# Impact of Mixed Reality Food Labels on Product Selection: Insights from a User Study using Headset-mediated Food Labels at a Vending Machine

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Auto-ID Labs ETH / HSG: Our Chair combines research on internet of things in the retail & health domain (consumer health)

Auto-ID Labs ETH/HSG (Focus: Retail)

- Focus on research on IOT in the retail domain. Strong partnership with GS1 - the global standards organisation.

- Team: 2 Professors, 1 PostDoc, 3 PhD candidates (Lead: Klaus Fuchs)

- Auto- ID Labs as a network of research centers around the globe: MIT, ETH, Keio, KAIST, Tongji, Cambridge

- www.autoidlabs.ch

- www.autoidlabs.org
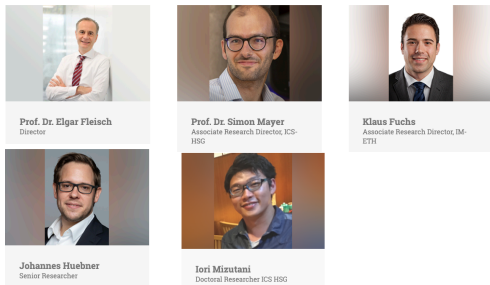
Center for Digital Health Interventions (Focus: Health)

- Focus on digital health interventions, incl. mobile coaches, chatbots and automatic sensing of health statuses in asthma, diabetes. Partnership with CSS - the largest Swiss health insurance.

- Team: 4 Professors, 9 PhD candidates (Lead: Dr. Tobias Kowatsch)

- www.c4dhi.org/

Motivation

Problem: Current diet tracking not supporting healthy choices in the supermarket, where most processed foods are purchased.

- **Diet tracking via diaries or mobile apps is effort-intense. 77% have never used a diet app, 18% stopped, only 5% actively use a diet tracking app**[1]**, despite their effectiveness when used.**

- **Most of unhealthy food is purchased in supermarket, esp. processed food**[2]**. But today's diet tracking apps are not designed for improving purchase decisions.**
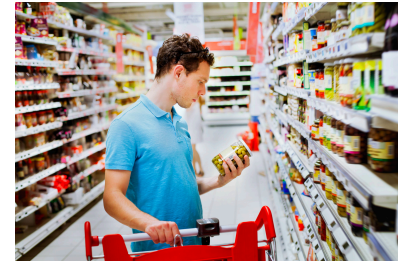
- **Current nutrition labels are hard to understand & 74% of citizens do not use them**[3]**. Novel labels like Nutri-Score**[4]** are effective and mandated <u>only in FR, ES, BE, NL</u>.**

1) König (2018) *JMIR*, 2) Chappuis (2011), 3) Spronk (2014), 4) Julia and Hercberg (2017) *Public Health Panorama*

Technological advances provide new opportunities in passively triggered & hands-free interactions

Mixed Reality Headsets

Computer Vision

Motivation: Make Nutrients ‚visible' without requiring human input

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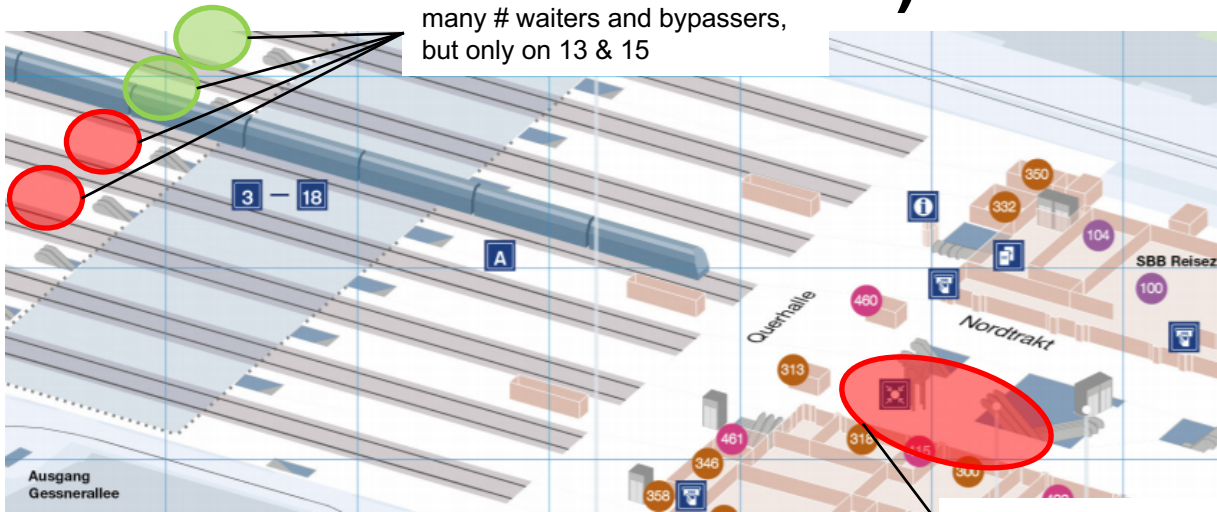
Research Design

