About me

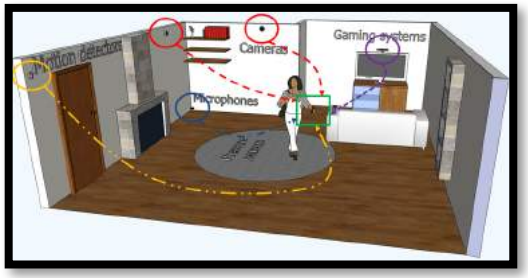
Oresti Banos, PhD, Asst. Prof.

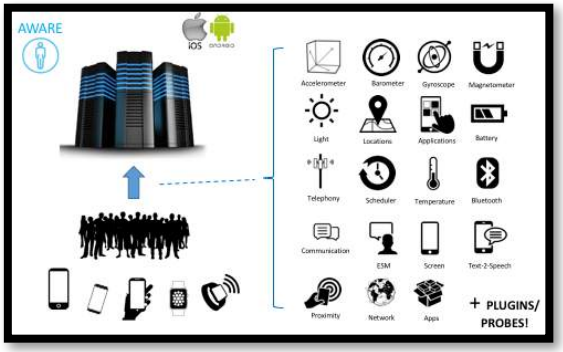
Web: http://orestibanos.com/

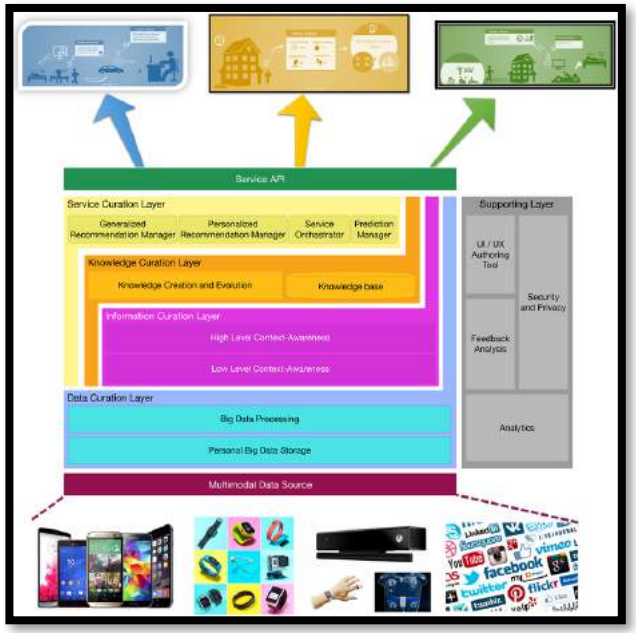
Twitter: @orestibanos

Research:

- smart mobile sensing
- holistic behaviour modelling
- virtual coaching systems





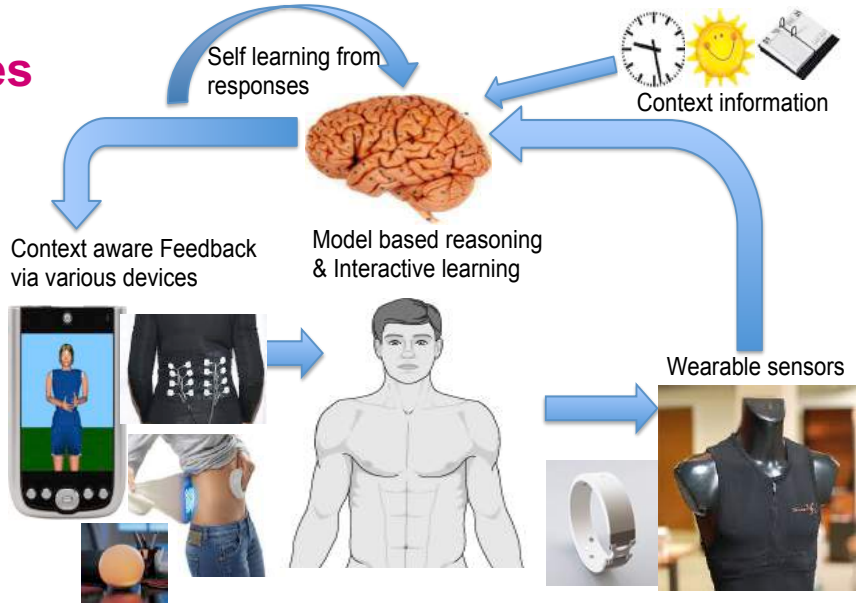


Center for Monitoring and Coaching:
"High Tech Care with a Human Touch"

https://www.utwente.nl/ctit/cmc/

Application domains:
Frailty, Stroke, Diabetes, Pain
Parkinson's, Alzheimer's, Autism

Human Behaviour Modeling
- Artificial intelligence
- Machine learning
- Behavior change frameworks
- Persuasive tech
- Coaching strategies



Multimodal Sensing
- Wearables
- Textiles
- Ambient sensors
- SNS
- ESM

Human-Computer Interaction
- Haptic interfaces
- (Embodied) Virtual agents
- Natural language processing

UNIVERSITY OF TWENTE.

