

Role of sensory signals in eating behavior and nutrition

April 2022, Kees de Graaf, Vlaardingen



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Sensory, eating behavior, and nutrition

- Some history
- Sensory beyond liking
- Role of taste and texture in energy intake and obesity
- Future on sensory, health and wellness



Sensory in 1980's

- Little link to consumers, marketing
- Attitudes
- Descriptive methods; Spectrum; QDA, profiling
- Scaling methods, VAS vs. magnitude estimation; ratios vs. differences
- Context



Meiselman, Pangborn 2021 lecture



Sensory in 21 st century

- Beyond liking; well being, emotions
- Nutrition and health; satiation
- Children, development of food preferences
- Elderly and nutritional status
- Implicit methods
- Big data/AI



Meiselman, Pangborn 2021 lecture

Beyond liking: sensory science is the bridge between food and health



Sensory Science





People living with HIV/AIDS



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Sensory science → health and wellness

- Sensory signals → positive emotions
- Development of food preferences
- Taste, texture, satiation and energy intake/obesity
- Fast foods, slow foods, food ultraprocessing
- Ambient odors and healthy food choices
- Taste and smell in health and disease
 - Chemotherapy in cancer treatment
 - Covid – related smell and taste loss
 - Anosmia



The role of taste and texture in energy intake in obesity

- Role of texture in satiation
- Sensory epidemiology



A calorie is not a calorie



1575 kCal



1575 kCal



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Source: Barbara Rolls



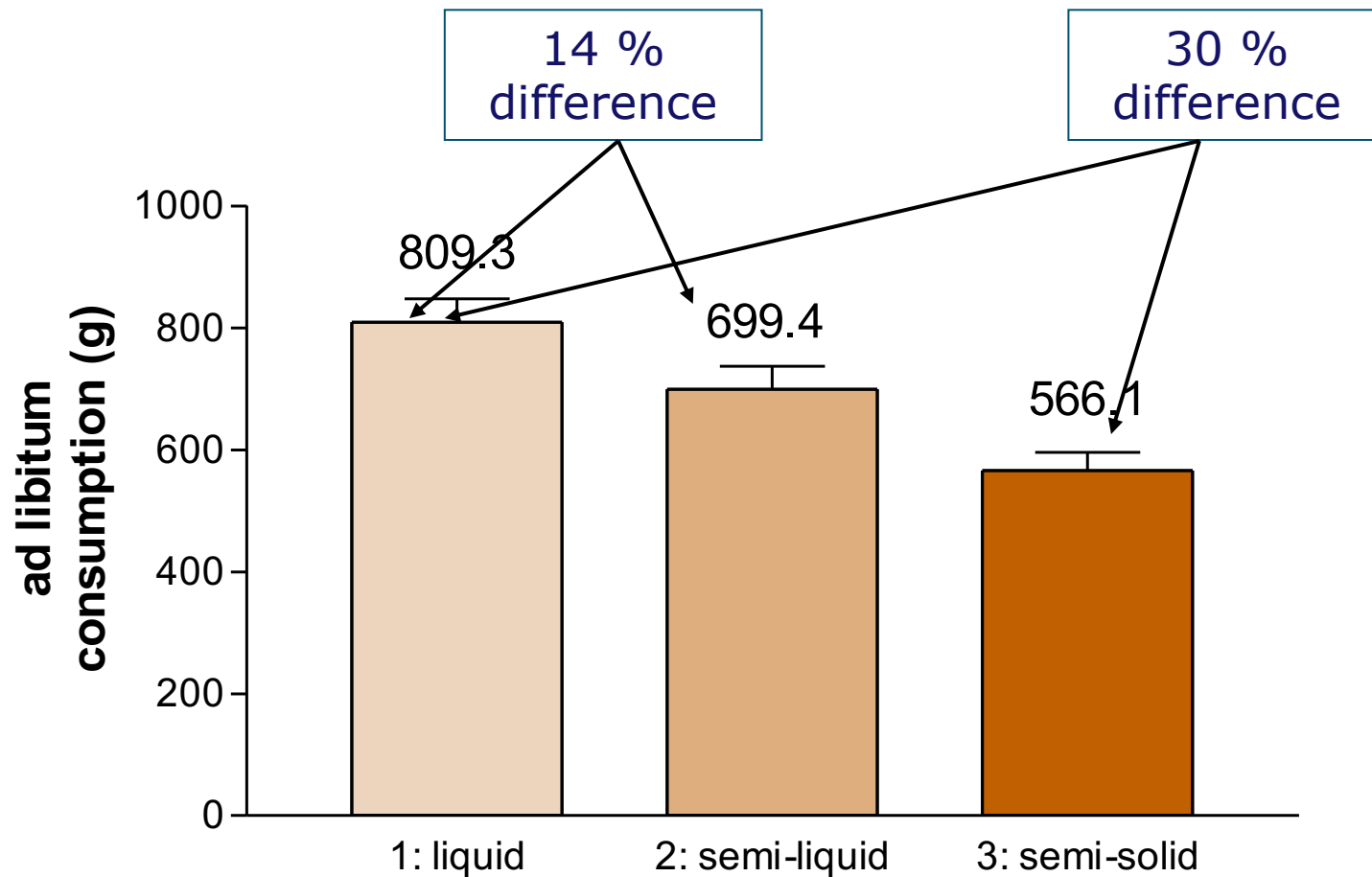
Viscosity, eating rate and satiation



- Study design:
- 108 Subjects
- Natural situation (cinema)
- 3 'blind' test products
 - Liquid
 - Semi-liquid
 - Semi-solid
- Test products similar in pleasantness, energy density and macronutrient composition