Setup

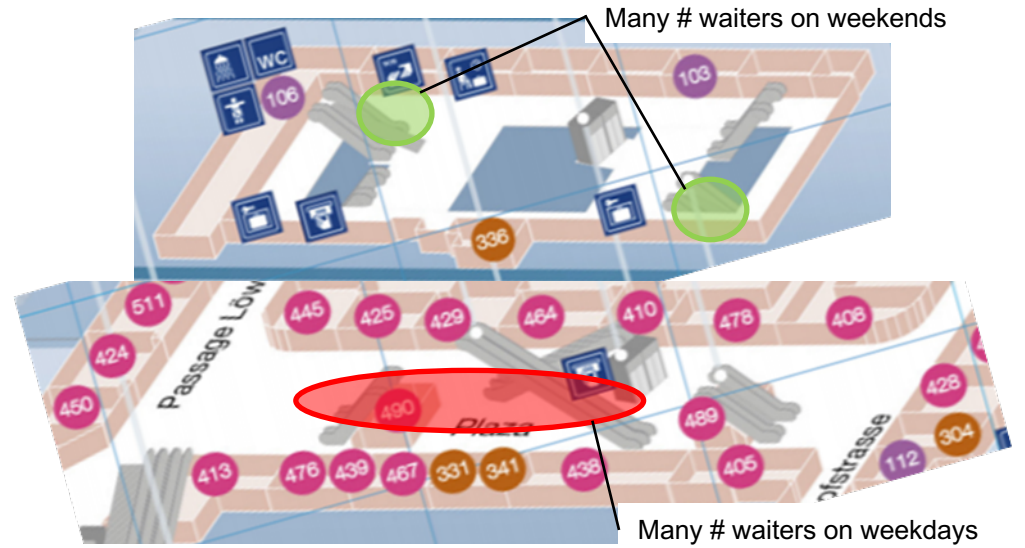**Microsoft Hololens**

Assisted Shopping

Vending Machine Zürich HB

Traffic observed around the vending machines and the station (Green: Vending machines with ideal conditions, Red: No waiters or no vending machines)

many # waiters and bypassers, but only on 13 & 15

Most # waiters at any time

Many # waiters on weekends

Many # waiters on weekdays
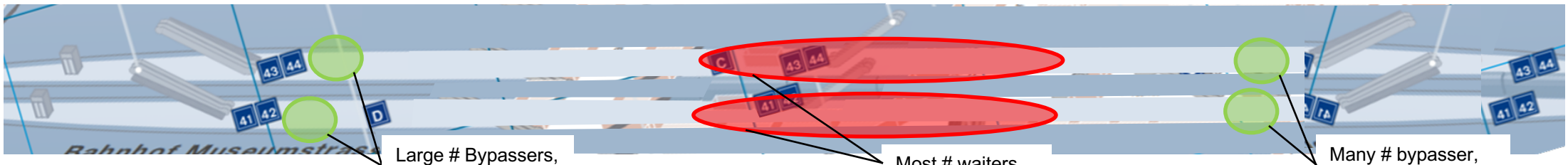
Large # Bypassers, few # waiters

Most # waiters

Many # bypasser, some # waiters

Randomized Controlled Trial Study (Image detection hard-coded)

