



Using technology methods for dietary assessment among:

Women during pregnancy

Children

Age of Study Participant (SP)	Main Respondent
2 to 5 years	Proxy
6 to 11 years	SP, with Proxy Assistant

Source: National Health and Nutrition Examination Survey, Mobile Exam Center in-person dietary interviewers procedures manual.



Different approaches to enhance dietary assessment with images

- Passive
 - Wearable camera/other devices
 - Lots of images/data collected
 - Users do not need to be “engaged”
 - Need to detect eating events
 - Images can be used for other things
 - Privacy issues
- Active
 - Use mobile telephone
 - Focused images
 - Users are “engaged”
 - Useful contextual information
 - Better quality images



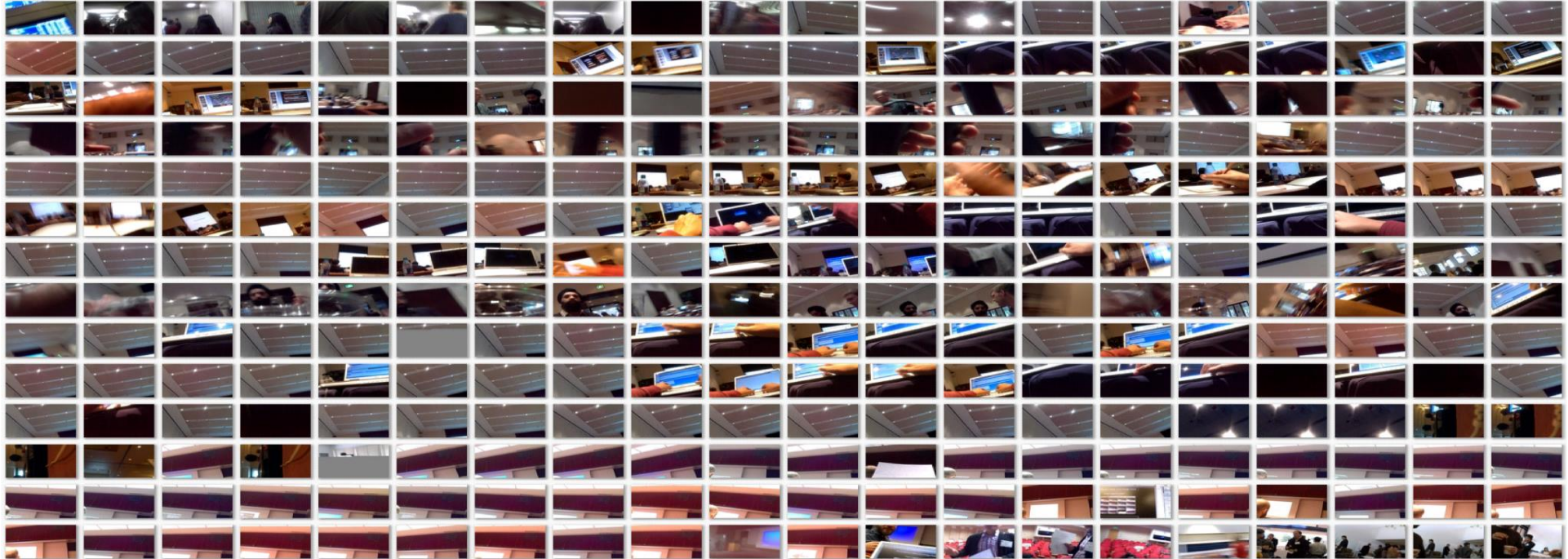


Passive Approach

- Passive Approach
 - ~ 1 image/5 sec → 400,000 images/day – most not related to food
- Active approach
 - ~ 6-12 images/day



Passive Approach



Time elapsed 24 minutes

Active Approach

Time elapsed 24 hours

Example of 1-day
images captured with
the mobile food record
showing the eating
occasions and time for a
woman