Ad libitum consumption



Test conditions

1. Free eating rate, different effort
→ consumption with a straw
2. Free eating rate, no effort
→ consumption with peristaltic pump
3. Fixed eating rate, no effort
→ Consumption with peristaltic pump
→ 50 g/min men; 40 g/min women



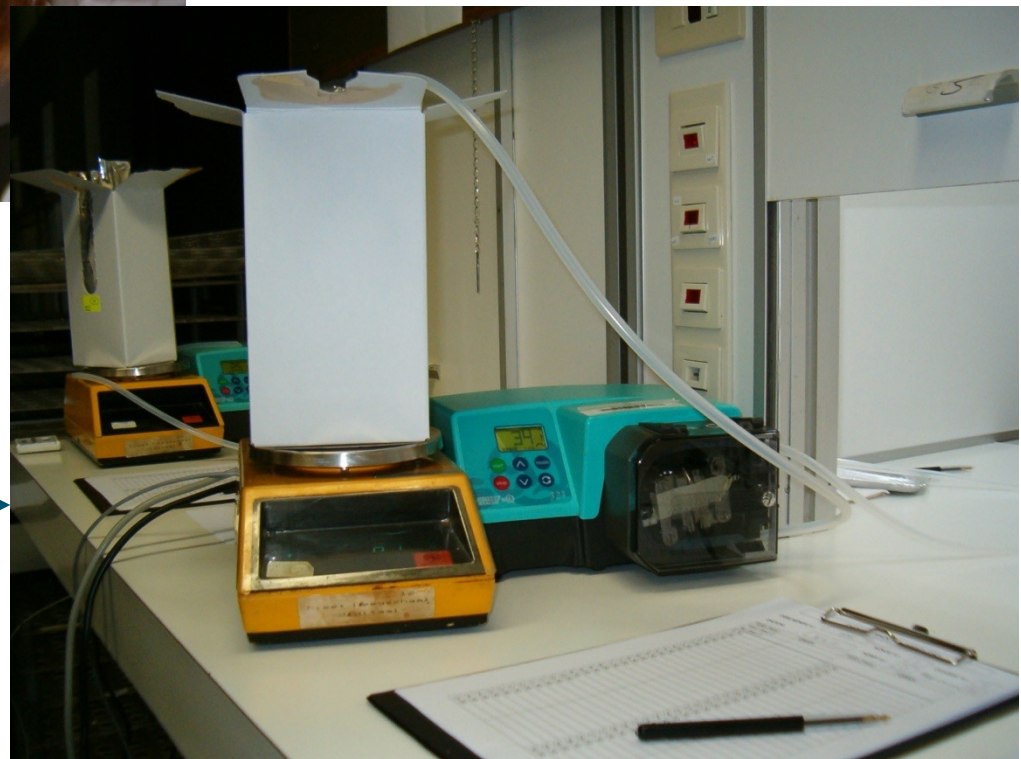


Free eating rate (no effort):

