



NANA: A System for Dietary Assessment in the Older Population

Conference on Automating Assessment & Collection of Dietary Data with ICT
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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.

Multidisciplinary research team

- **Psychology**

Arlene Astell, University of St. Andrews (now at the University of Sheffield)

- **Human Nutrition**

Liz Williams, University of Sheffield

- **Human Computer Interaction**

Faustina Hwang, University of Reading

- **Mechanical Engineering**

Tim Adlam, Bath Institute of Medical Engineering (now called Designability)

Context: Older Adults

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

The ICT needs to be designed to suit older adults.

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)

Context: Home Use

A significant proportion of malnourished older adults live in the community.

Regular monitoring of food intake could facilitate early intervention and prevent decline.

ICT-based dietary assessment needs to accommodate “free-living” diets, and be usable without on-site support.

Everybody has trouble with technology at some point...



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.”

... but older adults face particular challenges

Age-related differences including **declines in vision, motor movement, cognition and memory**, and less **familiarity** with technology can pose difficulties.

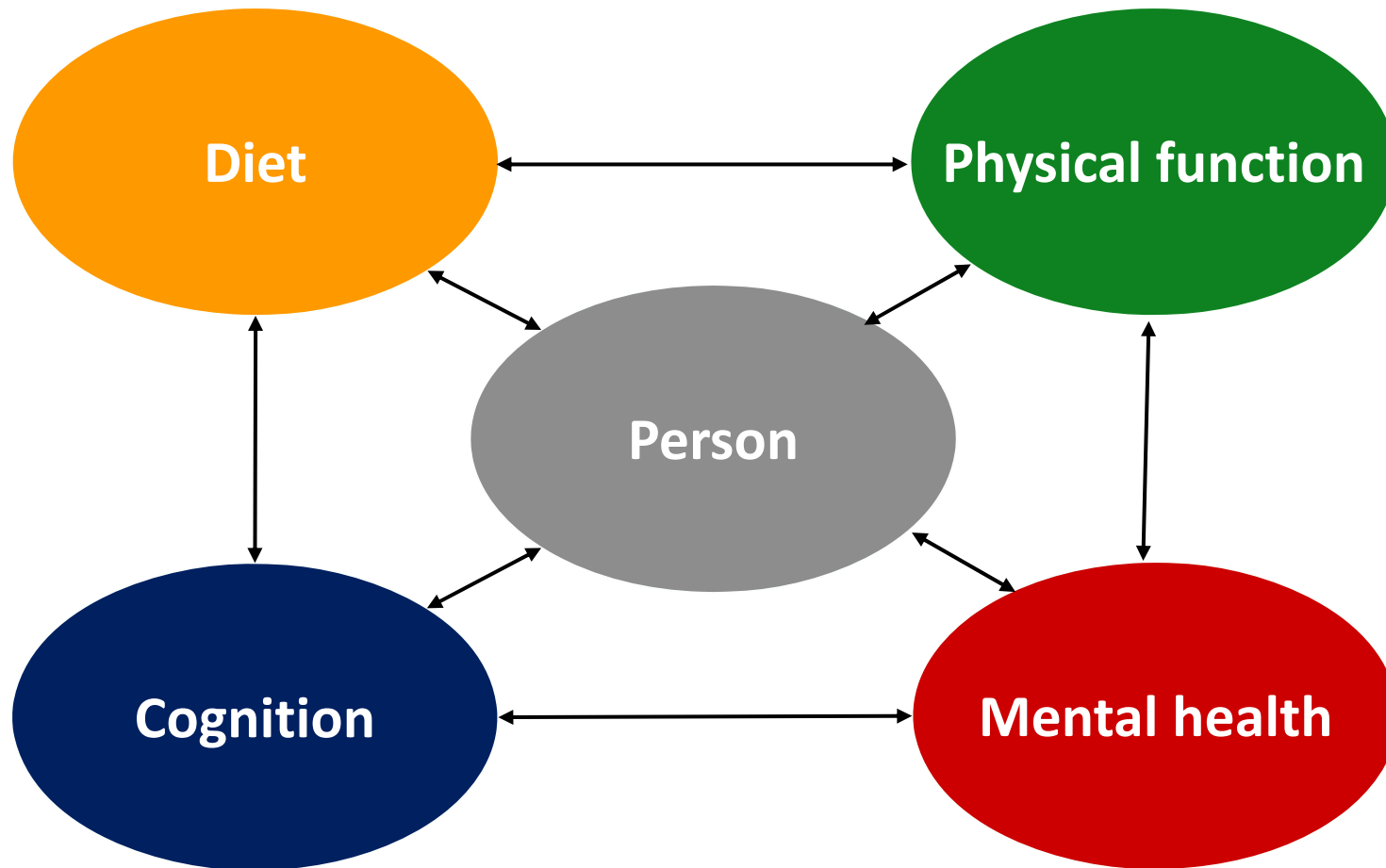
Older adults often benefit from:

- Larger fonts and high contrast
- Touchscreen interaction and bigger targets
- Uncluttered interfaces
- Clear navigation through the software
- Jargon-free language

Key objectives of the NANA project

- To design and develop a system for extended assessments of older adults at home
- To validate the system against current gold-standard methods.