N = 61

Treatment Group

Balanced Sampling

Control Group

4 Tasks: Select & Identify Healthiest / Snack & Beverage

Just-in-Time Interventions as an Experiment
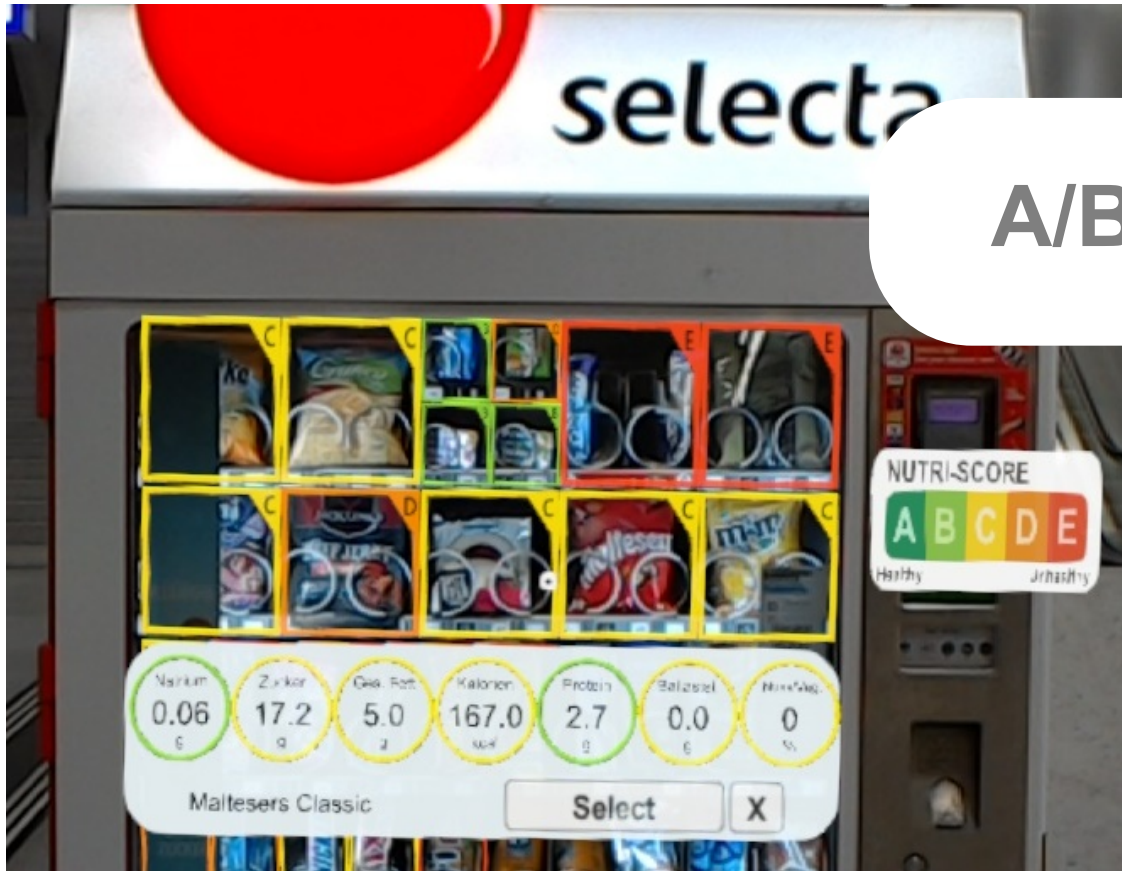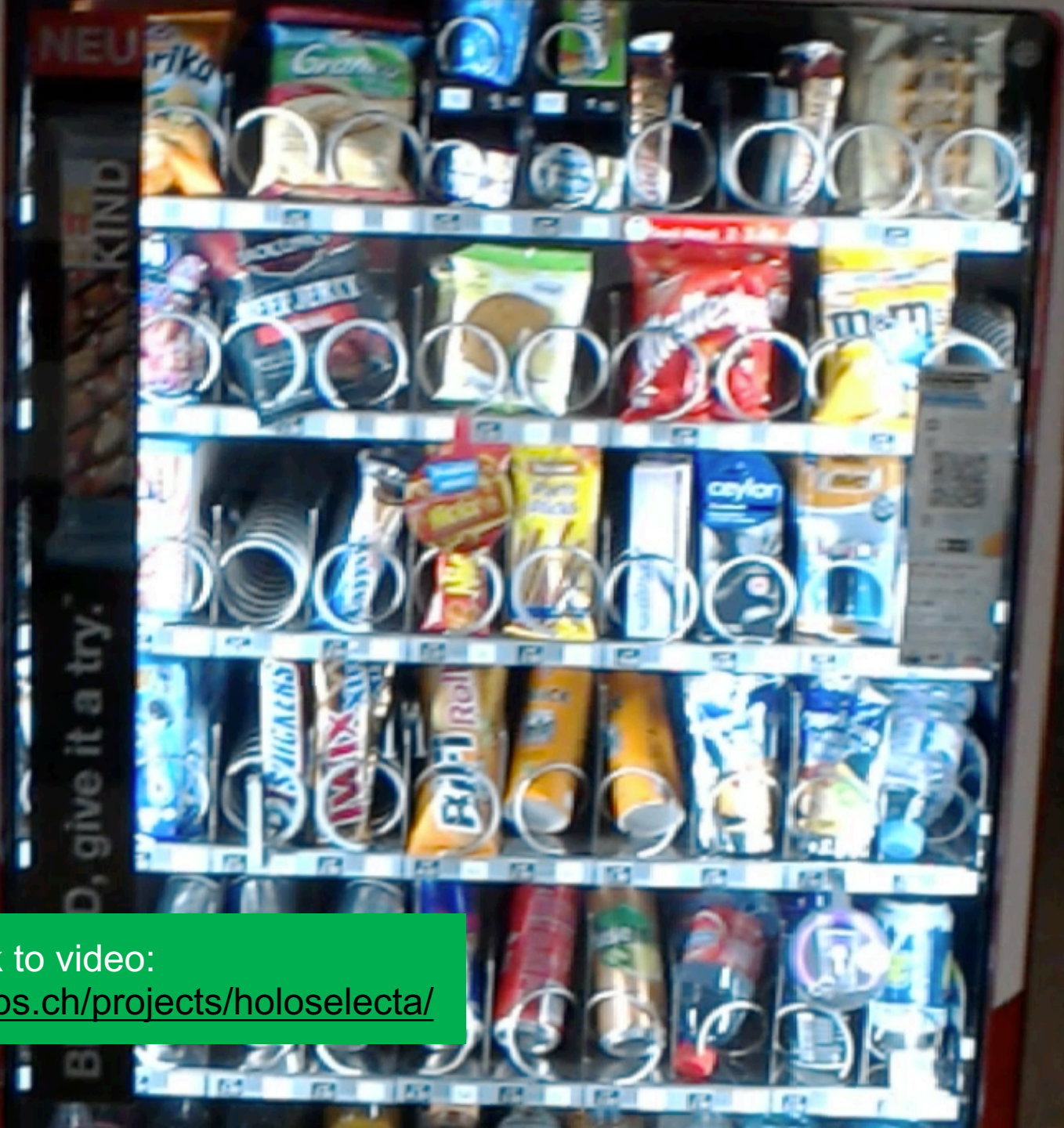
Results