Subjects control the pump themselves

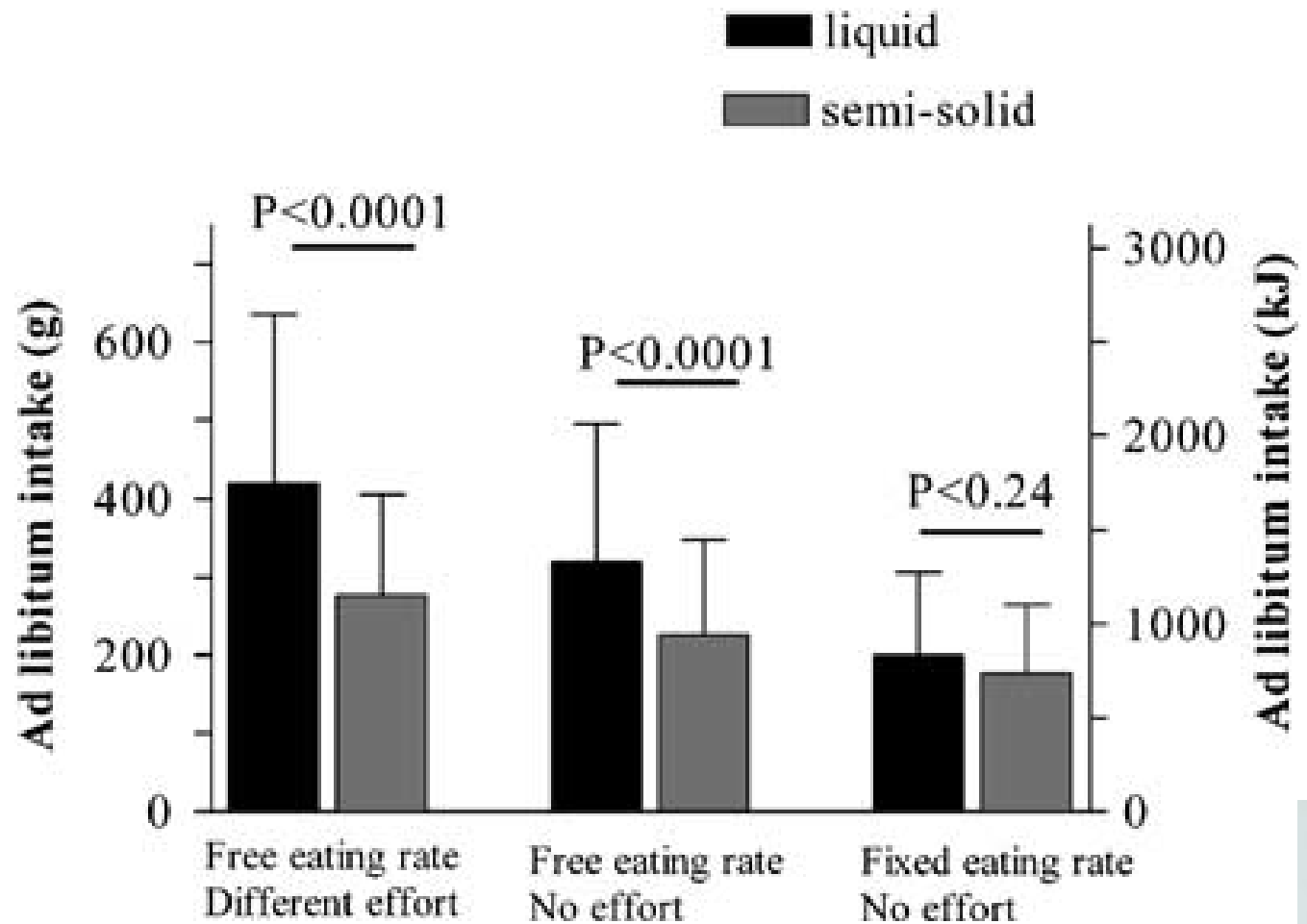
Fixed eating rate (no effort).

Pump 50 or 40 g/min, not visible to the subjects



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Results



Slow Food: Sustained Impact of Harder Foods on the Reduction in Energy Intake over the Course of the Day










Dieuwerke P. Bolhuis^{1*}, Ciarán G. Forde², Yuejiao Cheng¹, Haohuan Xu¹, Nathalie Martin², Cees de Graaf¹

- 50 Ss → lunch wit hamburger and rice salad, either hard or soft version of it → ad libitum intake
- Assessment of energy intake compensation throughout the remainder of the day



Sensory and physical characteristics of foods that impact food intake without affecting acceptability: Systematic review and meta-analyses

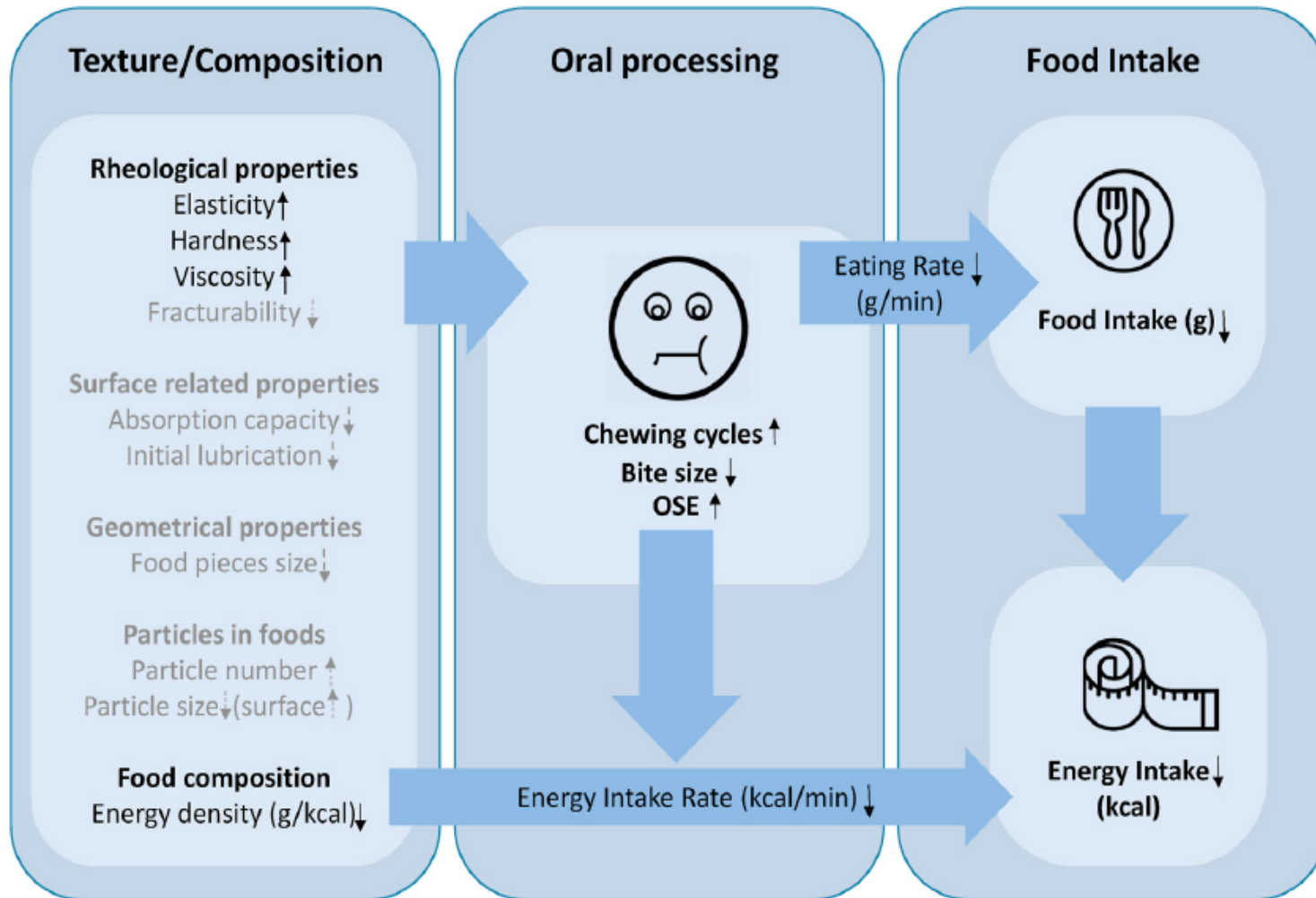
Katherine M. Appleton¹  | Annie Newbury¹ | Eva Almiron-Roig²  |
Martin R. Yeomans³  | Jeffrey M. Brunstrom⁴  | Kees de Graaf⁵  |
Lucie Geurts⁶  | Heidi Kildegaard⁷ | Sophie Vinoy⁸ 