A Holistic Approach



The NANA System

Touchscreen
desktop all-in-one

Webcam

NANA software
(launch on start up)

Mic for
voice
recordings



Digital hand
dynamometer

Dietary Intake

Touch the screen to start



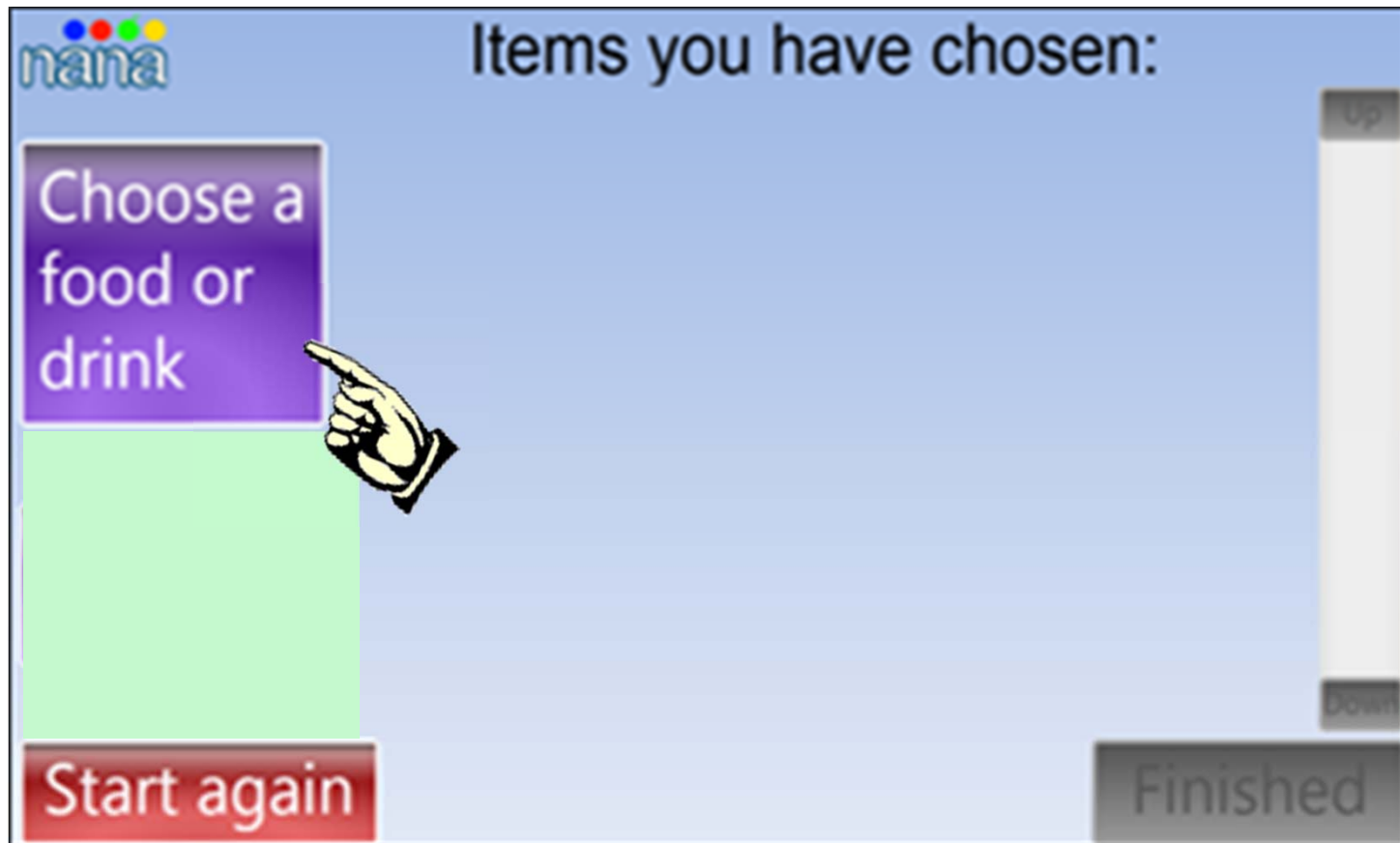
nana

Is this food/drink you are having now, or
is it something that you had earlier?