What your smartphone tells about your behavior

Challenges and Opportunities

Oresti Banos

4TU Symposium: Wearables in Practice

September 22, 2017

o.banoslegran@utwente.nl

@orestibanos

http://orestibanos.com/

Smartphones vs Wearables

Will the smartwatch destroy the smartphone? ANDROID AUTHORITY (2013)

WILL SMARTWATCHES KILL SMARTPHONES? WIRED (2014)

Will Wearables Wipe Out the Smartphone? AdvertisingAge (2015)

Will Smartphones Ever Be Obsolete?

TIME (2017)

Smartphones vs Wearables

Will the smartwatch destroy the smartphone? ANDROID AUTHORITY (2013)

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SM (2014)

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Will Smartphones Ever Be Obsolete?
TIME (2017)

Smartphones & Wearables

Foldable Smartphones

Projected Smartphones

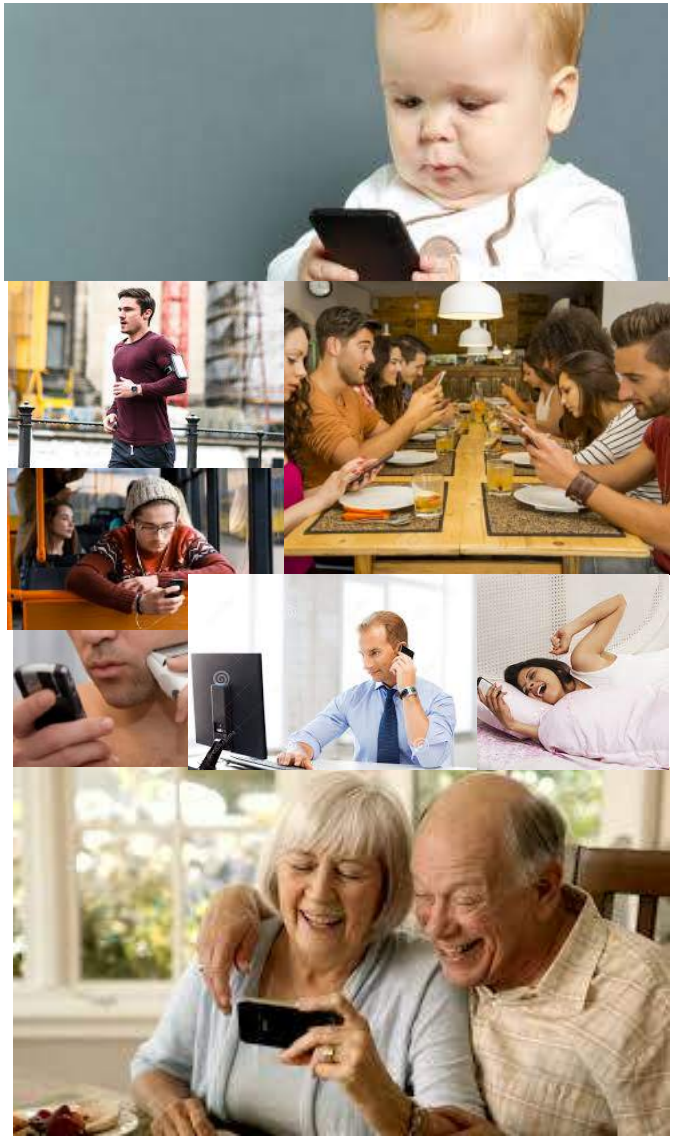
Wearable Smartphones

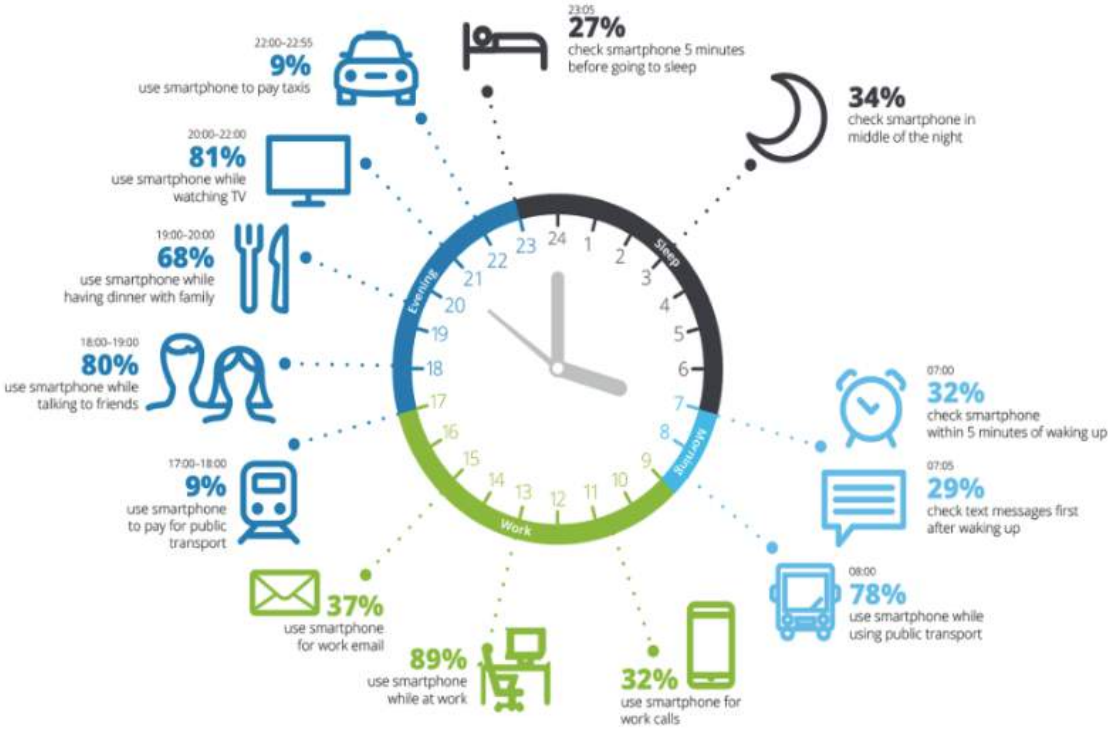
Implantable Smartphones

What's so special about smartphones (to consider them in social/behavioral/health sciences)?

- Mature technology
- Huge variety of built-in (and pluggable) sensors: accelerometer, gyro, proximity, compass, barometer, heart rate, SpO2, humidity, fingerprint, NFC, GPS, mic, iris scanner
- Everyday "omnipresent" companions/observers

The “silent” observers

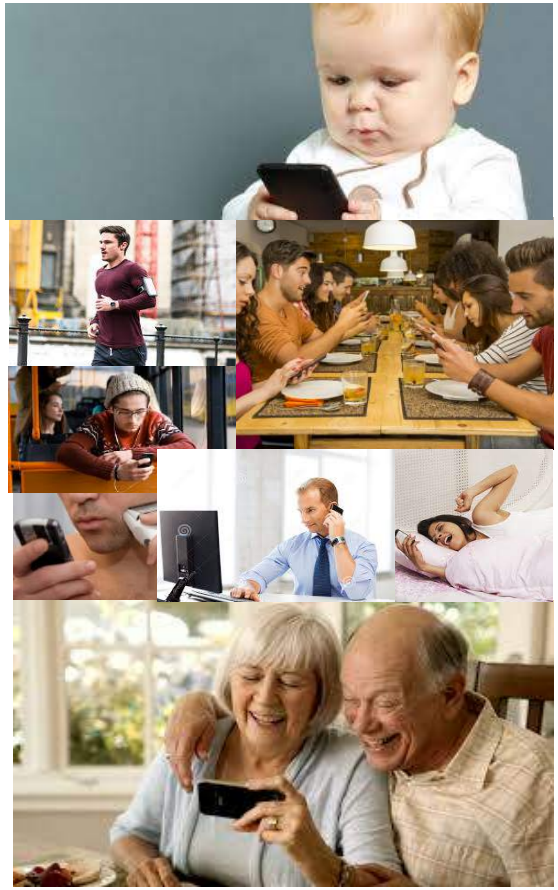




(Deloitte, Global Mobile Survey 2016)