Conclusion in abstract:

investigated effects on subsequent intake. Meta-analyses of within-subjects comparisons (random-effects models) demonstrated greater satiation (less weight consumed) from food products that were harder, chunkier, more viscous, voluminous, and/or solid, while demonstrating no effects on acceptability. Textural parameters had lim-



Model relating texture to oral processing to food intake



Sensory epidemiology

- Comparing sensory characteristics of diets across population groups
- Young, old, normal-weight vs. overweight; different cultures
- Helpful in establishing the role of sensory signals in health and disease
- Some examples on sweetness; sweetness → obesity ?



Selection foods based on food consumption surveys

- Selection of commonly consumed foods by 24hDR
 - DNFCS 2007-2010; n=1,402, 19-50y

- Consumption frequency >20%
- Energy, macronutrients, sodium
- Brands & cooking methods

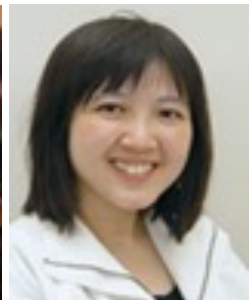


- ✓ A total of 469 Dutch foods, 83% of total energy intake

Teo et al, FQAP, 2018



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The Dutch reference scale for sweetness

- Modified Spectrum method with standard concentrations of sucrose (2, 5 and 10 g/100 ml) in water as reference points on VAS sweetness intensity scale of 100 mm
- First training with solutions and simple foods, and later with more complex foods with fixed references (> 50 hours of training)

Sweet



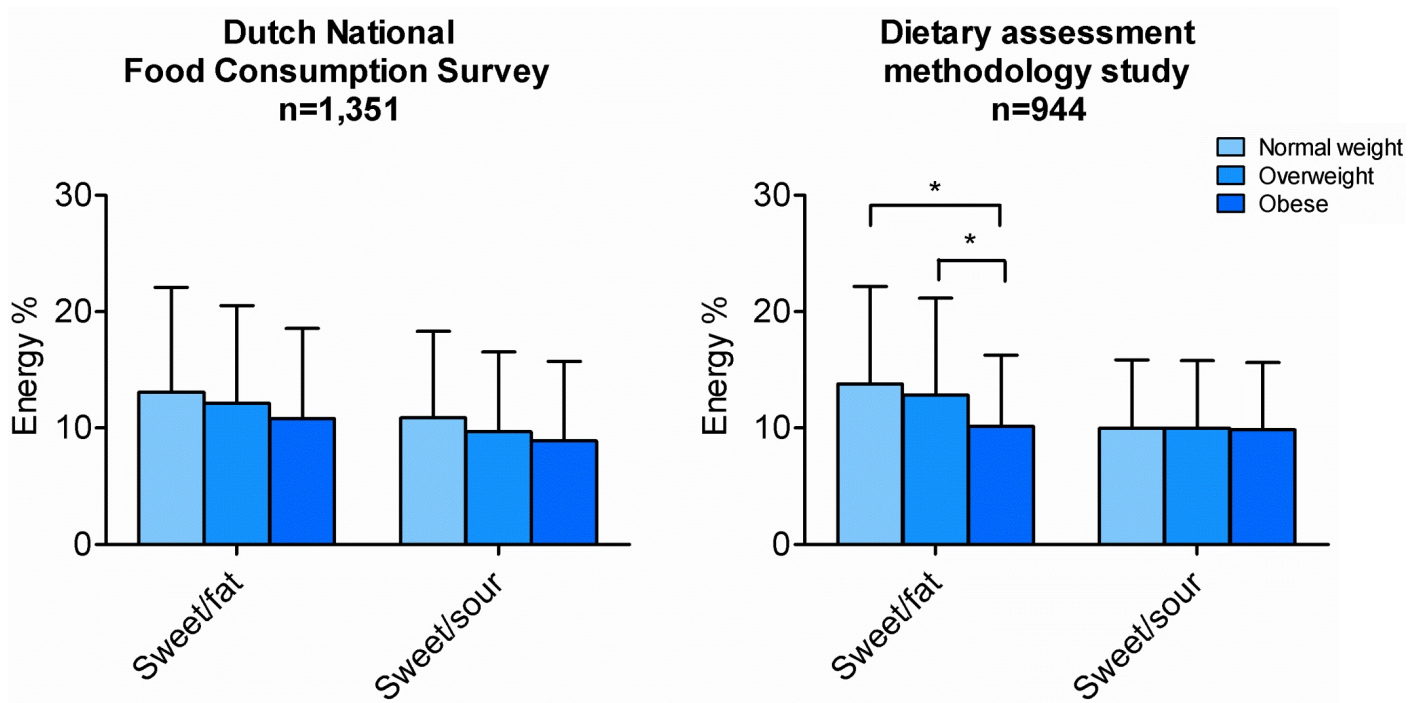
Dutch taste database → Six taste clusters