Now



Earlier



Select food/ drink category






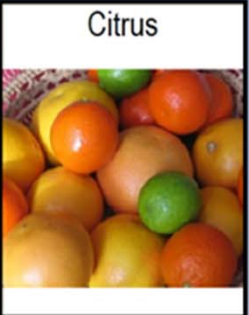



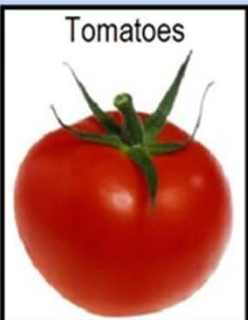





<p>Drinks</p> 	<p>Bread, cereal, pasta, rice</p> 	<p>Dairy</p> 	<p>Meat, poultry & eggs</p> 	<p>Fish and seafood</p> 	<p>Convenience, sandwiches, fast food</p> 
<p>Fruit</p> 	<p>Vegetables</p> 	<p>Desserts, cakes & biscuits</p> 	<p>Sweets & chocolate</p> 	<p>Savoury snacks, crisps & nuts</p> 	<p>Sauces,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



[Cancel this item](#)

Select 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

Cranberry juice

nana

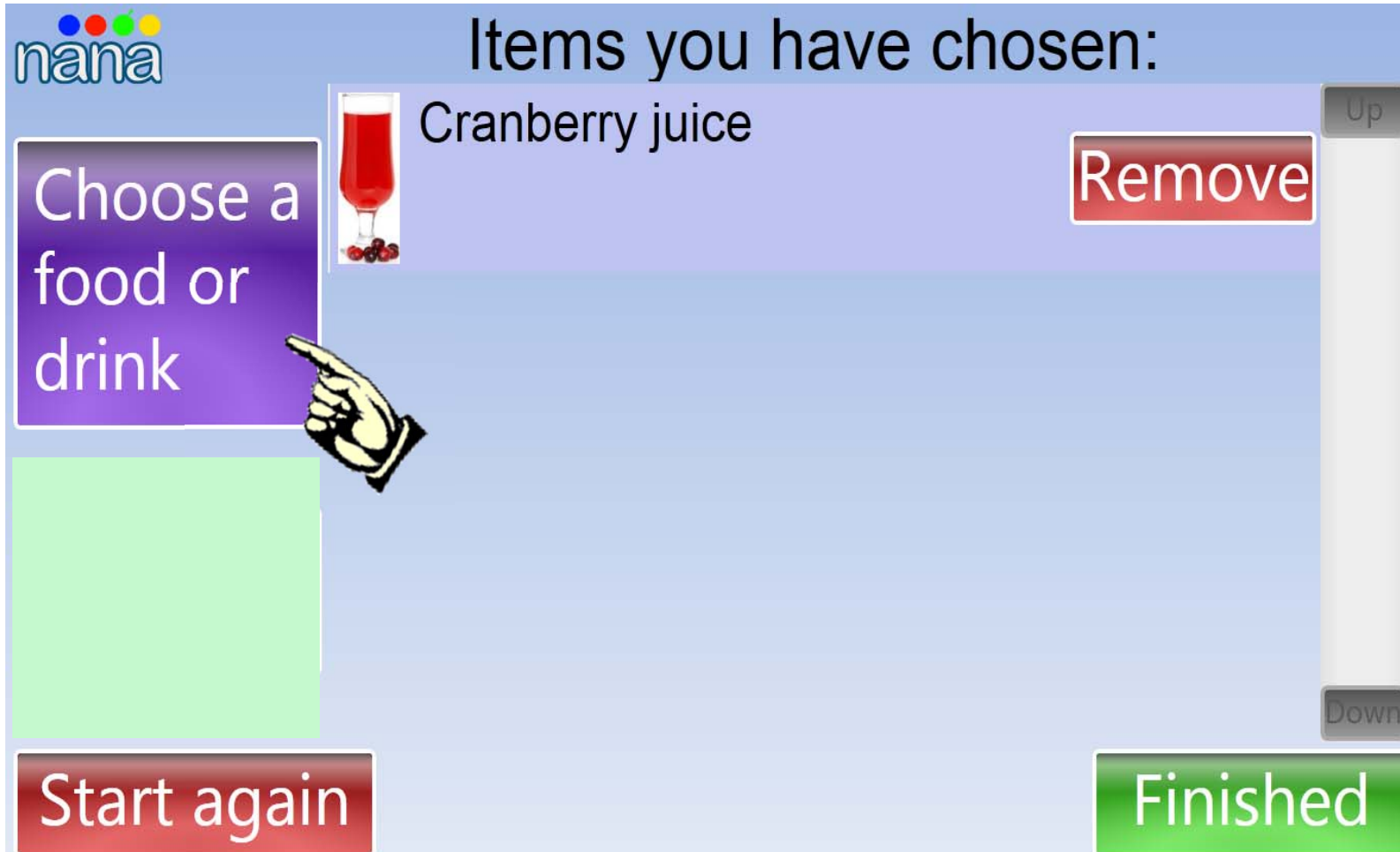
Back

