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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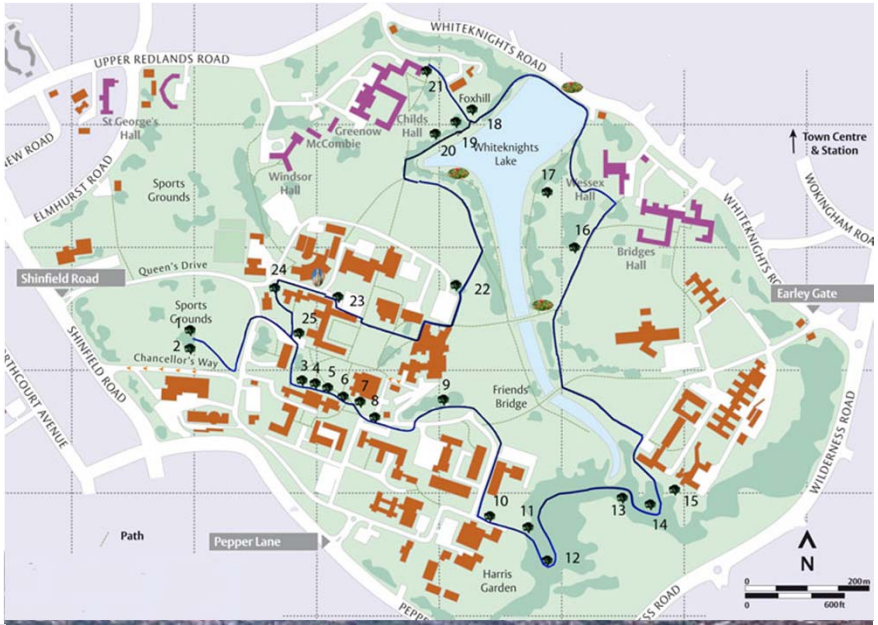

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School of Systems Engineering

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

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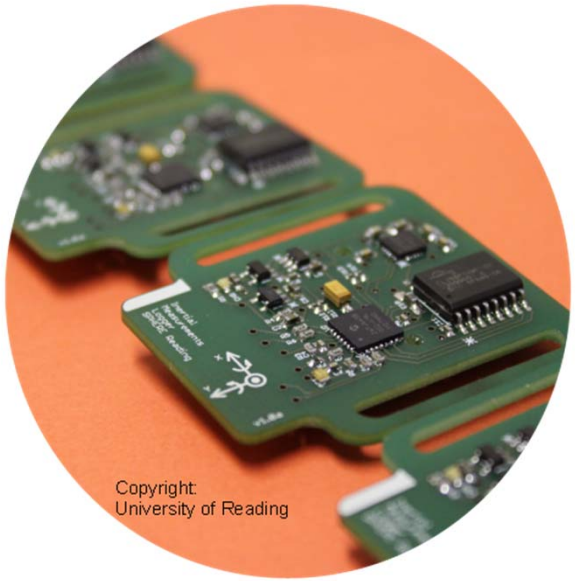
SPHERE – A Sensor Platform for Healthcare in a Residential Environment

(Prof. William Harwin, 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



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Technology for older adults and people with disabilities

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

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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

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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.”

-

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A framework to design for familiarity

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Mid-air gestures for older adults

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Making electronics accessible

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Technology for older adults and people with disabilities

- Making “ordinary” technology easier to use

- **Researching application areas for improved health, wellbeing, and/or independence**

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Technology to address malnutrition in older adults

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Using technology to promote physical activity in sedentary older adults

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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

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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.

University of St Andrews

The University Of Sheffield.

University of Bath

BIMC Bath Institute of Medical Engineering

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nda PROGRAMME

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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

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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, last accessed 26 Nov 2014)

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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.

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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.

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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.

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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 1/2		
8:0	coffee		
9-0	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

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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

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Touchscreen desktop all-in-one

NANA software (launch on start up)

Digital hand dynamometer

Webcam

Mic for voice recordings

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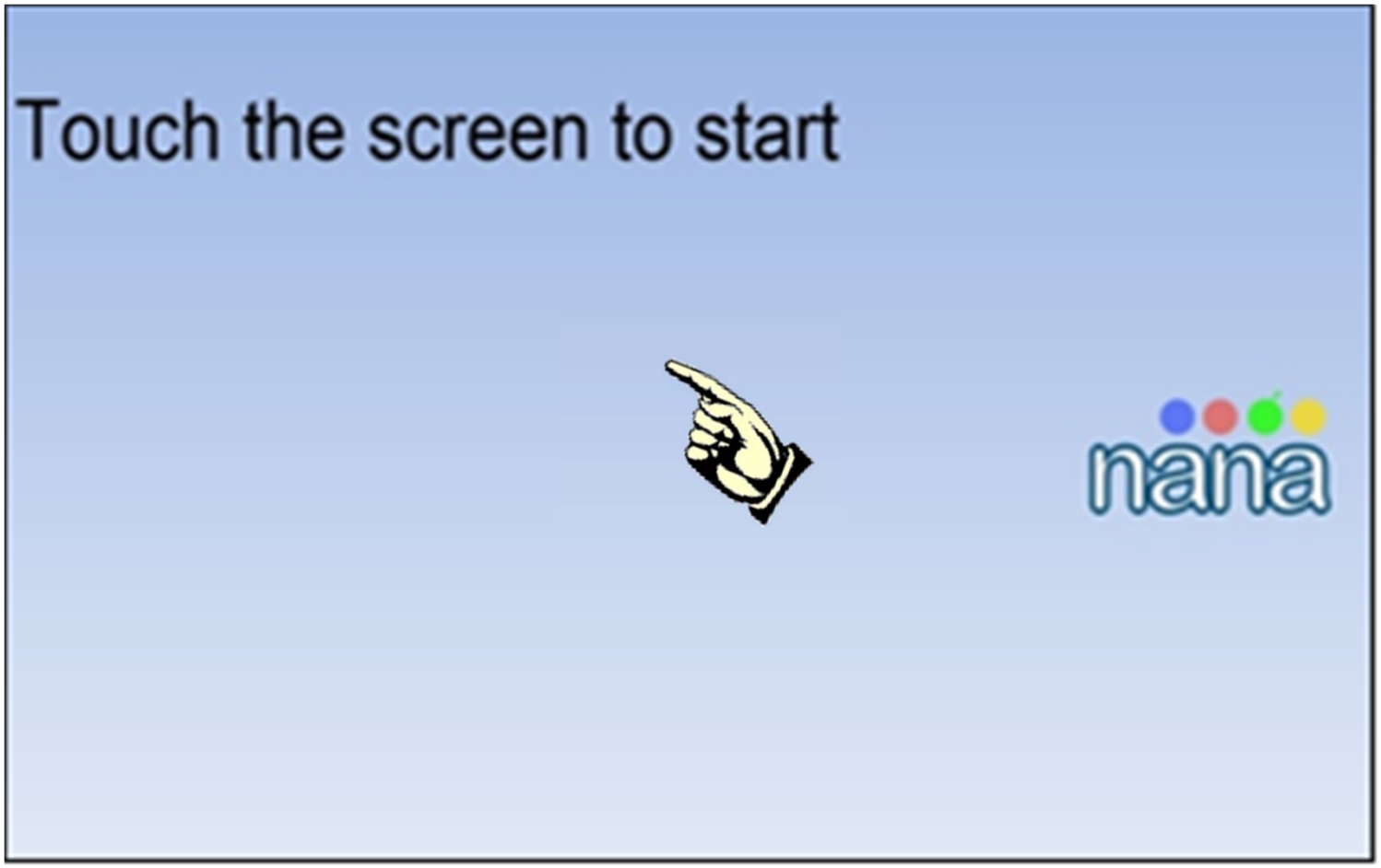
Software



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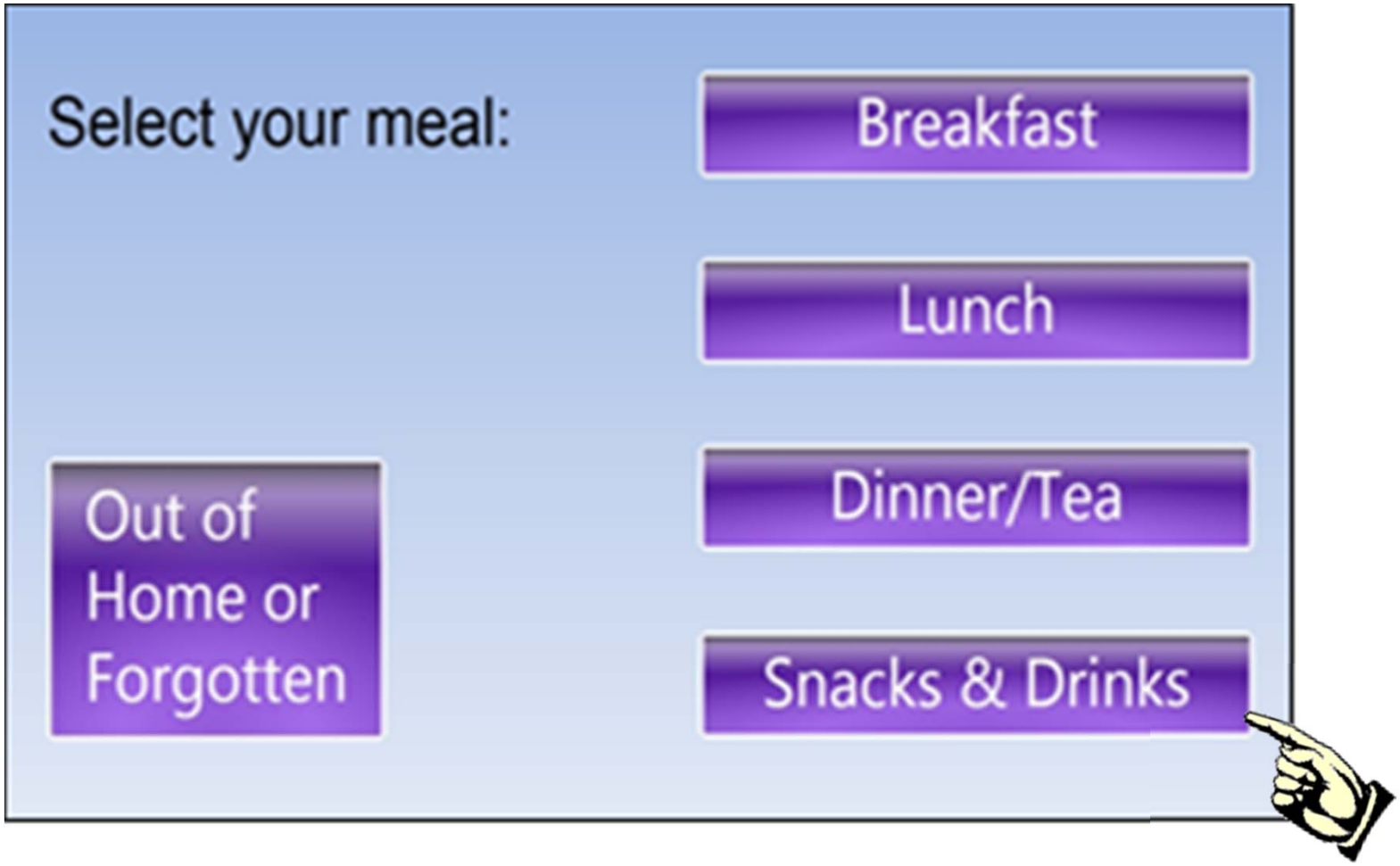
Select meal