In total 476 foods (Dutch National Food Consumption Survey 2007-2010)

Food product	Taste intensity (0-100 mm)						Cluster
	Sweet	Sour	Bitter	Salt	Umami	Fat	
Apple with skin average	22	40	1	1	1	3	Sweet/sour
Bread brown wheat	3	2	3	13	0	8	Neutral
Mayonnaise	10	33	1	8	25	76	Fat
Coffee prepared	2	9	63	3	1	4	Bitter
Cheese Gouda 48+ average	6	18	1	41	17	51	Salt/ umami/fat
Chocolate bar milk nuts	65	2	3	5	11	64	Sweet/ fat

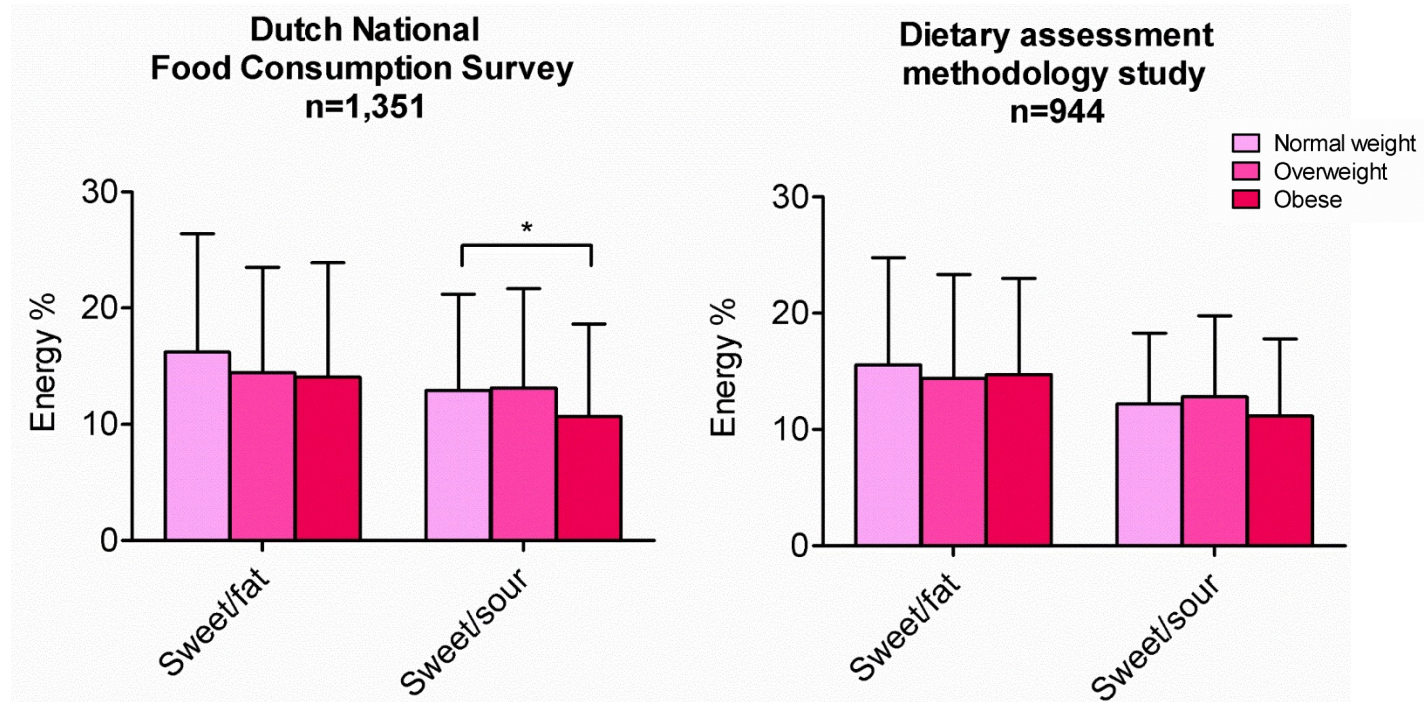


Contribution of sweet/fat and sweet/sour taste clusters as a function of reported weight status in two samples of Dutch men