BMI = 32.8

Eating Occasions = 8



06:36



10:14



13:03



15:13



17:54



18:28



18:54



21:35



One Eating Occasion

Passive

Active



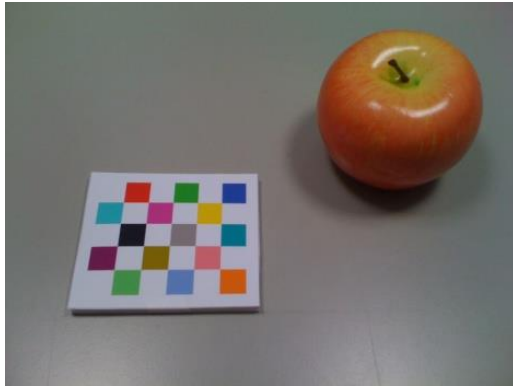
35 images from ~ 180 images over a 15
minute eating occasion



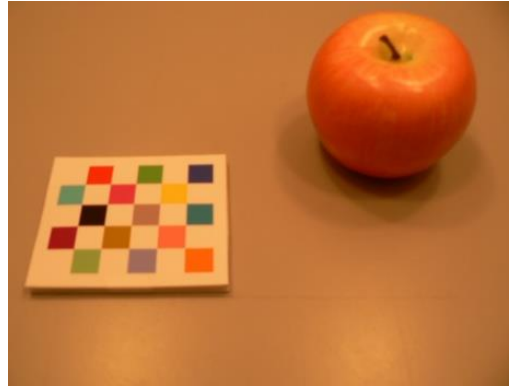


Color Fiducial Marker

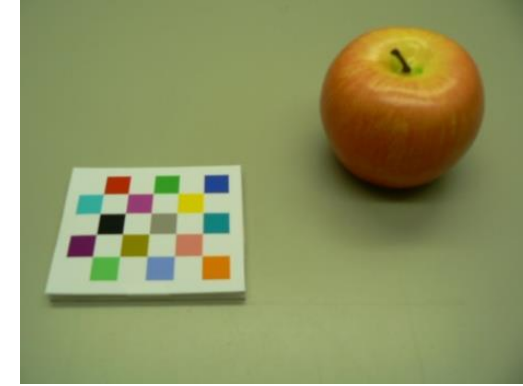
Reference Illumination



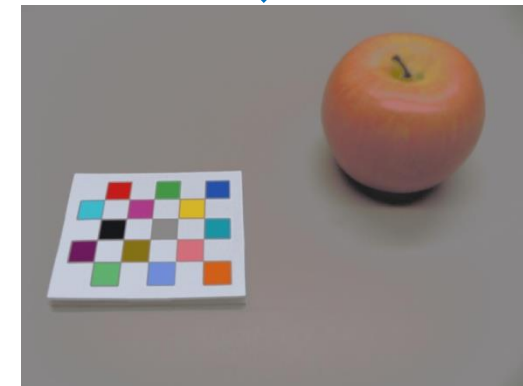
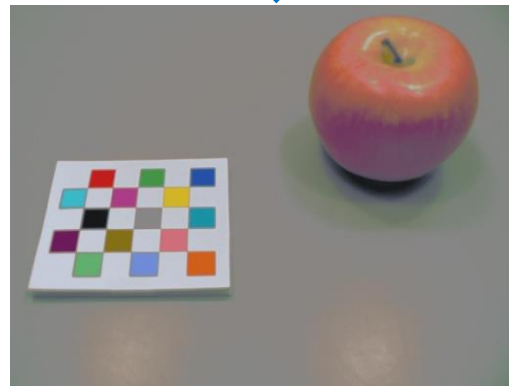
New Illumination #1