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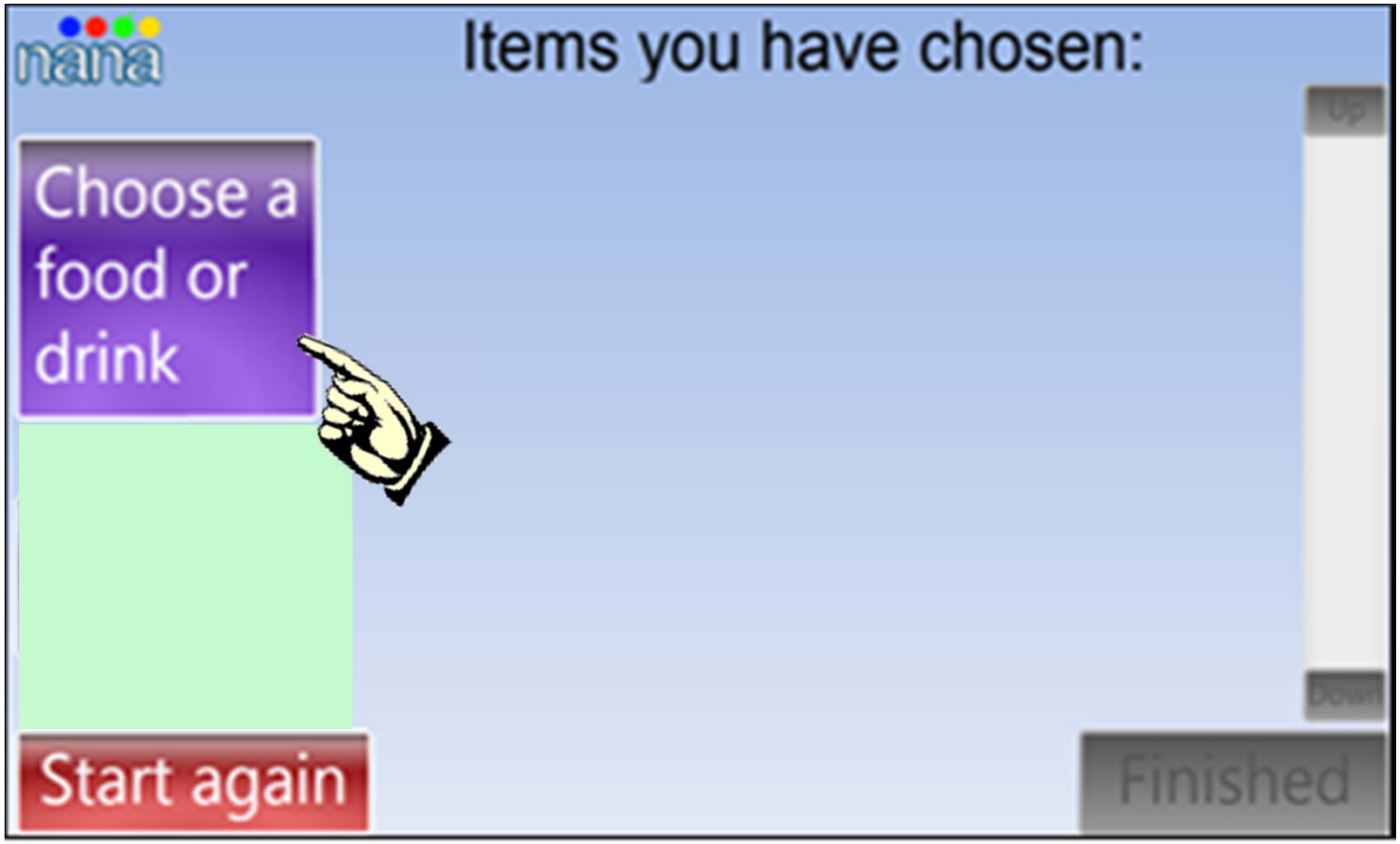
Select choose a food or drink



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Select food/ drink category

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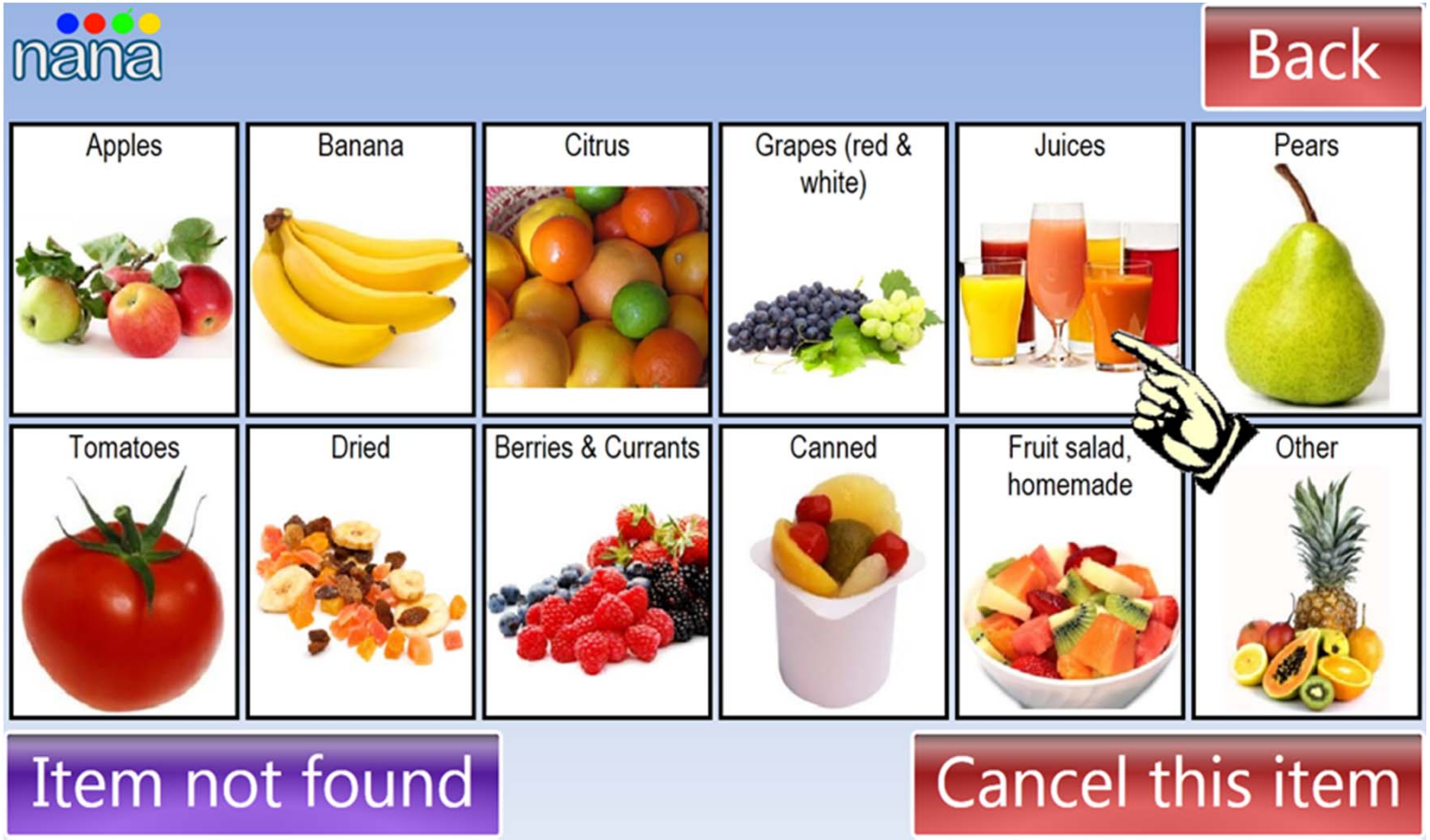
Select food/ drink item



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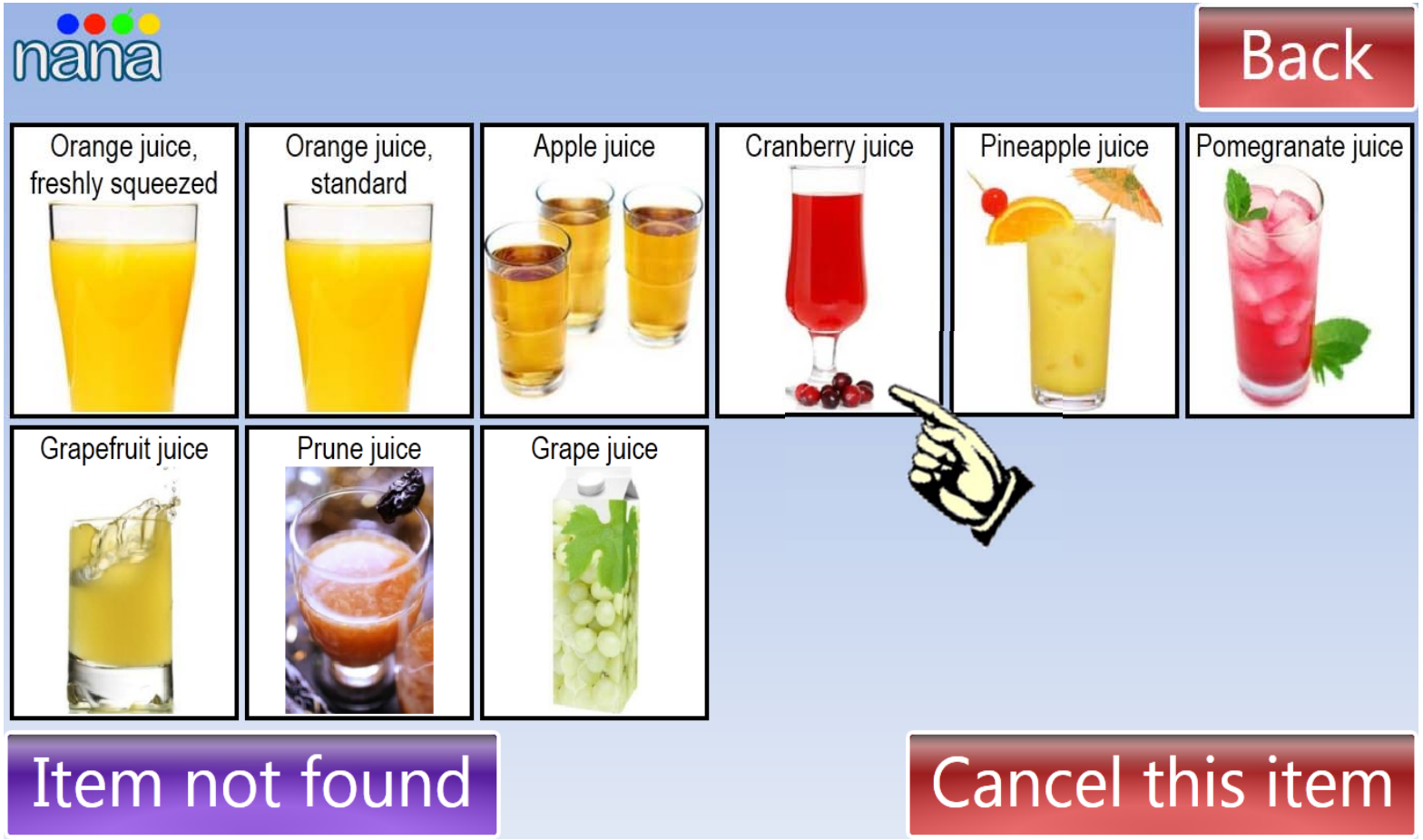
Cranberry juice