Orange juice, freshly squeezed 	Orange juice, standard 	Apple juice 	Cranberry juice 	Pineapple juice 	Pomegranate juice 
Grapefruit juice 	Prune juice 	Grape juice 			

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' with a hand icon pointing to it, 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




nana













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



Cancel this item

Select another food/ drink item

 Back

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

Item not found Cancel this item

Selected items

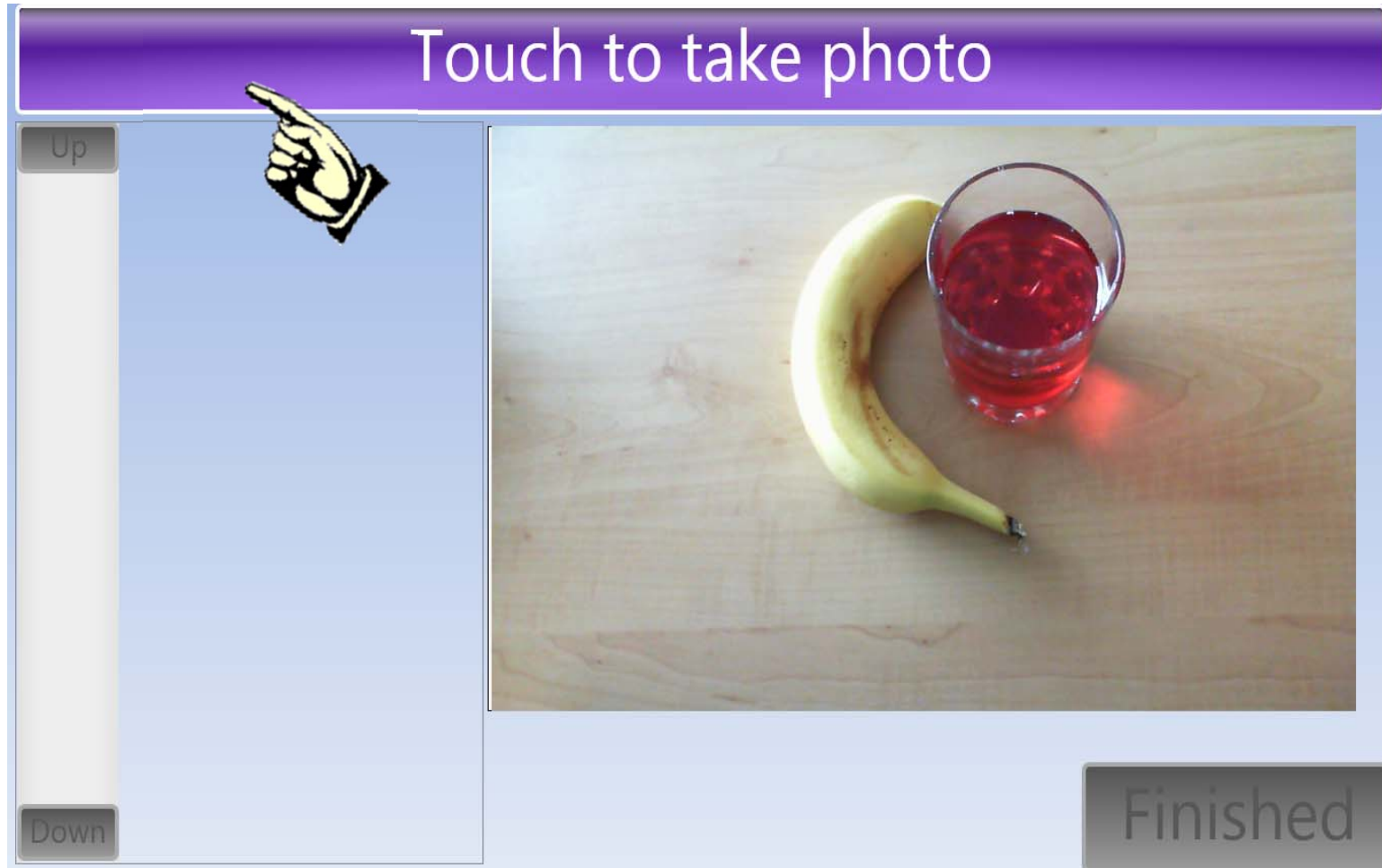


The screenshot shows a user interface for 'nana' with the following elements:

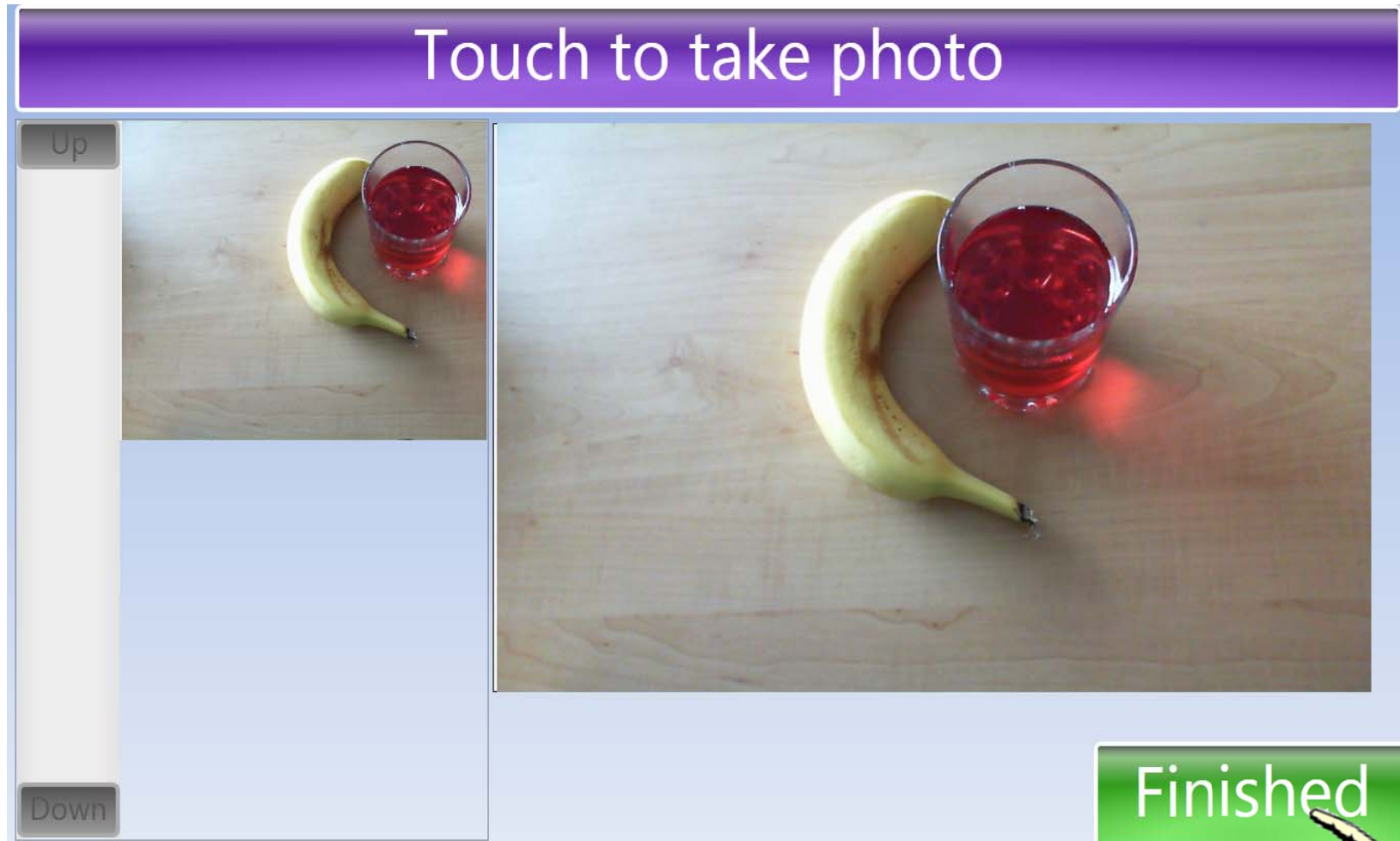
- Logo:** 'nana' with four colored dots (blue, red, green, yellow) above the letters.
- Navigation Buttons:** 'Choose a food or drink' (purple), 'Favourites' (purple), 'Start again' (red), and 'Finished' (green).
- Title:** 'Items you have chosen:'
- Selected Items List:**
 - Cranberry juice:** Includes a glass of red juice icon, a 'Remove' button, and an 'Up' arrow.
 - Banana:** Includes a banana icon, a 'Remove' button, and a 'Down' arrow.