New Illumination #2



Color Correction

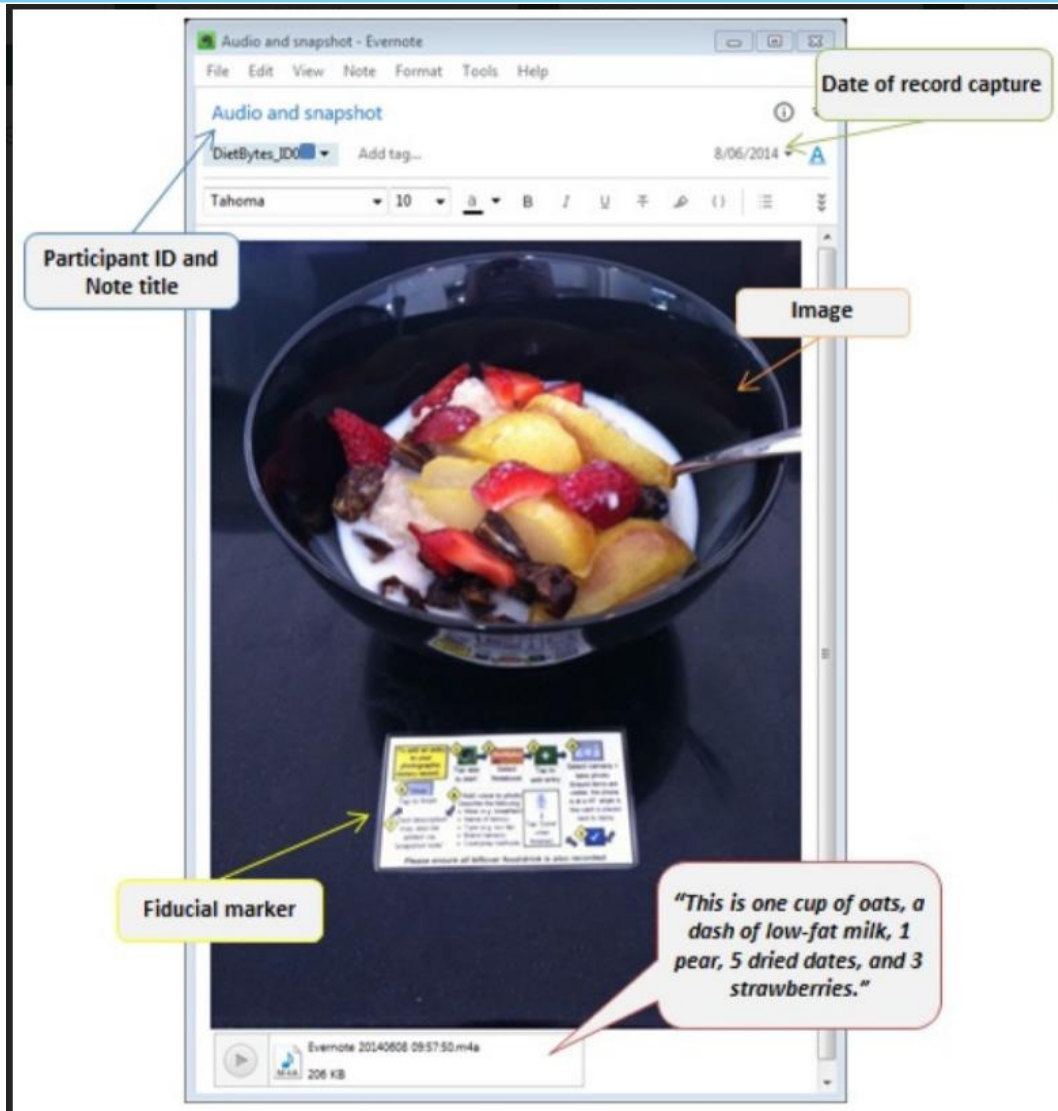




Pregnancy



Compare a smartphone image-based dietary assessment to 24-h recalls among pregnant women



- Diet Bytes and Baby Bumps Study
- Audio and “snapshot” available for recording
- Fiducial Marker

Rollo ME et al Nutrients, 2015; Ashman AM et al JMIR mHealth and uHealth 2016.