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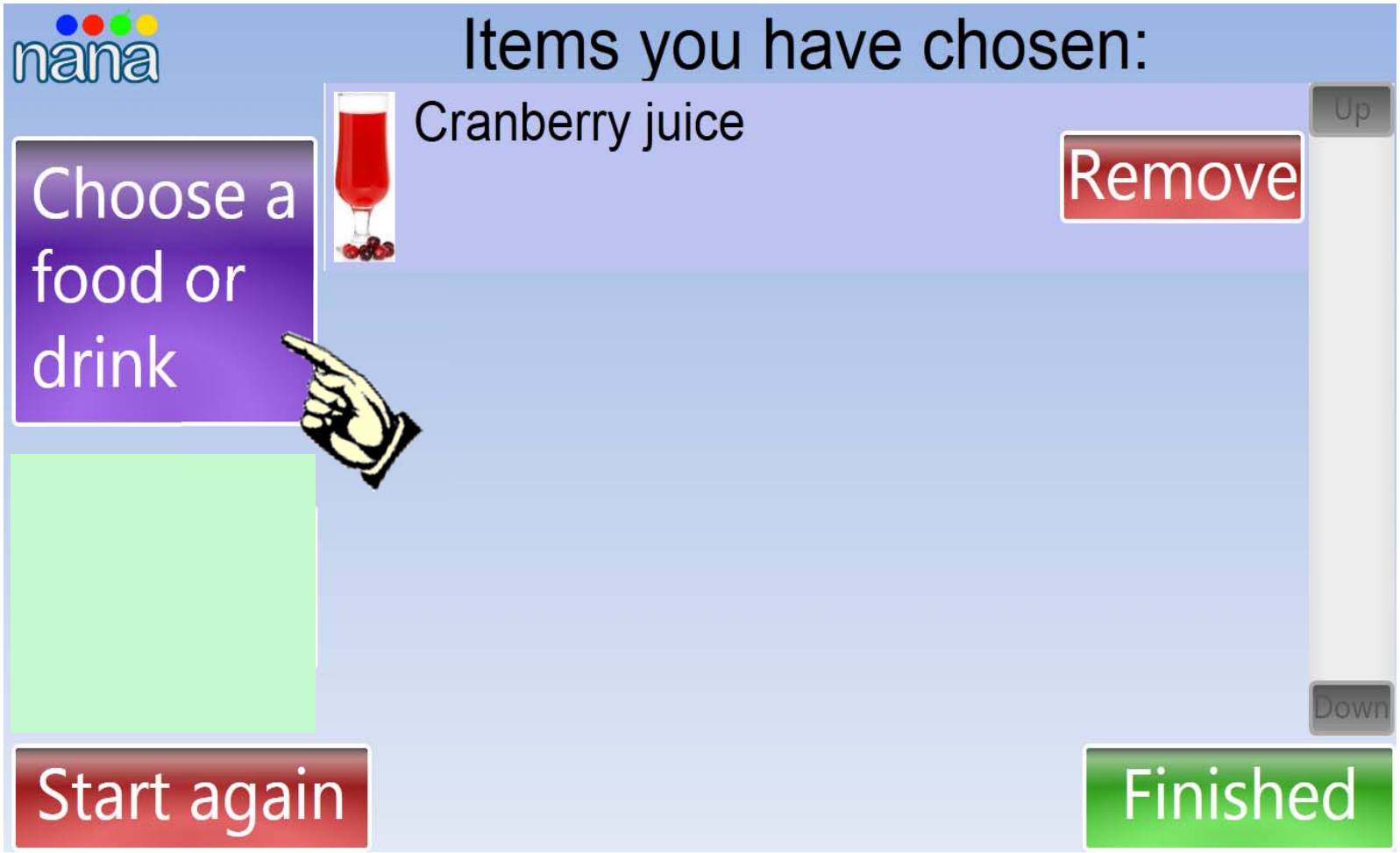
Add another item



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Select another category

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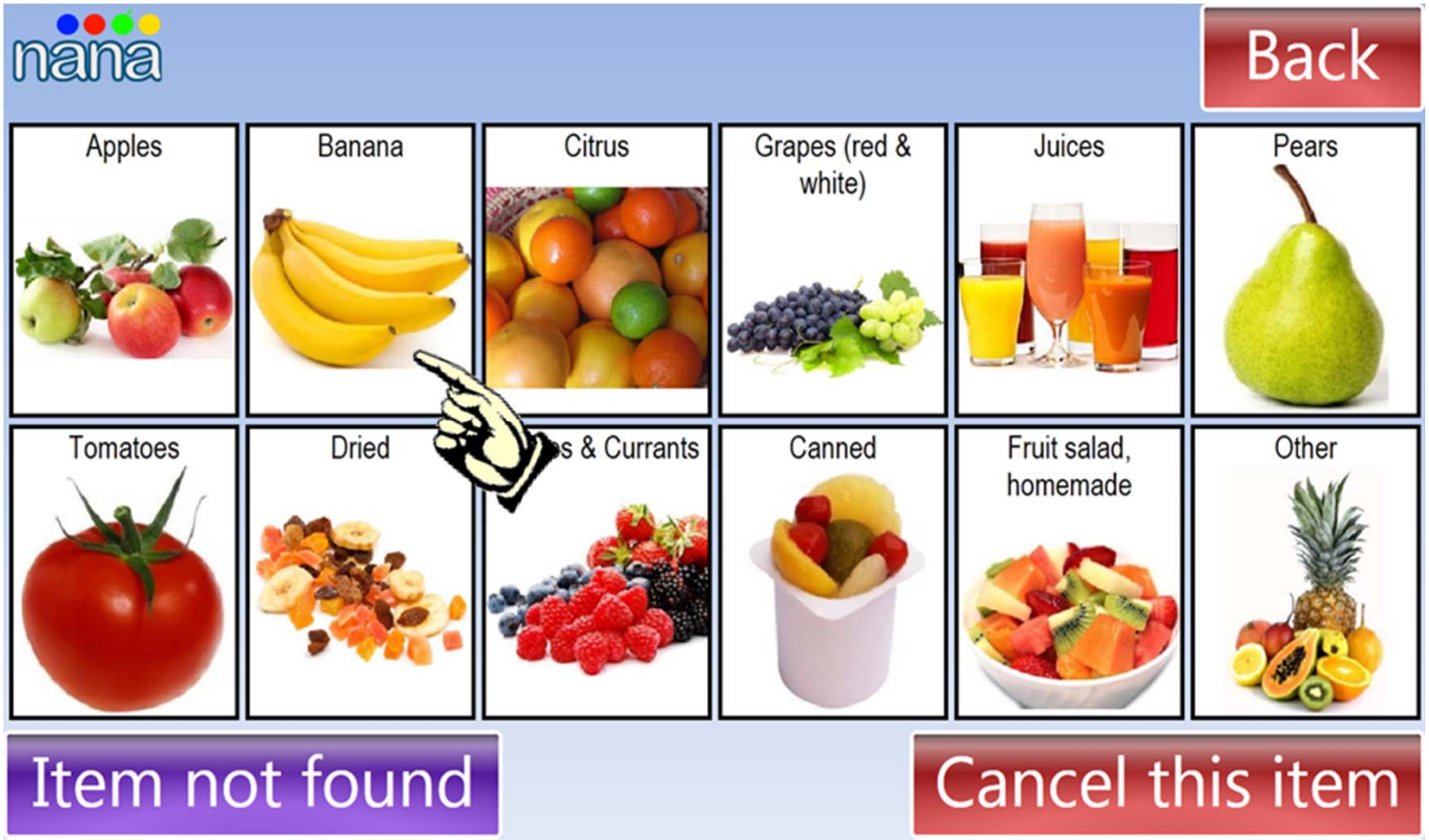
Select another food/ drink item



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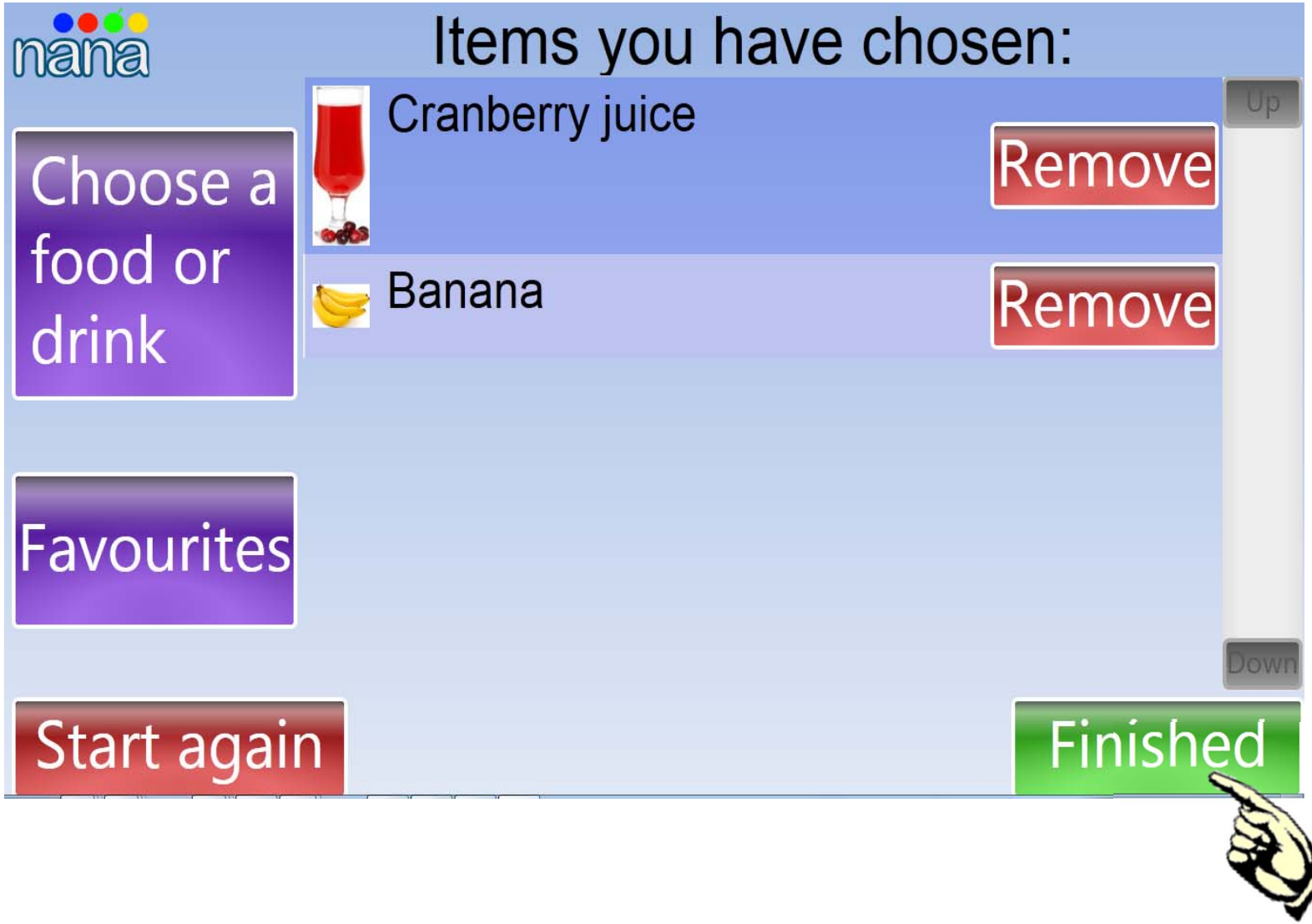
Selected items