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




Is this food/drink you are having now, or
is it something that you had earlier?

Now

Earlier








Skip

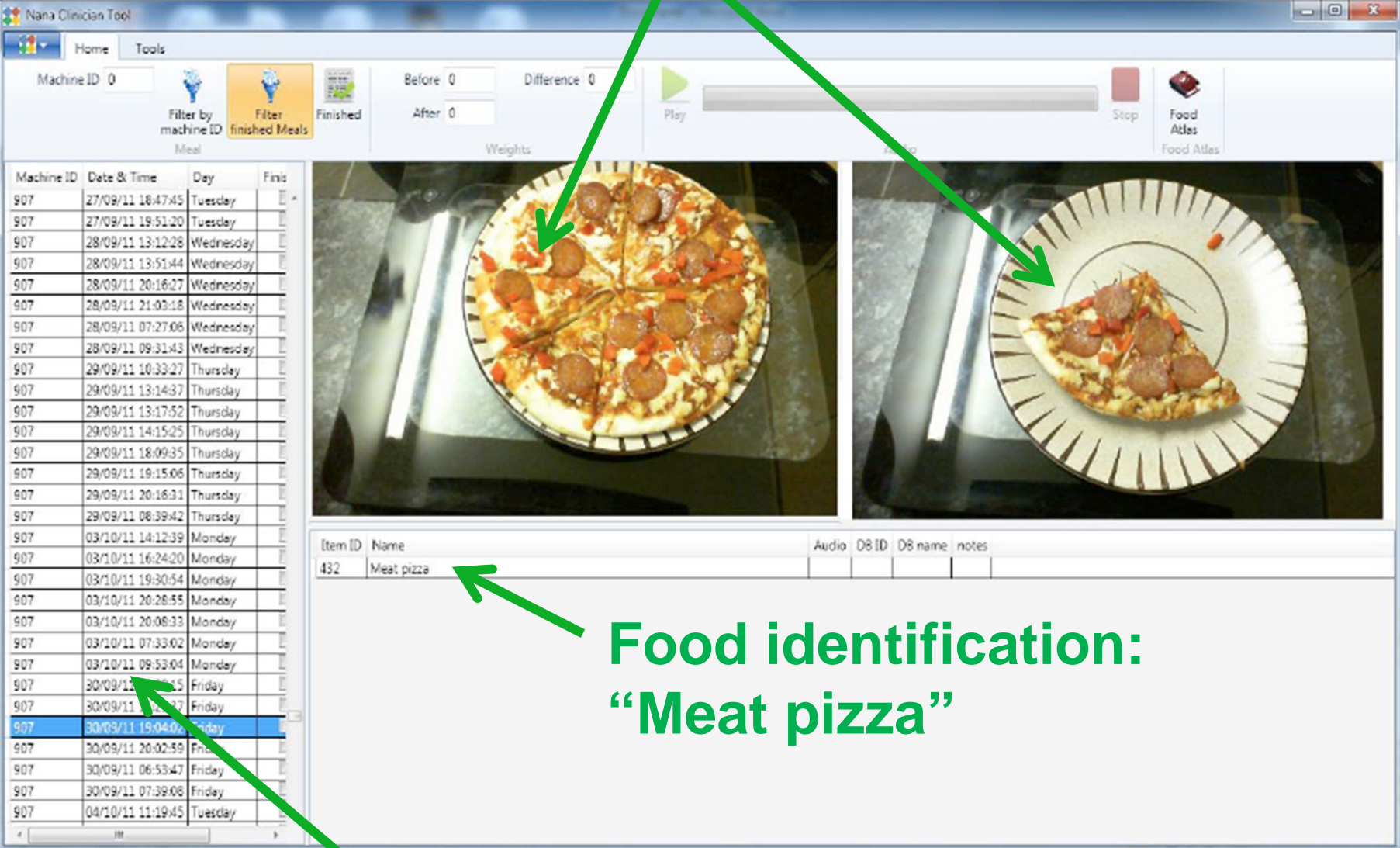
Please describe the amount you ate/drank.

Recording will begin when you press the Start button.



Stop

Portion size



The screenshot displays the Nana Clinician Tool interface. On the left is a table with columns for Machine ID, Date & Time, Day, and Finish. The right side features a video player with two images: a whole pizza and a single slice. Below the images is a table for food identification with columns for Item ID, Name, Audio, D8 ID, D8 name, and notes. A green arrow points from the text 'Portion size' to the slice image. Another green arrow points from the text 'Food identification: "Meat pizza"' to the 'Meat pizza' entry in the table. A third green arrow points from the text 'One entry per meal' to the highlighted row in the meal log table.