Summary: Compare a smartphone image-based dietary assessment to 24-h recalls among pregnant women

- 25 women, median age 29 years
- Intakes from the image-based method were compared to intakes collected from three 24-h recalls, taken on random days; once per week, in the weeks following the image-based record.
- Significant correlations between the two methods were observed for energy, macronutrients, micronutrients and fiber ($r = 0.58\text{--}0.84$, all $p < 0.05$).
- Overall acceptable relative validity.



Another example of using images

- Twenty-three obese pregnant women used a smartphone app to capture images of food consumed (SmartIntake)
- The women also underwent dosing with doubly labeled water (DLW)
- Thus, energy intake estimated from the app could be compared with energy expenditure from DLW
- Energy intake from SmartIntake was 63.4% of energy from DLW
- Among this group, the SmartIntake appeared to under estimate energy intake compared to DLW.



Possible explanations

- Participation higher when participants used their own mobile phones to take food images.
- Reported energy intake was significantly higher compared to participants provided with an iPhone.
- Carrying and using an additional phone may increase burden and reduce compliance with recording.
- Consider exclusion of days when energy below 60% of total daily energy expenditure.



Thoughts forward

- Studies addressing dietary intakes of pregnant women appear to under use digital technology
- Self-administered web based questionnaires appear to be more widely used
 - e.g., Validation of a self-administered web-based 24-hour dietary recall among pregnant women (Savard et al BMC Pregnancy and Childbirth 2008)
 - e.g., Use of a web-based dietary assessment tool in early pregnancy (Mullaney et al Ir J Med Sci 2016)



Ages 2 to 11 years old



Validation & Feasibility/Preschool Children

Overall Total Food in Grams	Estimated Weight, Mean $\pm$ SD	Actual Weight, Mean $\pm$ SD	Food Intake, Mean $\pm$ SD	Paired <i>t</i> test, <i>P</i>
Metabolic Research Unit: Validation study	244.8 $\pm$ 28.9	255.4 $\pm$ 29.9		0.11
n=22 pre-school children for one eating occasion				
	Food Selected, Mean $\pm$ SD	Plate Waste, Mean $\pm$ SD	Food Intake, Mean $\pm$ SD	
Head Start (HS): Feasibility study	217.6 $\pm$ 48.1	69.8 $\pm$ 39.4	147.8 $\pm$ 56.8	
n=12 HS children for 3 lunch meals				
Home environment: Feasibility study	232.2 $\pm$ 44.5	78.2 $\pm$ 23.0	154.2 $\pm$ 39.0	
n=12 HS children for 3 home dinner meals				