Distribution of the participants in the study is overall balanced but not representative of Switzerland

N

61

Ø Age

29.8 J

42.2 Ø CH

% Overweight

21 %

42 % CH

% Male

67 %

50 % CH

Education

% Primary

19.7 %

11.6 % CH

% Tertiary

52.5 %

43.7 % CH

Observations on Positioning of Advertising

Users don't realize there are products, behind the stickers. Move ads to the frame or between the products.

Most products are easier to recognize by the top half then by the bottom half.

Name: Valser Sparkling PET
Weight: 50 ml
Barcode: 76404160

Select   X

Control Group

NUTRI-SCORE
A B C D E
Healthy   Unhealthy
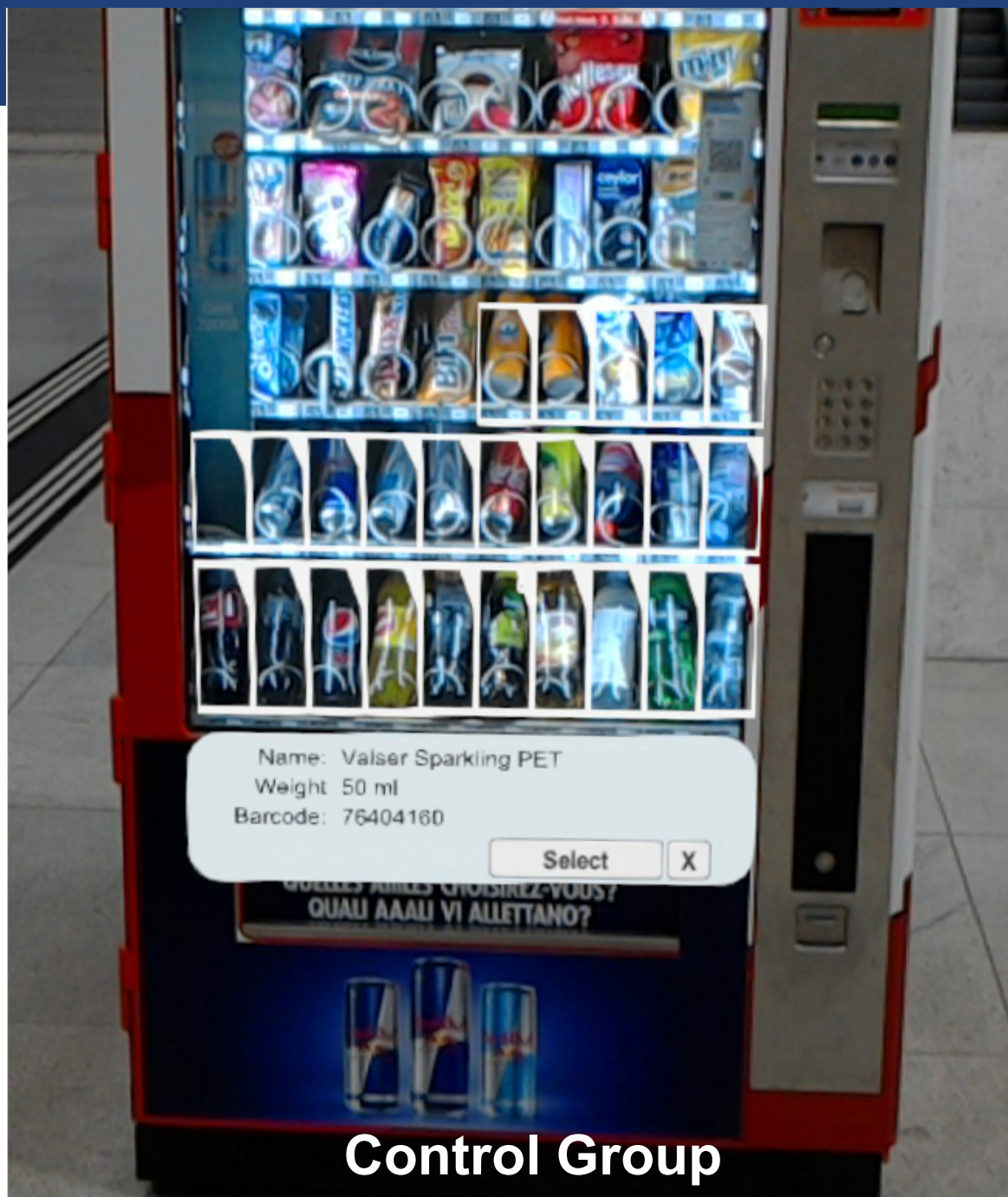
Treatment Group

Study results indicate strong effects of the intervention on the choice of beverages.

Available Beverages:

Drinks	Mean (SD)
Weight (ml)	400 (118.3)
Price (CHF)	3.18 (0.61)
Drinks in VM by Nutri-Score	**Count (%)**
A (Healthy)	4 (20%)
B	4 (20%)
C	4 (20%)
D	4 (20%)
E (Unhealthy)	4 (20%)