Van Langeveld et al, Brit J Nutr 2018

Contribution of sweet/fat and sweet/sour taste clusters as a function of reported weight status in two samples of Dutch women

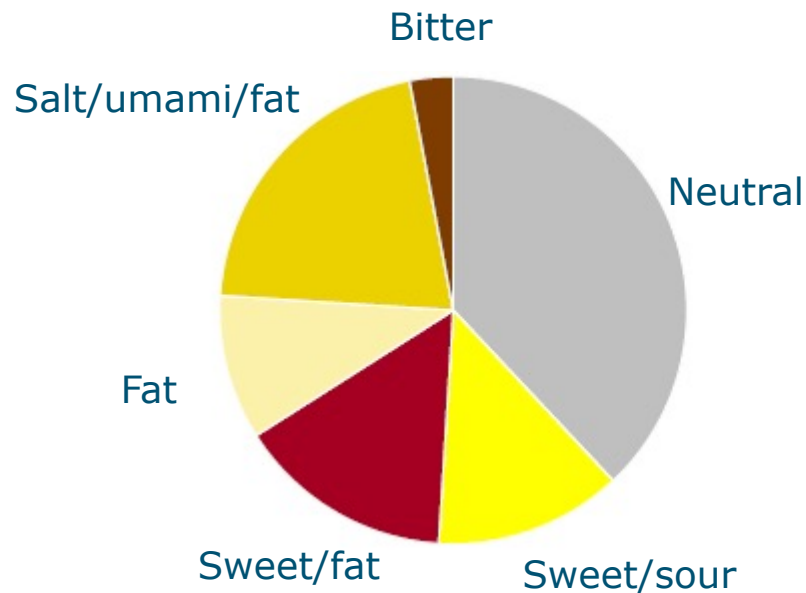


Van Langeveld et al, Brit J Nutr 2018

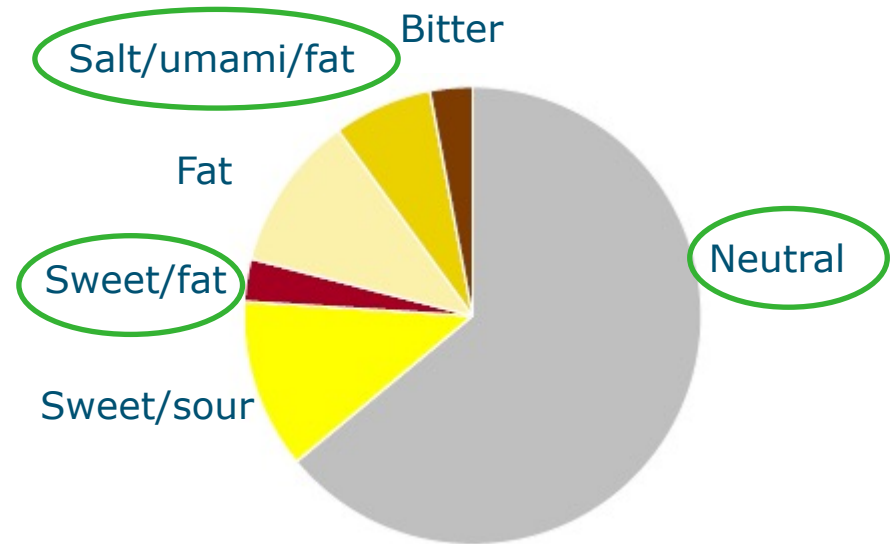


Taste profiles of different diets

Current (adult woman)



Recommended



Taste patterns among 1 and 2 y olds in the Netherlands

66

Nguyen et al.