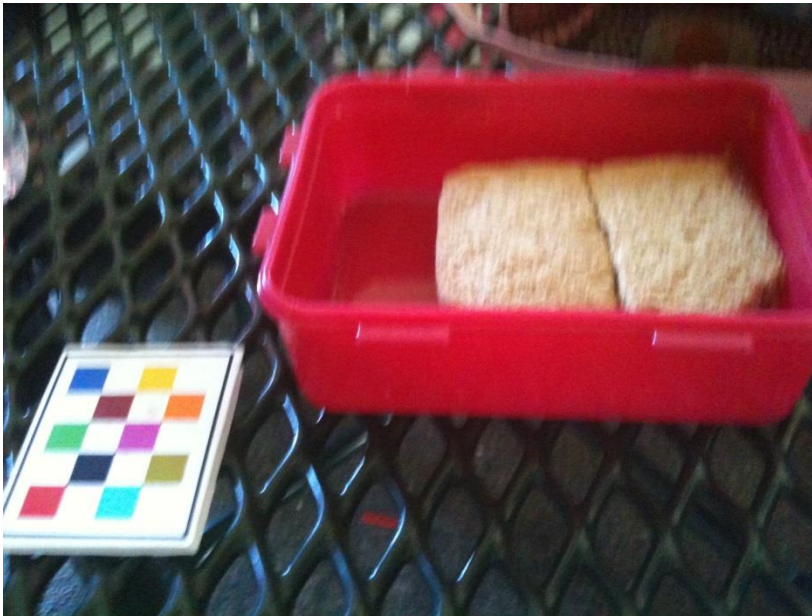
Assessing dinner meals eaten at home

- Captured before and after dinner meal images of preschoolers intakes using the Remote Food Photography Method (RFPM)
- 31 families in Head Start/preschool programs with children 3-5 years enrolled.
- Captured dinner meals over 1 week
- Parents trained in-person to use the RFPM (best practices for capturing images and labeling)



Examples

Before eating



After eating



How old is this participant?

3 years old!



Using the mobile food record (mFR)

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- Brief instructions for children:
 - Researcher demonstrated mFR use
 - Distributed mFR, Fiducial marker & wristband
 - Children (3-10 y) asked to demonstrate taking a usable image pair

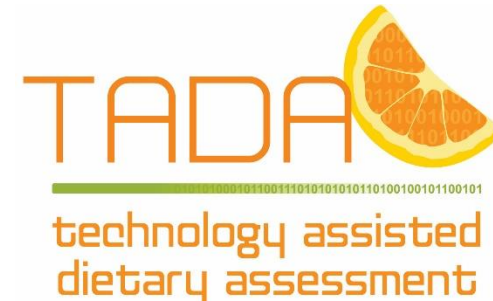


Before eating

After eating



- Images auto-loaded to the cloud





Examples

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Before eating



After eating



How old is this participant?

5 years old!



Methods: unique to each sample

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Sample 1

Children possessed
mFR for 6 to 8 hours

- 1-4 opportunities to take image pairs:
 - Practice, AM snack, lunch, and PM snack
- Brief questionnaire:
 1. Usability of mFR
 2. Acceptability of mFR
 3. Carry the FM