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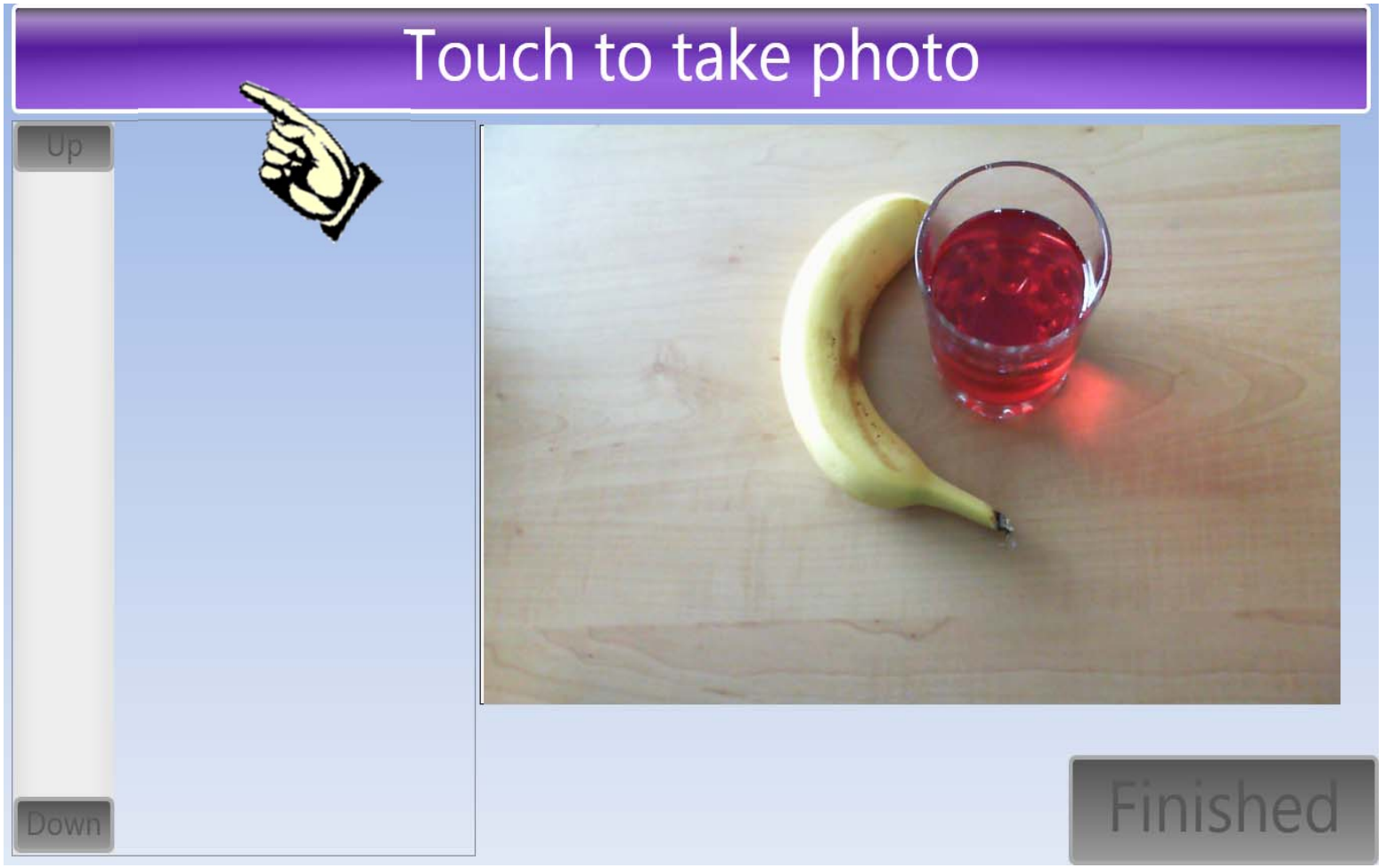
Take a photograph



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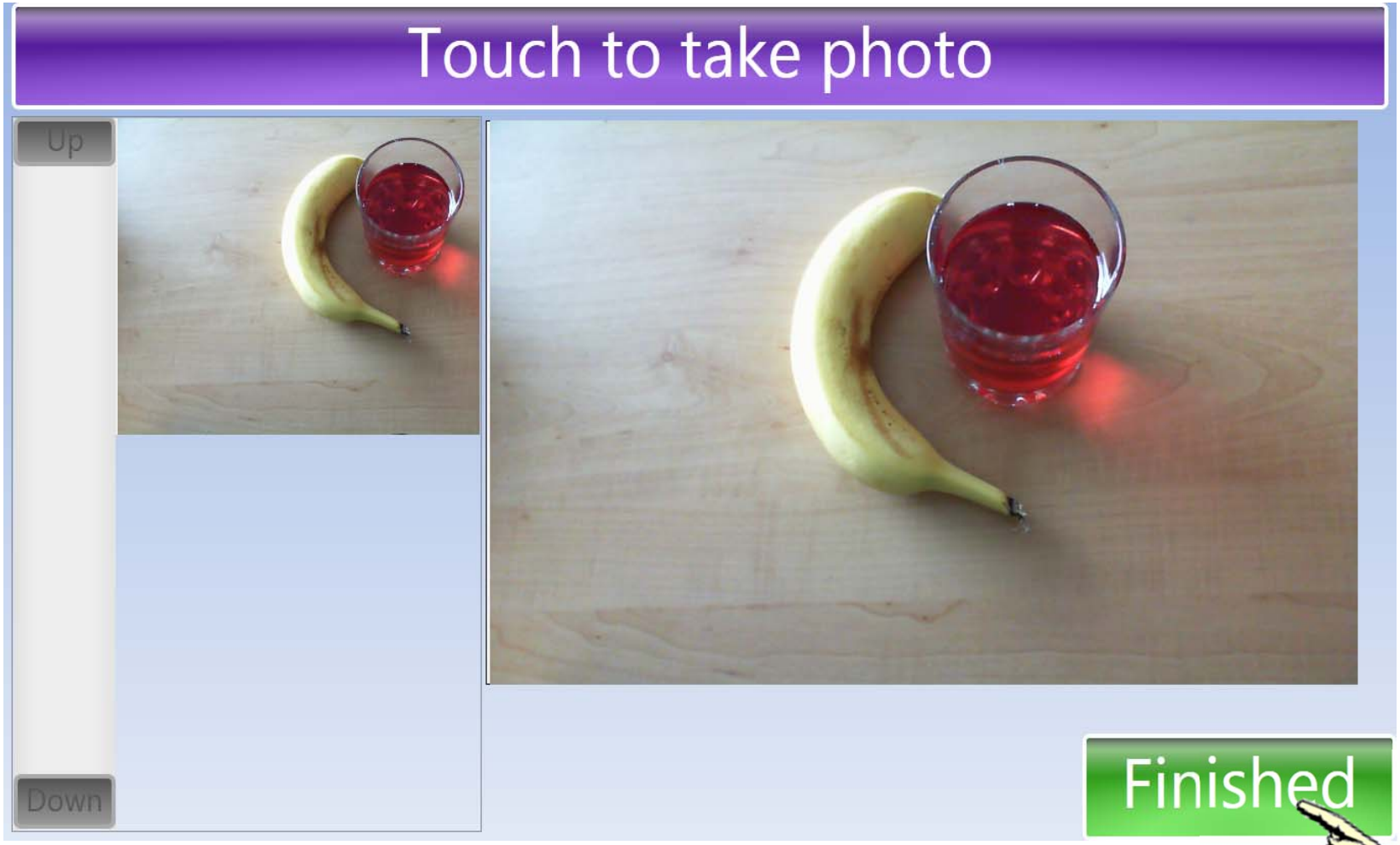
Take more photos if required



