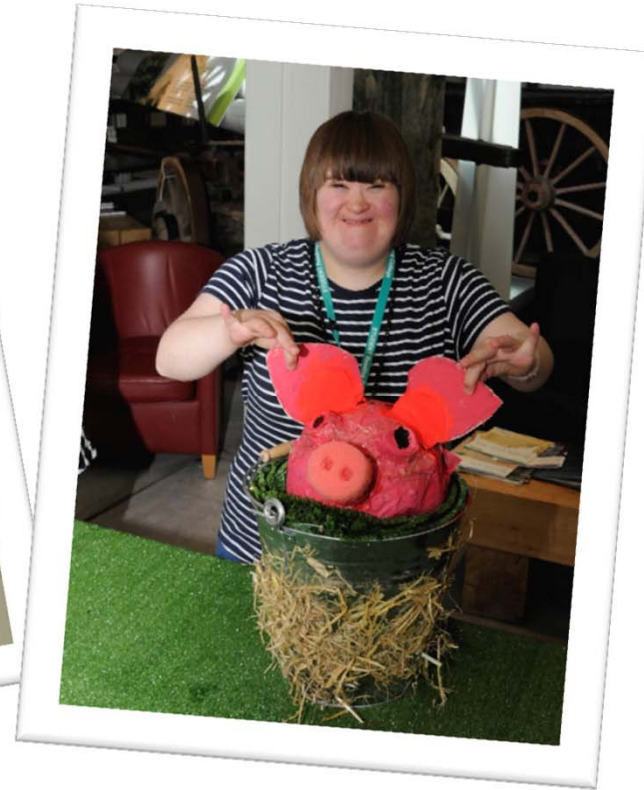
## Discussion

- A very high level of engagement by people with learning disabilities in all aspects – art, technology, dissemination
- Personal/individual approach worked well
- Positive responses from the museums and heritage sites – some evidence of uptake
- A need for greater sharing of practice

## Concluding notes

- Designing technologies that are useful/helpful for older adults and people with disabilities
- Working closely with end users
- In-situ studies
- Interdisciplinary collaboration

Thank you.



**Faustina Hwang**  
f.hwang@reading.ac.uk