Sample 2



- Carrying case and charger





Examples

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Before eating



After eating

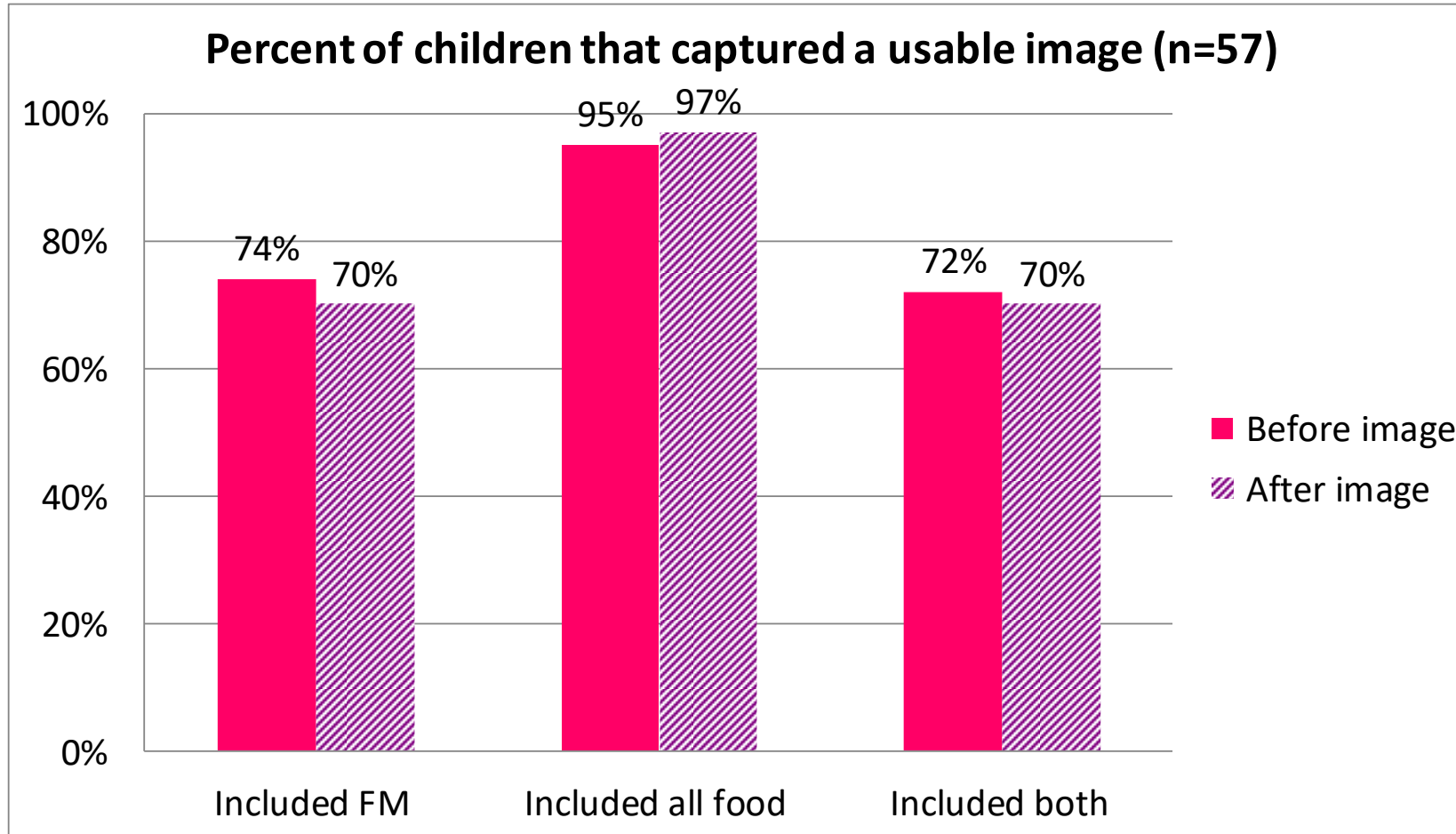


How old is this participant?

9 years old!