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 per meal

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 “in the wild” deployments

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

3rd validation

Participants

- 40 older adults (16 men)
- Mean age of 72.39 years, range 65 - 89
- 20 from Sheffield, 20 from St. Andrews
- Living independently in the community
- No serious illnesses, no anticipated deviations from their usual diet

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>.

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	█



of
69

Morning



Mid-morning



Mid-day/afternoon



Mid-Day/afternoon



Afternoon



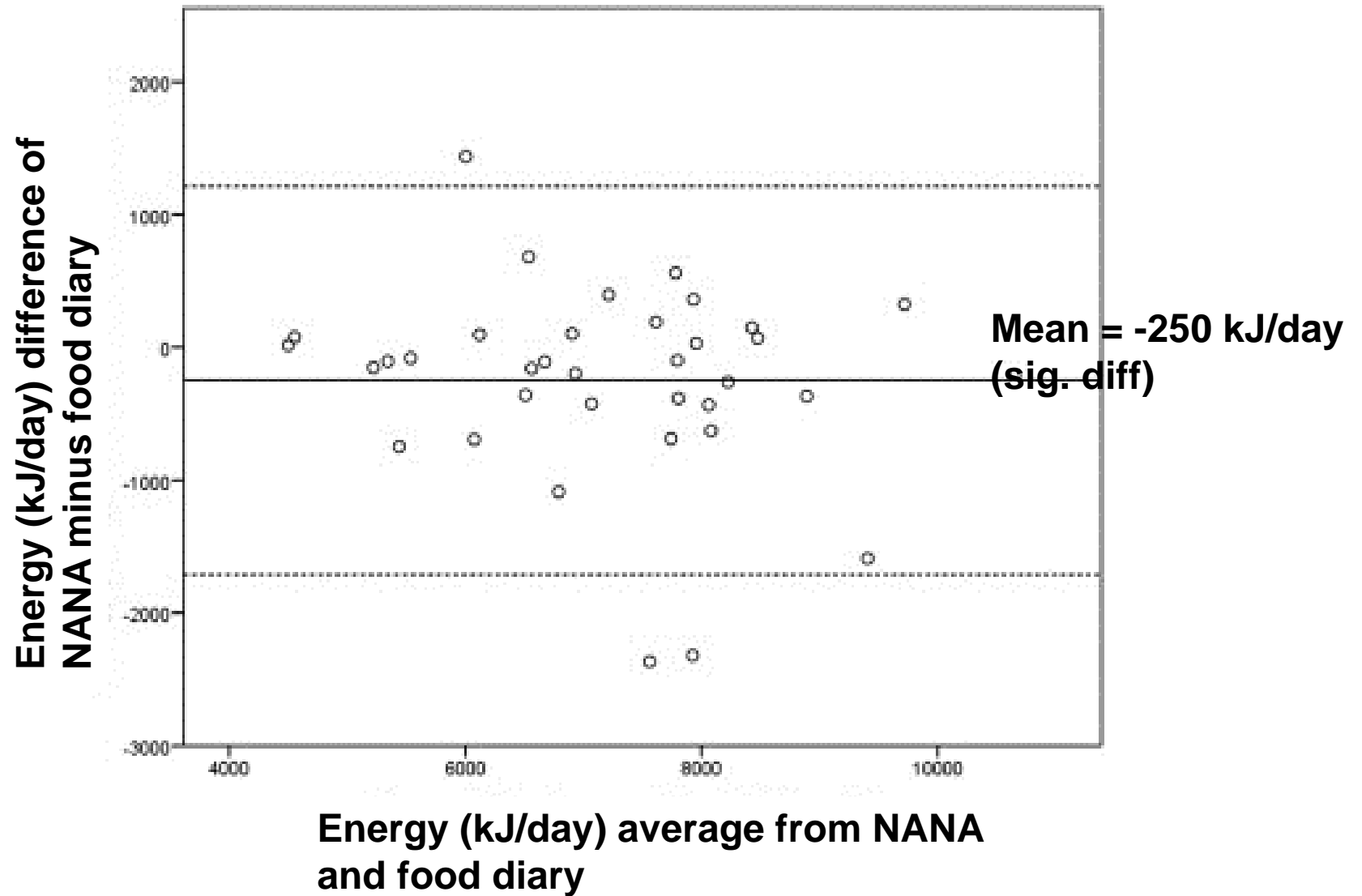
Evening



Dietary validation results

	Food diary mean (SD)	NANA mean (SD)
Energy (kJ/day)	7348 (1502.9)	7098 (1381.8)
Carbohydrates (g/day)	192 (55.6)	185 (51.8)
Protein (g/day)	79 (17.5)	76 (16.0)
Fat (g/day)	70 (18.2)	71 (17.0)