Beverages

	Mean	(SD)
Test	-0.97	(10.33)
Control	4.80	(7.59)
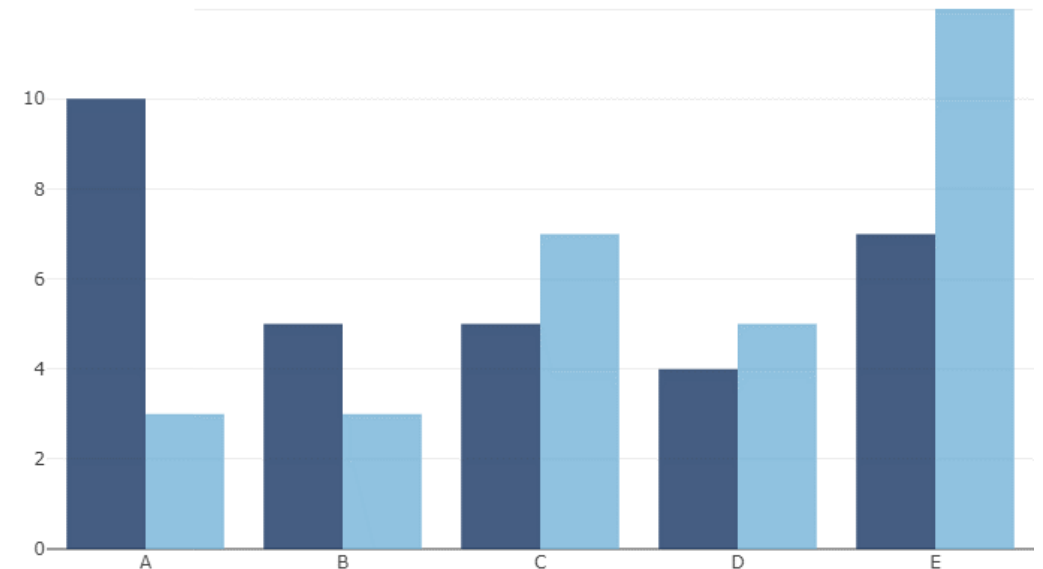
Buying a drink of their choice ($p = 0.0092$)

Results: Beverages

Significant improvement:
- Nutri-Score (-15 = best ; 45 worst)
- Sugar

Non-significant, relative improvement:
- Calories

All users can identify healthy beverages (mineral water), but intervention helps with salience & selection.

Table 3: Comparison between Treatment Group (N=31) and Control Group (N=30) for task 1) Select an item of your choice, task 2) Identify the healthiest beverage available.

Task \ Item	Beverages	
	ΔTG-CG	P
1. Select		
NS	-5.8	**0.009***
Energy	-11.4 (-34%)	.06
Sat. Fat	+.02 (+66%)	.37
Sugar	-1.91 (-28%)	**0.049***
Salt	0 (0%)	.43
Protein	+.11 (+48%)	.38
Fiber	0 (0%)	.50
2. Identify		
NS	-0.8	.27
Energy	-1.26 (-67%)	.27
Sat. Fat	0 (0%)	.16
Sugar	-0.29 (-66%)	.28
Salt	0 (0%)	.35
Protein	-0.02 (-100%)	.16
Fiber	0 (0%)	.50
* : significant at 5% level		

Table 4: Nutrients of Selected Beverages for users differing in BMI, Education and Food Literacy

BMI

	BMI >25kg/m²			BMI ≤ 25kg/m²		
	P	TG N=7 M (SD)	CG N=3 M (SD)	P	TG N=22 M (SD)	CG N=26 M (SD)
NS	0.010*	-12.7(6.1)	3.7(3.5)	.068	2.9(8.1)	5.0(8.1)
EN	0.005*	0.4 (1.1)	41.3(23.6)	.41	28.8(20.6)	33.2(29.8)
SF	0.017*	0.0(0.0)	0.2(0.3)	.07	0.1(0.2)	0.0(0.0)
SU	0.003*	0.0(0.0)	7.8(3.0)	.28	6.4(4.3)	6.8(4.6)
SO	.101	0.0(0.0)	0.0(0.0)	.28	0.0(0.0)	0.0(0.0)
PR	0.017*	0.0(0.0)	1.7(2.5)	.23	0.5(1.3)	0.1(0.2)
DF	0.5	0.0(0.0)	0.0(0.0)	0.5	0.0(0.0)	0.0(0.0)
FNV	.10	0.0(0.0)	0.0(0.1)	.40	0.0(0.0)	4.6(16.3)