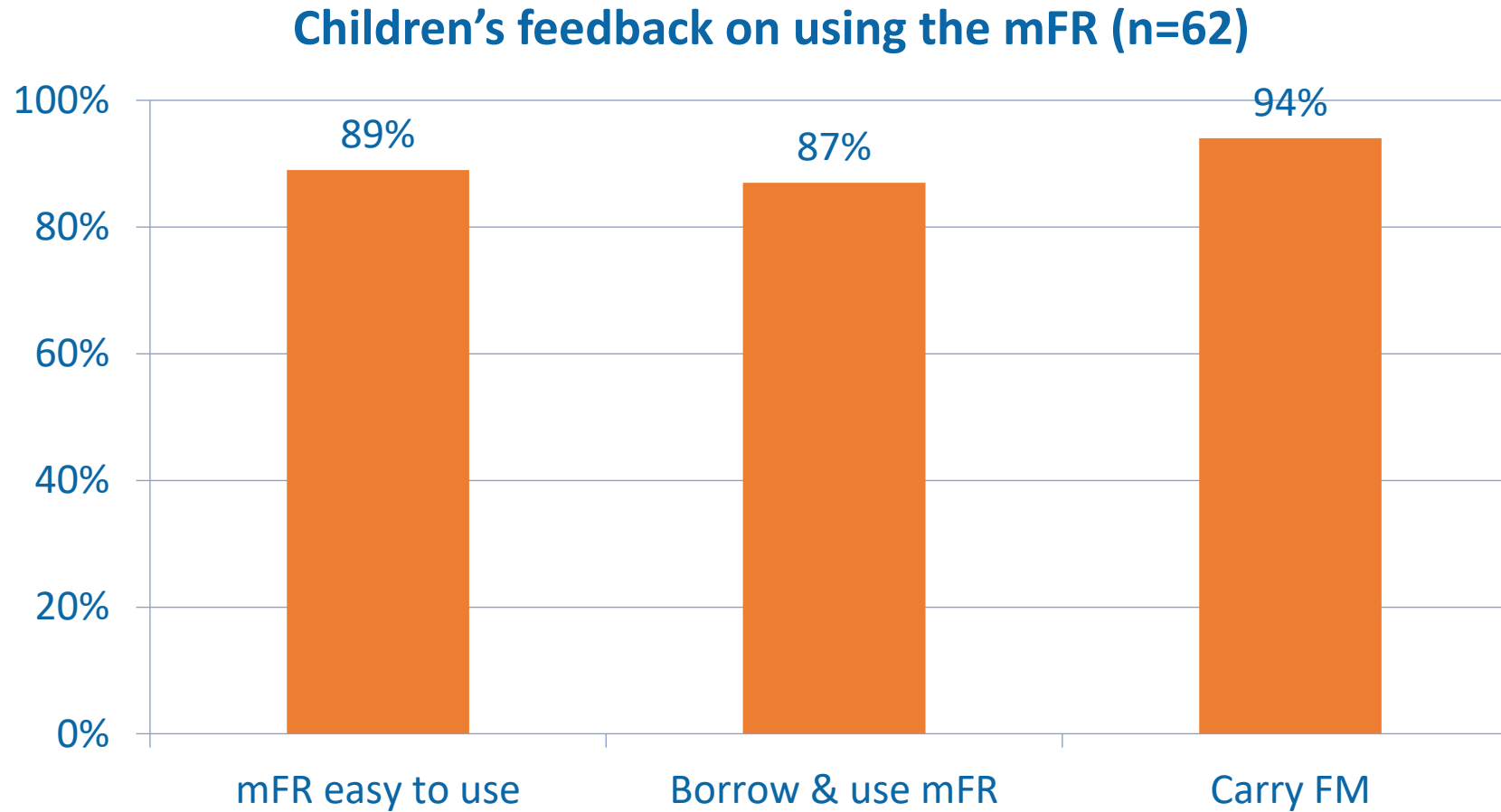


Sample 1 Results: usable image





Sample 1 Results: Feedback



Sample 2 Results (n=63)

Number of children	Age	Length of time mFR used	Number of image pairs per day
n (percent, %)	Mean (years)	(days)	Median (range)
Time 1			
4 (6)	5.5	0	0
8 (13)	7.7	1	1.00 (1.00-4.00)
20 (32)	8.2	2	2.00 (1.00-4.00)
20 (32)	8.2	3	2.42 (1.33-6.00)
11 (17)	9.8	4+	2.67 (1.33-4.25)
Time 2			
14 (22)	7.8	0	0
5 (8)	7.8	1	1.00 (1.00-2.00)
16 (25)	8.3	2	2.00 (1.00-5.00)
18 (29)	8.3	3	1.83 (1.00-3.33)
10 (16)	8.0	4+	1.75 (1.20-3.75)



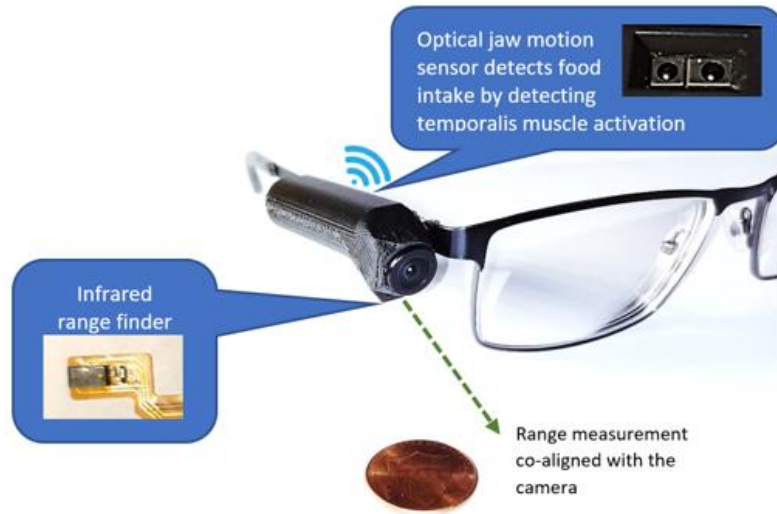
Sample 1 Results: Return undamaged

- All children (n=63) returned the mFR undamaged!