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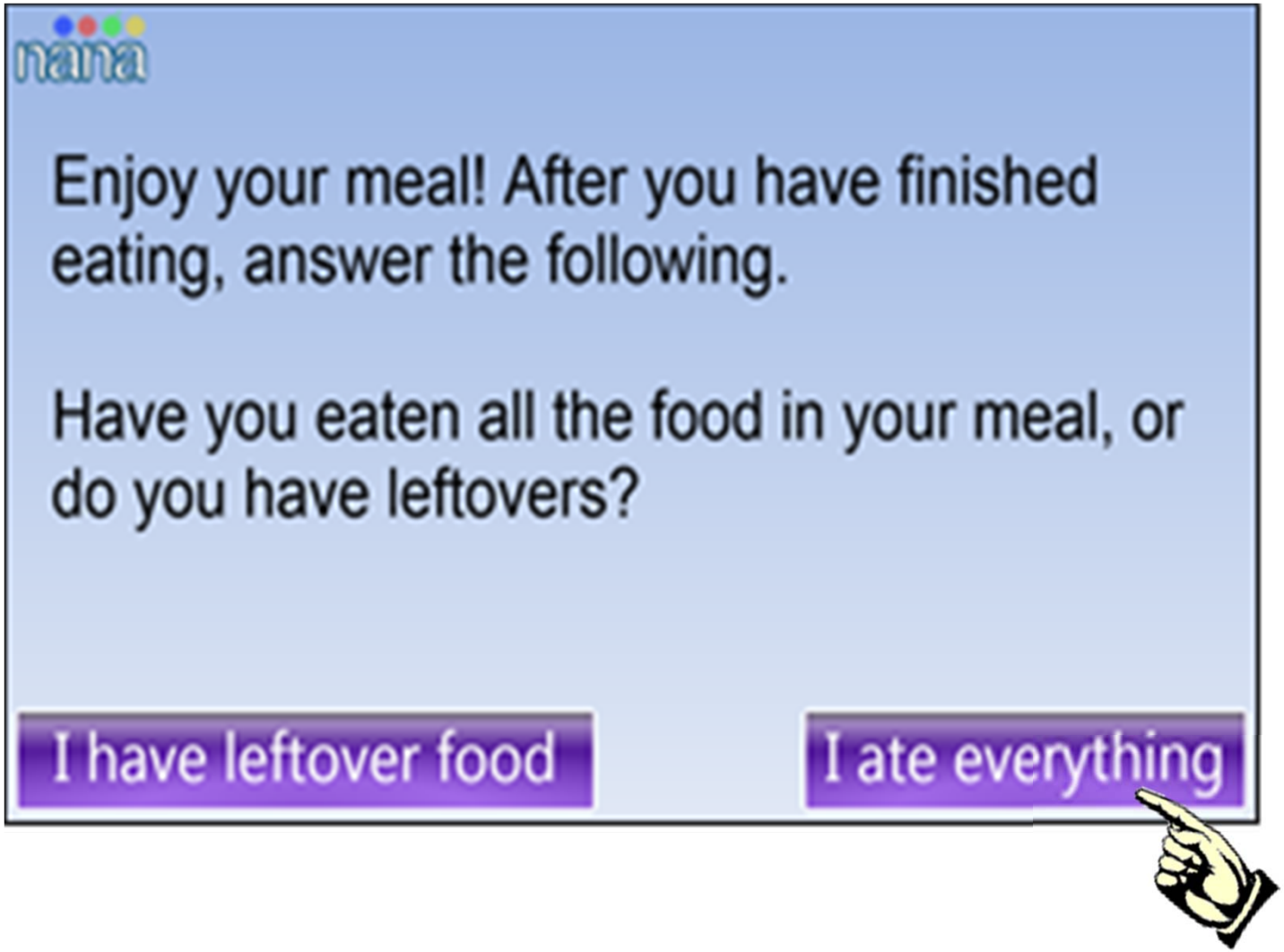
Enjoy your meal



Portion size

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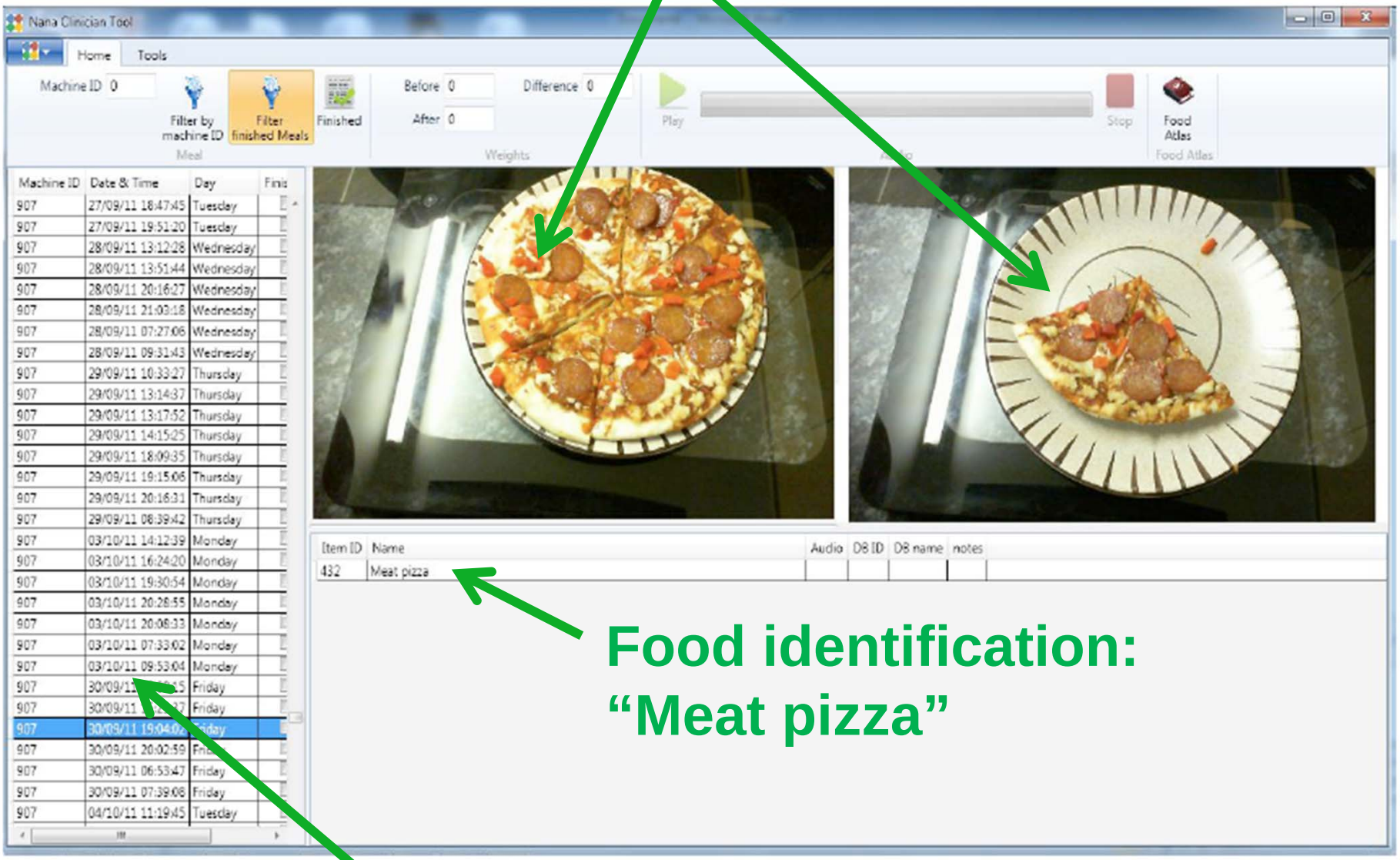
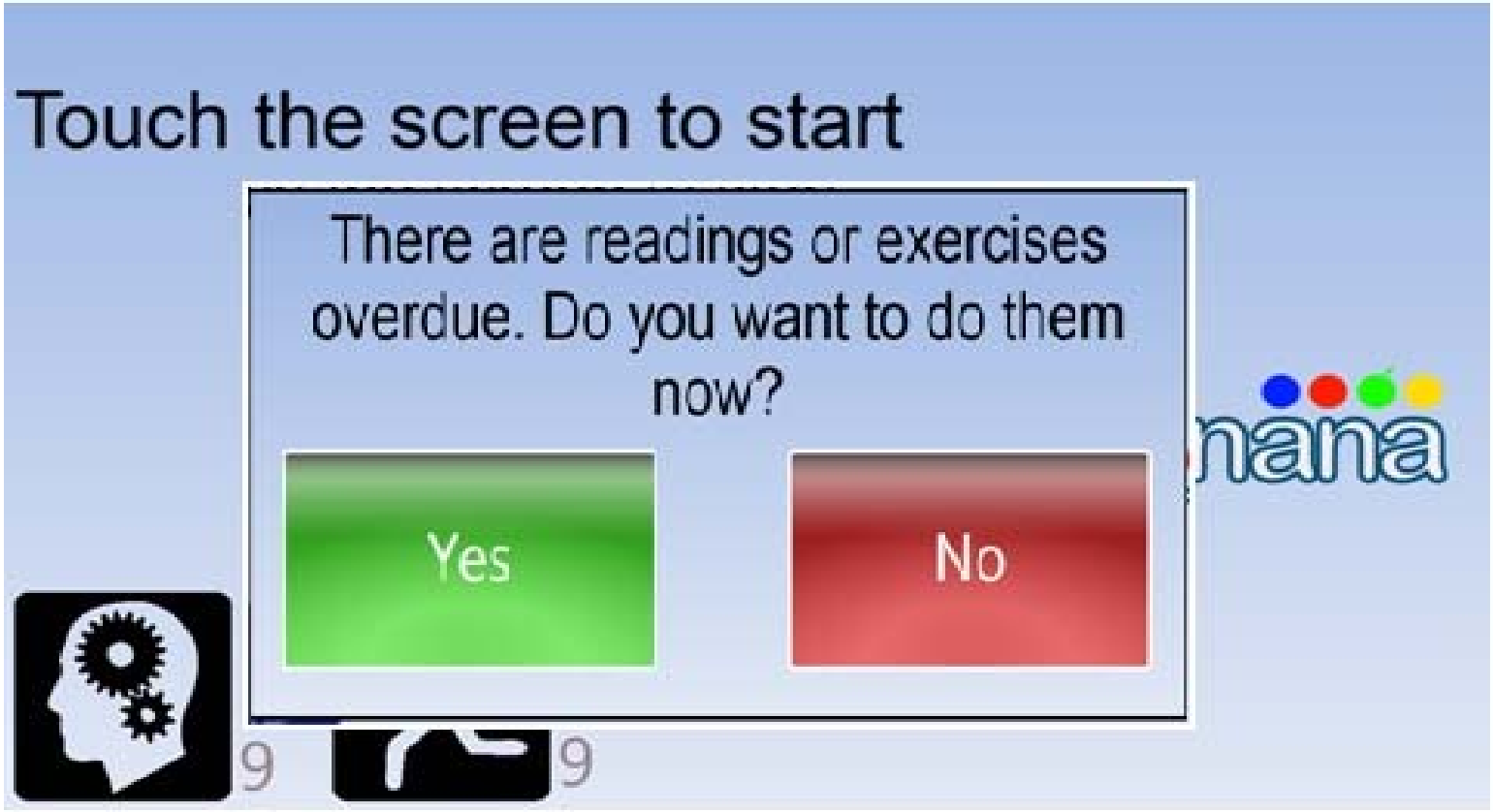


Food identification: “Meat pizza”

One entry for every meal

Non-diet assessments



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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

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Three deployments

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

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3rd 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.