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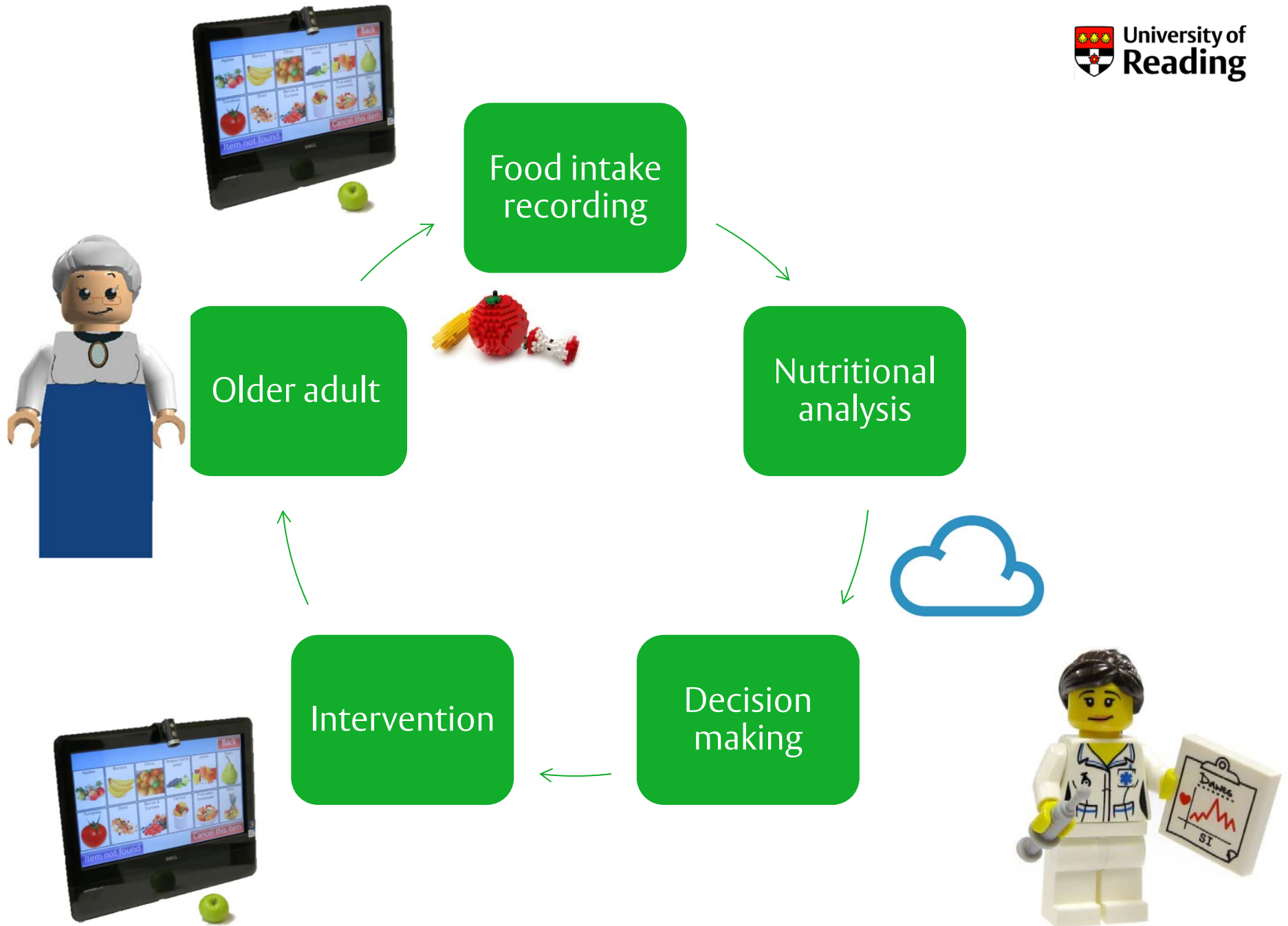
Validation of cognition, mood, physical activity and physical function

- Good completion rates of the self-administered measures
- Cognition, mood, and grip strength – correlations between traditional measures and NANA
- Physical activity – hours of physical activity reported using traditional assessment was higher than with NANA

Discussion

Proof-of-principle established:

- Deployed in 100 homes, real-world settings
- Usable by and acceptable to older adults
- Allows for regular assessment via computer
- Good validity





Acknowledgements



All Participants

Funders

The NANA team

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Claire Timon

Lin Maclean

Daynor Spurr

Hassane Khadra

Simon Halsey

Alan Godfrey

Bridey Monger

NANA Advisory Panel



Thank you.



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