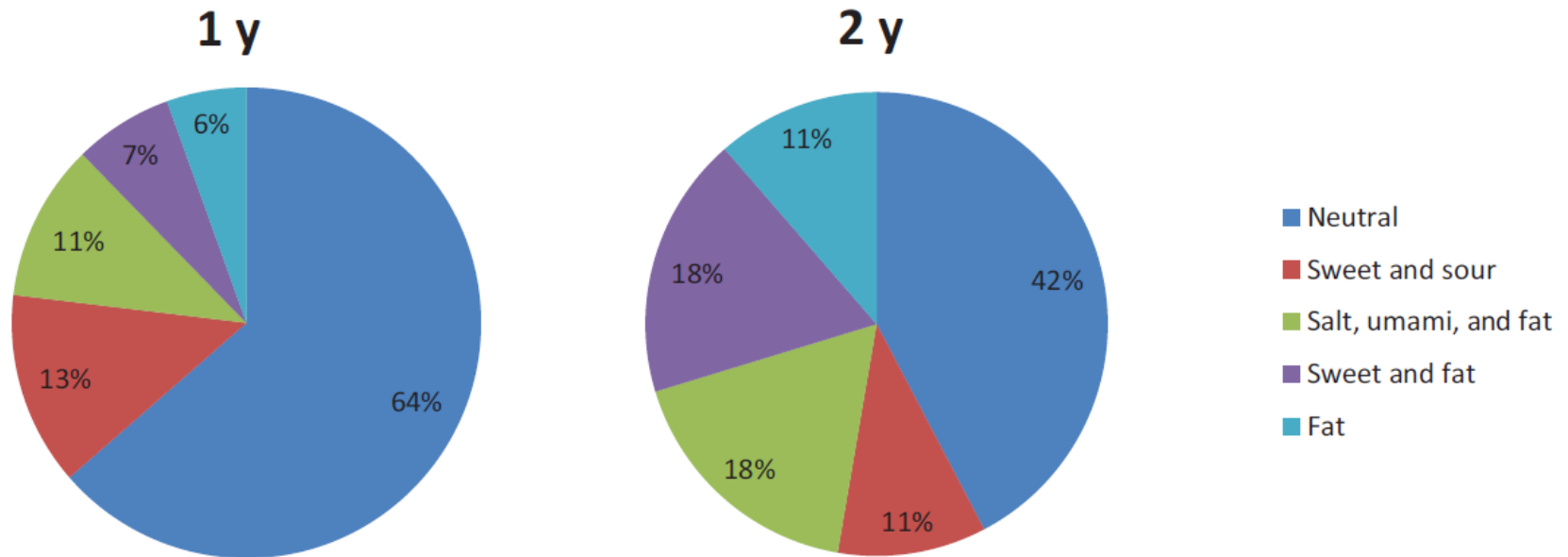


FIGURE 1 Percentage energy intake from each taste pattern in children at the ages of 1 y ($n = 3629$) and 2 y ($n = 844$).

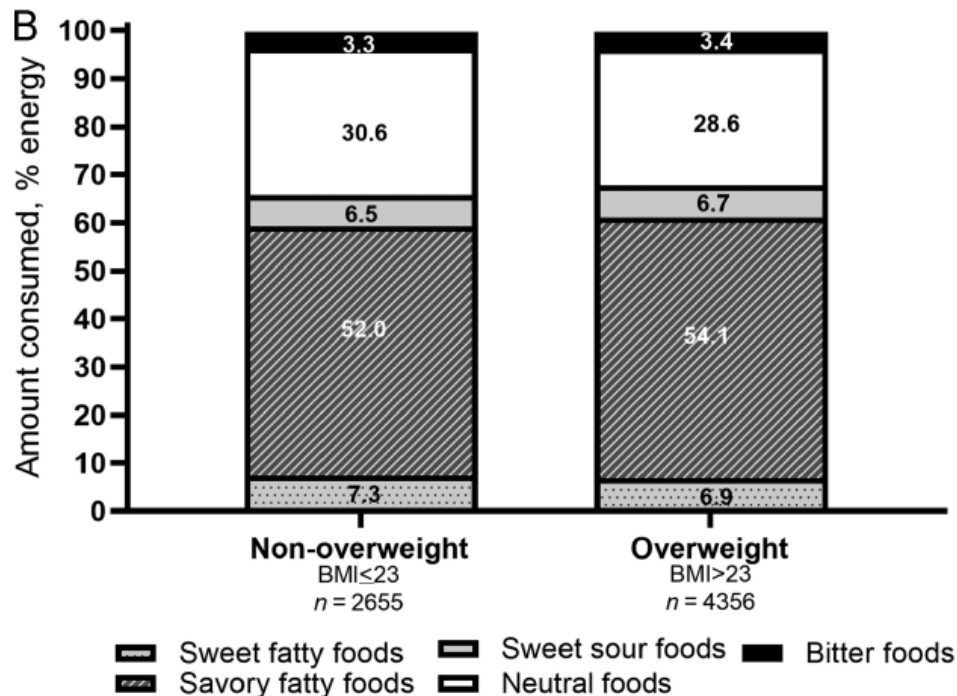
Nguyen et al, Am J Clin Nutr 2020



Taste of Modern Diets: The Impact of Food Processing on Nutrient Sensing and Dietary Energy Intake

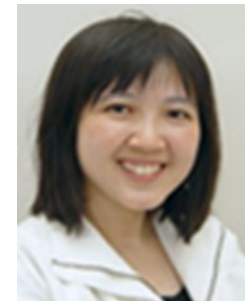
Pey Sze Teo,¹ Rachel Tso,¹ Rob M van Dam,² and Ciarán G Forde^{1,3,4}

¹Clinical Nutrition Research Centre (CNRC), Singapore Institute of Food and Biotechnology Innovation (SIFBI), Agency for Science, Technology and Research (A*STAR), Singapore; ²Saw Swee Hock School of Public Health, National University of Singapore, Singapore; ³Department of Physiology, Yong Loo Lin School of Medicine, National University of Singapore, Singapore; and ⁴Sensory Science and Eating Behavior, Division of Human Nutrition and Health, Wageningen University, Wageningen, The Netherlands



Taste profiles of the diets of non-overweight and overweight individuals in Singapore ;