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3rd validation (cont'd)

Week														
Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Consent	■													
Measurement of cognition, depression, physical activity, grip strength, weight, timed up and go	■										■			
NANA system used to record diet, cognition and physical activity		■				■				■				
Collection of blood and urine for biomarkers of nutrient intake								■						
Four-day estimated food diary completed													■	
Four-day food diary interview														■

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3rd validation (cont'd)

Week														
Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Consent	■													
Measurement of cognition, depression, physical activity, grip strength, weight, timed up and go	■										■			
NANA system used to record diet, cognition and physical activity		■				■				■				
Collection of blood and urine for biomarkers of nutrient intake								■						
Four-day estimated food diary completed													■	
Four-day food diary interview														■

3rd validation (cont'd)

Activity	Week 1	2	3	4	5	6	7	8	9	10	11	12	13	14
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Measurement of cognition, depression, physical activity, grip strength, weight, timed up and go	■										■			
NANA system used to record diet, cognition and physical activity		■				■				■				
Collection of blood and urine for biomarkers of nutrient intake								■						
Four-day estimated food diary completed													■	
Four-day food diary interview														■

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Example

- 79 year old female

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Morning

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Morning

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Mid-day/afternoon

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Mid-Day/afternoon

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Afternoon

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Evening

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Example

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

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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

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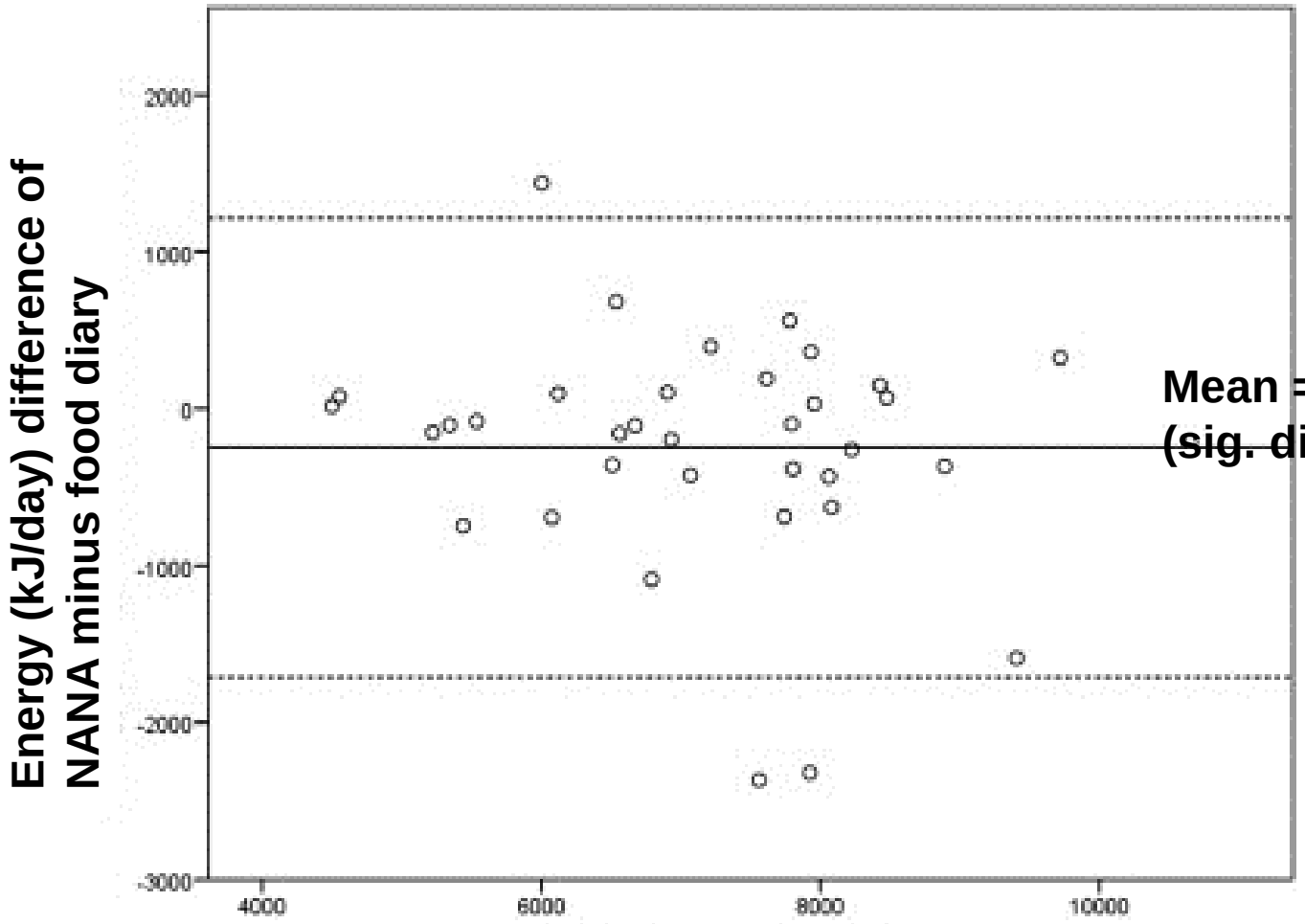
Example

- 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

Results – Energy (kJ/day)



Mean = -250 kJ/day (sig. diff)

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,

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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

University of Reading

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 & extrasensoryobjects.wordpress.com

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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*

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Three-years, three sites (2012-2015)

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

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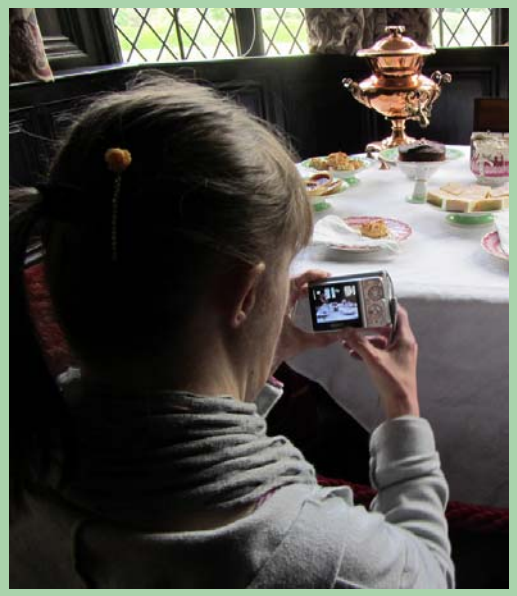
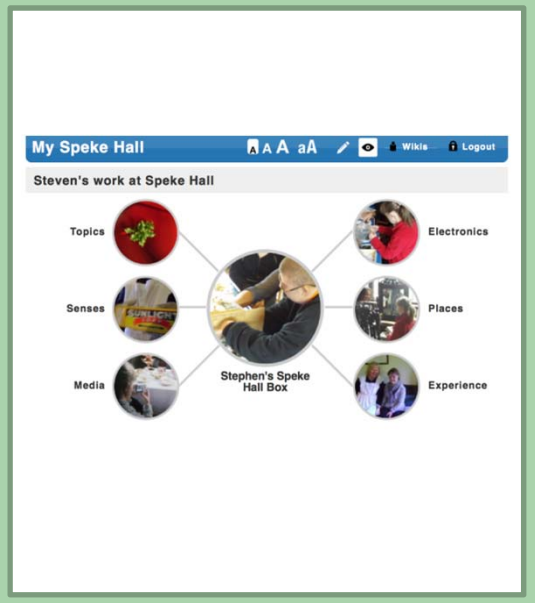
Workshops

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



Multisensory expeditions

Making interactive artwork



Reflecting and sharing

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Workshops - Multisensory Expeditions

Designing activities for engaging with the site through the senses

Reading College

STUDENT Reading College

KINGS QUEENS

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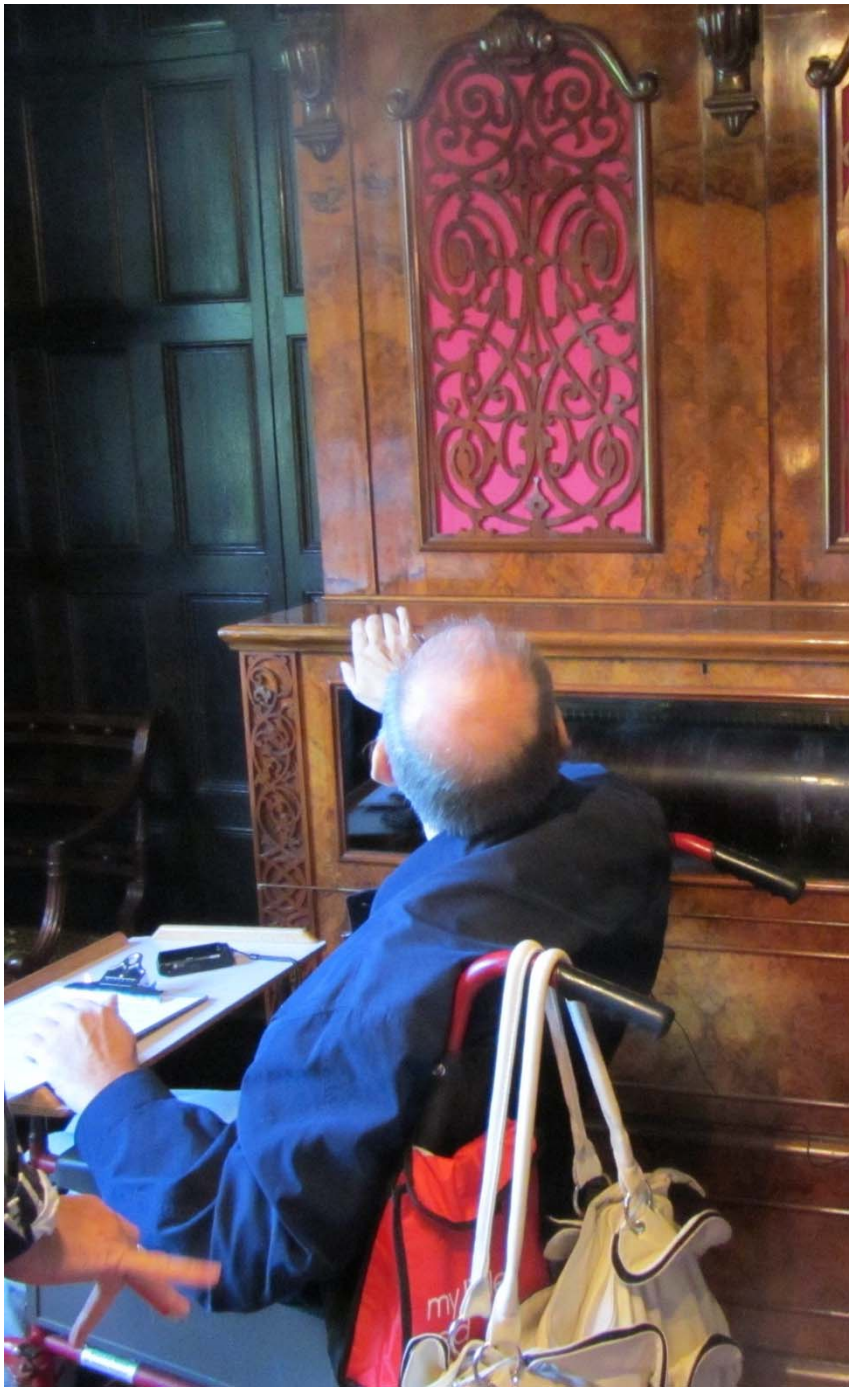

WORKSHOP Collecting the smells of Speke Hall

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Helping the war effort
Camp schools

Local ingredients
Food, glorious food!
What went into your last meal?
Aerial view

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Workshops - Making interactive artwork

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

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Reading College

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Working with interactive technology