Education

	Education high			Education low		
	P	TG N=17 M (SD)	CG N=15 M (SD)	P	TG N=12 M (SD)	CG N=14 M (SD)
NS	.07	-3.3(10.5)	2.7(8.2)	0.049*	1.0(10.2)	6.6(6.7)
EN	.29	21.2(24.0)	26.8(31.7)	.07	21.6(20.0)	39.4(25.2)
SF	.24	0.1(0.2)	0.1(0.2)	.34	0.0(0.0)	0.0(0.0)
SU	.31	4.4(4.7)	5.0(4.6)	.07	5.1(5.0)	8.4(3.4)
SO	.45	0.0(0.0)	0.0(0.0)	.47	0.0(0.0)	0.0(0.0)
PR	.40	0.6(1.5)	0.4(1.2)	.19	0.0(0.1)	0.1(0.2)
DF	.50	0.0(0.0)	0.0(0.0)	0.5	0.0(0.0)	0.0(0.0)
FNV	.43	0.0(0.0)	4.0(15.5)	.18	0.0(0.0)	4.3(16.0)

Food Literacy (FL)

	FL >3.5			FL ≤ 3.5		
	P	TG N=25 M (SD)	CG N=25 M (SD)	P	TG N=6 M (SD)	CG N=4 M (SD)
NS	0.025*	-0.8(10.5)	4.6(8.1)	.13	-1.8(10.3)	6.0(4.9)
EN	.17	23.5(23.2)	32.7(30.3)	.052	16.0(14.6)	42.3(20.1)
SF	.31	0.1(0.2)	0.0(0.0)	.38	0.0(0.0)	0.2(0.3)
SU	.11	5.2(5.0)	6.5(4.6)	.052	3.7(3.4)	9.0(3.2)
SO	.30	0.0(0.0)	0.0(0.0)	0.033*	0.0(0.0)	0.0(0.0)
PR	.42	0.4(1.2)	0.1(0.2)	.38	0.1(0.2)	1.1(2.3)
DF	.50	0.0(0.0)	0.0(0.0)	.50	0.0(0.0)	0.0(0.0)
FNV	.10	0.0(0.0)	4.8(16.6)	.27	0.0(0.0)	0.0(0.0)

* : significant at 5% level, N varies as answers were skippable

NS: Nutri-Score, EN: Energy in KJ/100ml, SF: Saturated Fat, SU: Sugar, SO: Sodium, PR: Protein, DF: Dietary fiber, FNV: Share of fruit/vegetable/nuts

P: P value, M: Mean, SD: Standard deviation

Healthiest mean values for each nutrient in **bold**

Results

Significant improvement for:
- Users with high BMI, less education, high food literacy

Non-significant, relative improvement:
- All other users as well

Positive intention to use, performance expectation and social influence of intervention was confirmed

Table 5: Survey Comparison between Treatment Group (N=31) and Control Group (N=30)

Construct (# Items)	TG (N=31) mean (SD)	CG (N=30) mean (SD)	*P(X)*
Usage Antecedents			
Intention (3)	5.84 (1.30)	4.98 (1.55)	.017
Perf. Expect. (5)	5.44 (1.47)	3.53 (1.74)	<.001
Social Infl. (2)	4.77 (1.51)	3.67 (1.44)	.0048
Hedonism (2)	6.35 (0.79)	6.00 (1.17)	.27
Unobserved (1)	5.23 (1.71)	4.79 (1.95)	.29
Randomization Checks			
Innovativeness (3)	5.80 (1.03)	5.60 (1.03)	.27
Food Literacy (2)	5.02 (1.45)	5.11 (1.41)	.44
Wearable Exp. (1)	0.79 (0.99)	0.55 (0.51)	.20
Duration			
Time taken (sec.)	37.2 (20.0)	31.58 (13.7)	.12
Perf. Expect.: Performance Expectancy, **Social Infl.:** Social Influence, **Wearable Exp.:** Experience w/ wearable headsets			

Conclusion

Passively triggered, Just-in time adaptive interventions via mixed reality headset are very promising (handsfree and automatic)

Computer vision is not easy, still lots of work to be done in order to support correct detection of most packaged products in the wild

Limitations lie in the supervision, one-time setup, limited availability of mixed reality headsets.

Discussion