Chewing sensor & other sensors: passive

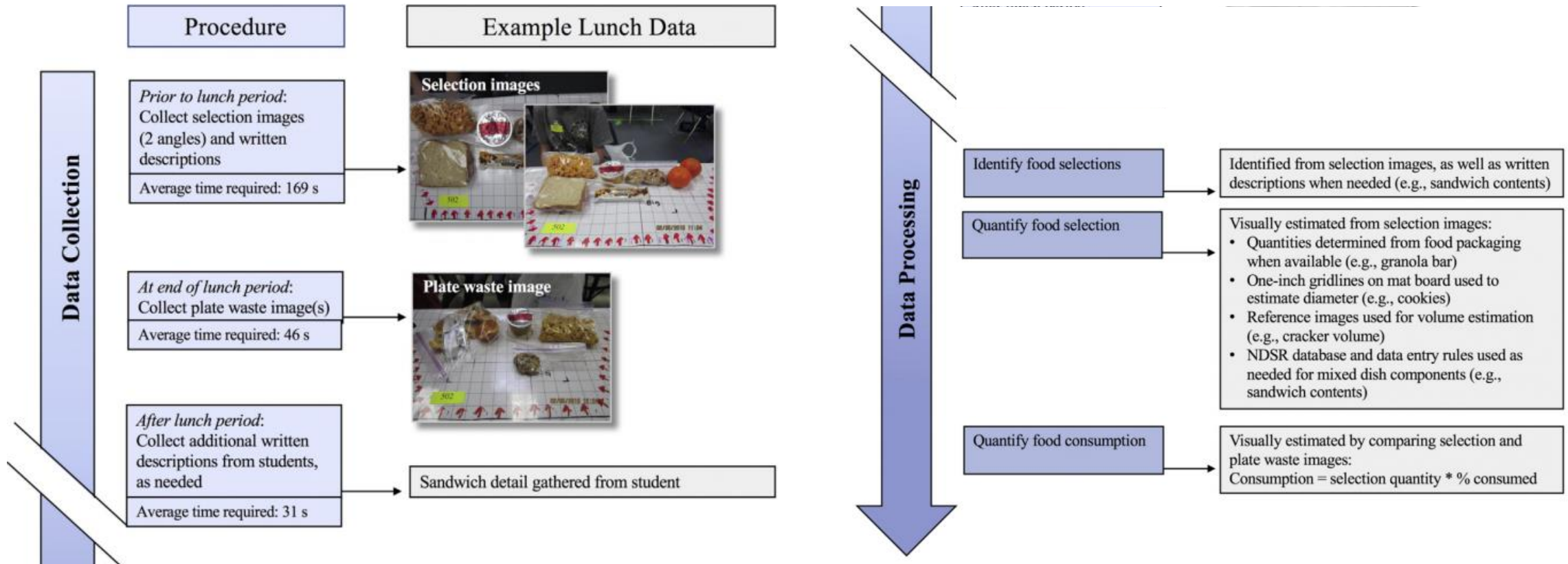


- Passive
- Continuous video feed (can be turned off)
- Multiple sensors for detecting chewing





Procedures for collection & processing





Procedures for collection & processing



1A



2A



1B





Conclusion & Next Steps

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- Given instructions, children 3-10 years old can use the Mobile Food Record to record their dietary intake
- Results do support the need to include parents to help with reminders that are tailored to the child's age.
- All of the methods shared today and in use by others appear to hold promise for child use.