Squishy circuits

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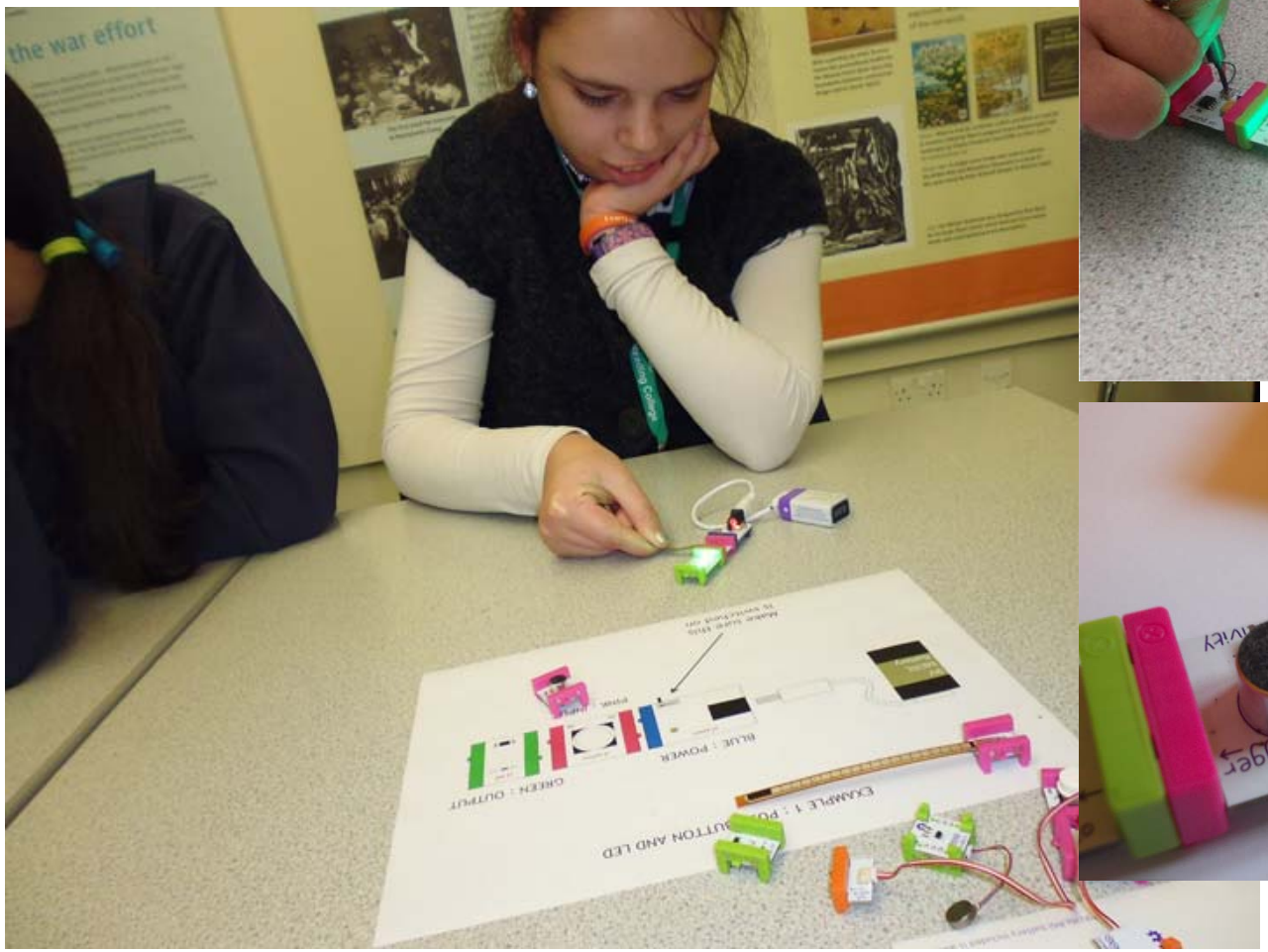
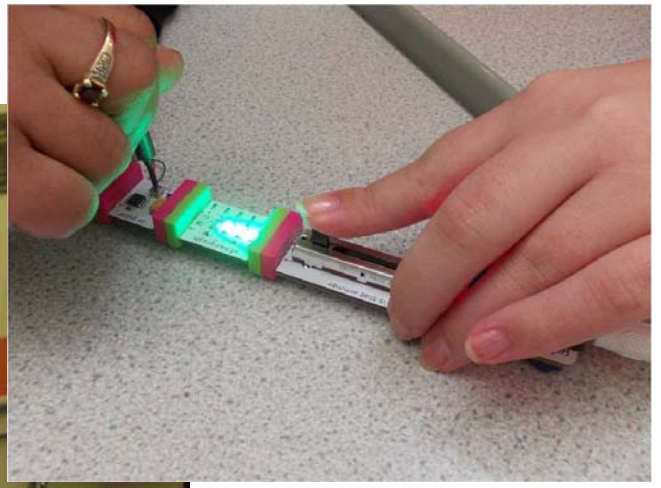
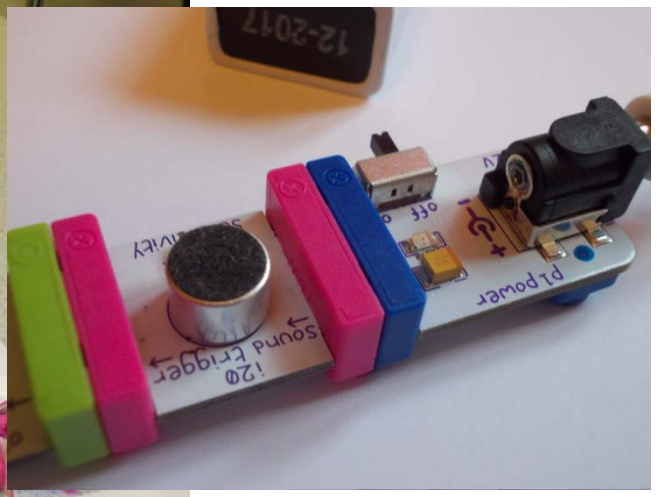
Working with interactive technology

littleBits and littleBits go LARGER







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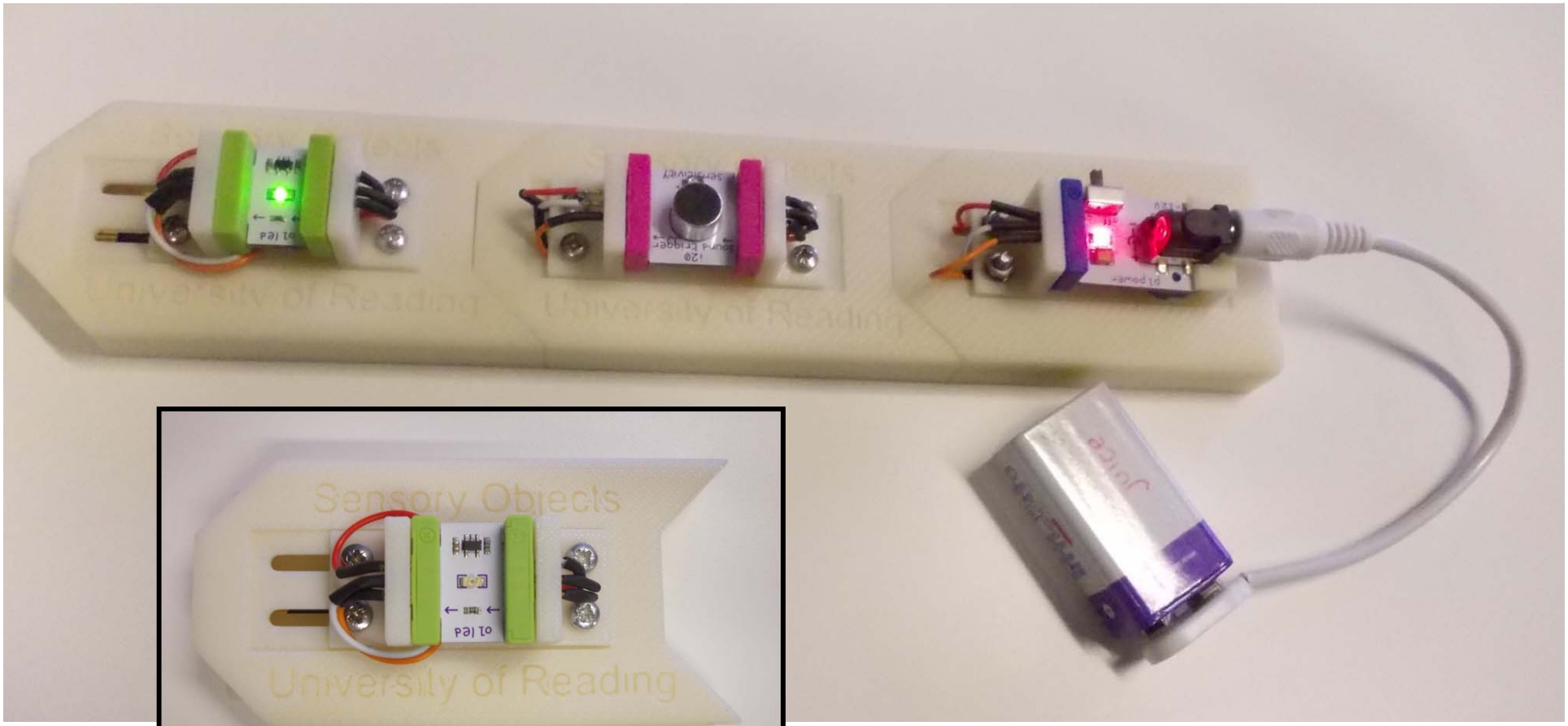
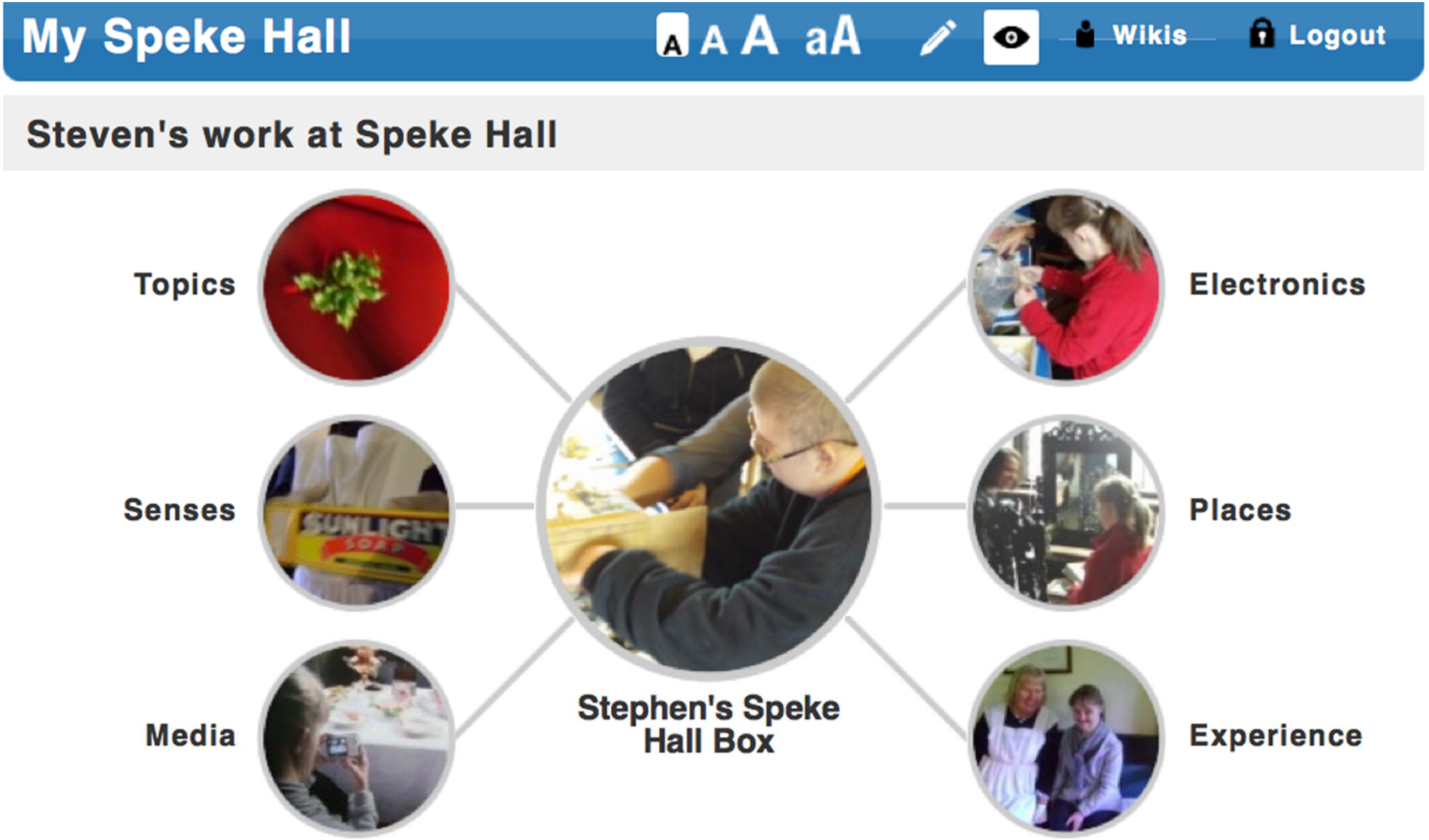
Working with interactive technology