Note: low amount of sweetness



Sensory science, eating behavior and nutrition; future developments

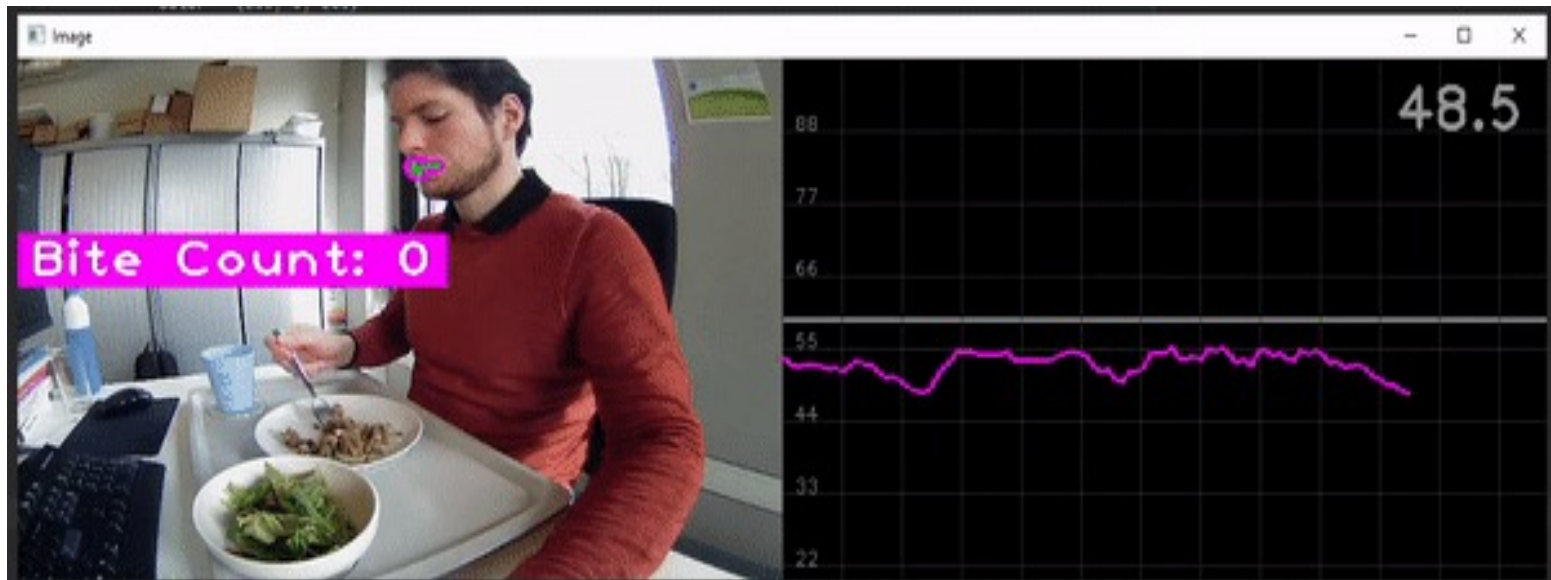
- Food processing, taste/texture properties, energy intake and obesity
- Automatic detection of eating behavior with the help of AI
- Dietary recommendations; reduction of salt, sugar, fat; increase vegetable/fruit consumption; all have a sensory dimension → sensory science → bigger role in public health discussion



mEETr version 2



45 cm from the center of the tray
at a 30 cm height



Symposium

Sweet dreams are made of this:
reflections on a tasty career in
sensory nutrition

Programme

Thursday 12 May 2022

Omnia building, Hoge Steeg 2, Wageningen

Symposium organized by the Division of Human Nutrition & Health at Wageningen University on the occasion of the retirement of Prof. Kees de Graaf. Colleagues and former PhD fellows give an impression of their current activities and vision on nutrition, sustainability and health, and give you an inspiring view on sensory nutrition.



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Guido Camps, master of ceremony

- | | |
|---------------|---|
| 12:00 – 13:00 | Welcome, registration and lunch |
| 13:00 – 13:30 | Keynote 1: Herb Meiselman
<i>'Where (places) and with whom (people) should we conduct sensory and nutrition research?'</i> |
| 13:30 – 14:15 | <i>'A journey in time'</i>
Gerda Feunekes , Executive Director, Netherlands Nutrition Centre
Sanne Griffioen-Roose , Manager Expert Team Sustainability FrieslandCampina
Marlou Lasschuijt , Assistant Prof. Sensory Physiological Aspects Eating Behavior, Wageningen University
Eva Cad , PhD-fellow on Sweet Taste Exposure Study, Wageningen University |
| 14:15– 14:45 | Keynote 2: Ciarán Forde , Prof. Sensory Science and Eating Behaviour, Wageningen University
<i>'Better living through sensory'</i> |
| 14:45– 15:00 | Katja Gruijters , Food Designer
Monica Mars , Associate Prof. Wageningen University
<i>'On the taste of diets and the tastes in the tea break'</i> |
| 15:00 – 15:45 | Tea Break: Tasty Bites by Katja Gruijters |
| 16:00 – 17:00 | Farewell address Kees de Graaf |
| 17:00 – 18:30 | Reception |
| 20:00 – 23:00 | Party with DJ Promiss |



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Thank you for your attention

Questions?



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