littleBits and littleBits go LARGER

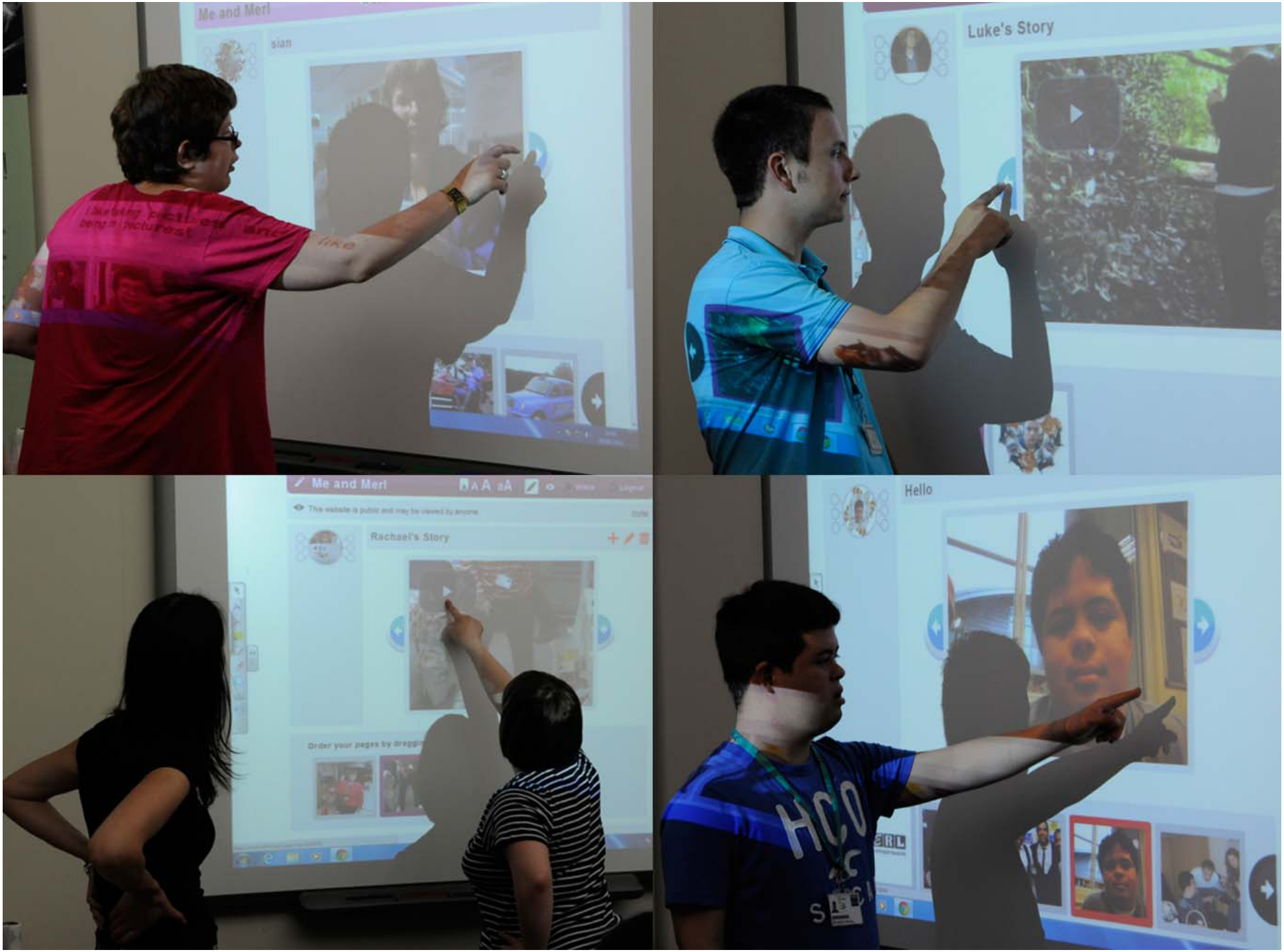


Workshops – Reflecting and sharing

Multimedia advocacy and public engagement



Easy-build wikis


Me and Me!
sian
Luke's Story
Me and Me!
Rachael's Story
Hello

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

DESIGN FOR ALL GOOD PRACTICE

WINNER 2014

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

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

9–15 June 2014 UNIVERSITIES WEEK Ideas for Life | Reading College | University of Reading | MERL Museum of English Rural Life | theRIXcentre | UEL | Arts & Humanities Research Council

'SENSORY OBJECTS IN PROGRESS' SEMINAR 2014

DESIGN FOR ALL GOOD PRACTICE

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.

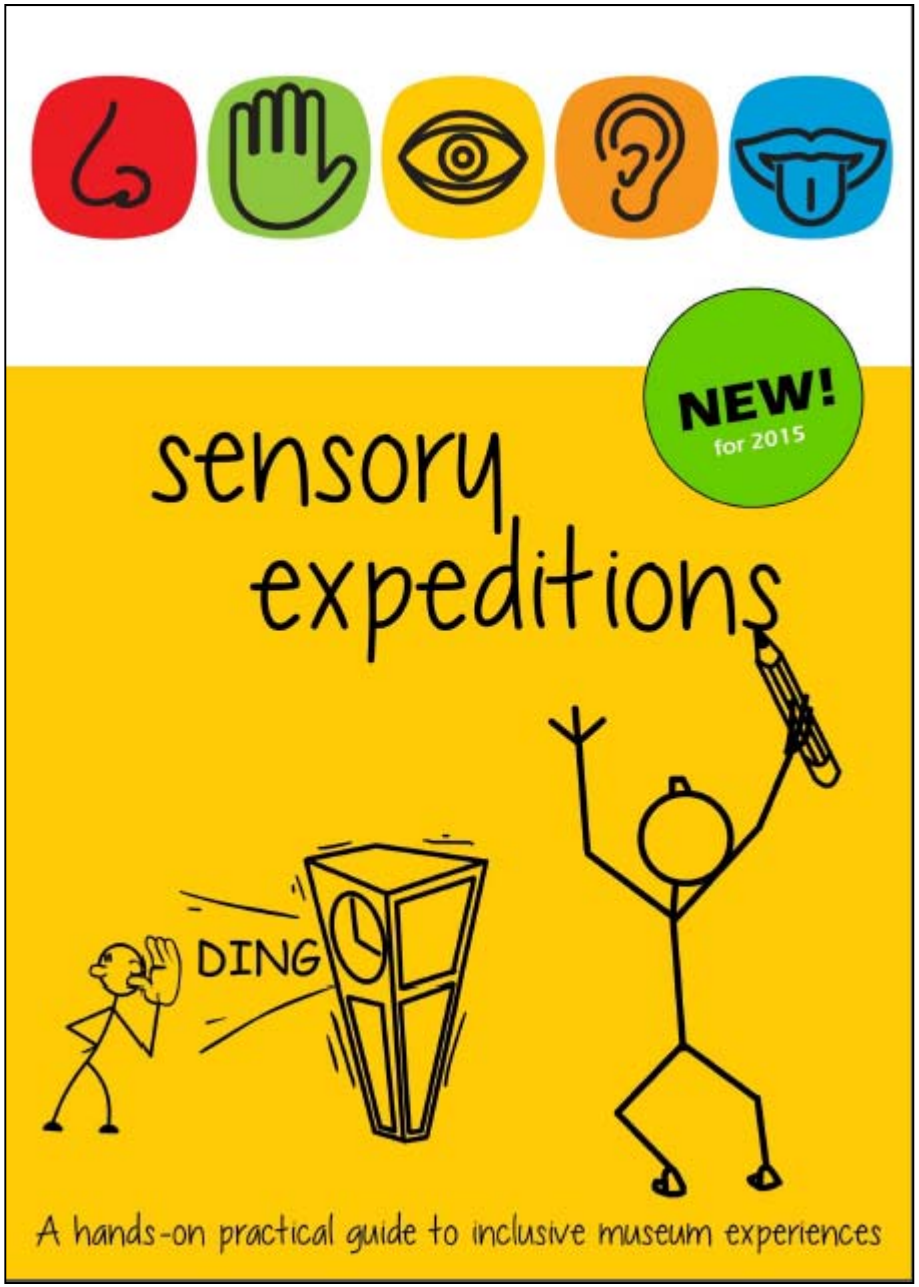
The event is free, but places are limited. Please book by May 31st
e: k.allen@reading.ac.uk t: 0118 378 8050

Find out more at www.sensoryobjects.com

9–15 June 2014 UNIVERSITIES WEEK Ideas for Life | Reading College | University of Reading | MERL Museum of English Rural Life | theRIXcentre | UEL | Arts & Humanities Research Council

Mencap Reading Coffee Club

Clarks



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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

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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.

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