The “silent” observers

Explicit interactions



Implicit interactions

Observing and measuring behavior

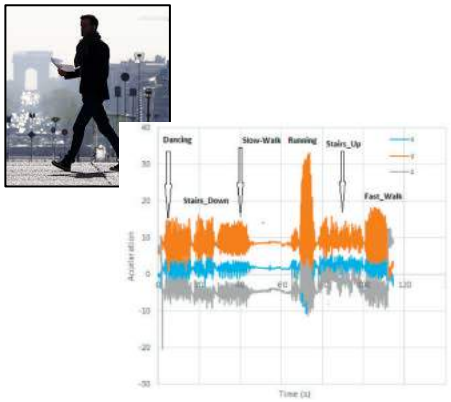
Observe & Measure Human Behavior

In the wild – Naturalistic Sensing

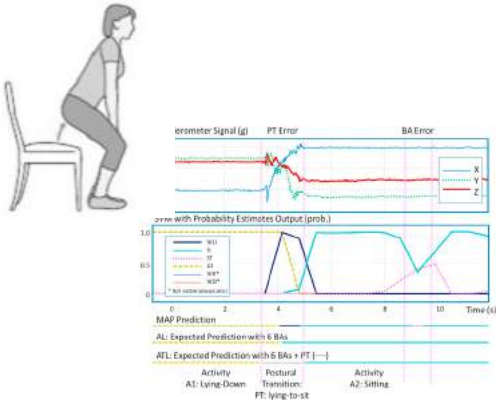
Large groups – Crowd Sensing

Multiple dimensions – Holistic Sensing

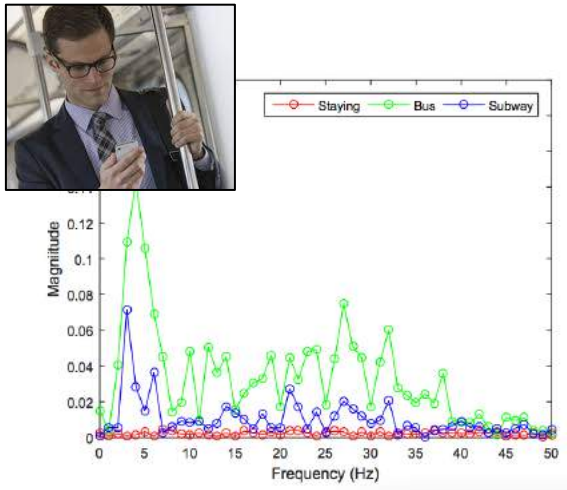
Physical behavior



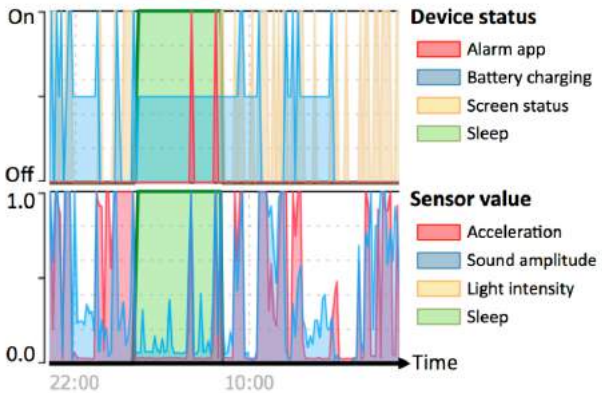
(Procedia Comp. Sci., Bayat et al. 2014)



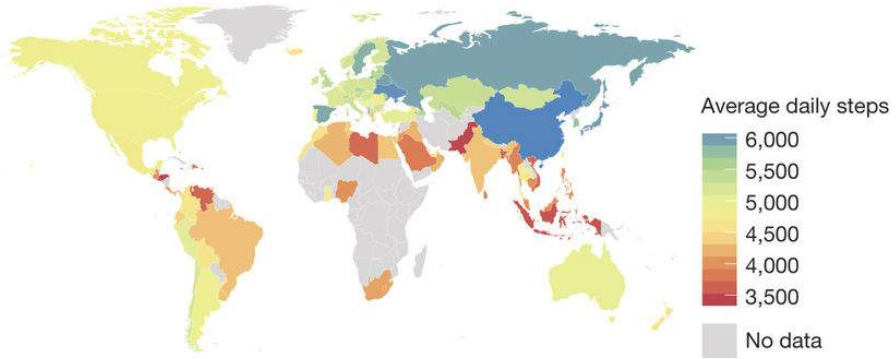
(Neurocomp., Reyes et al. 2016)



(*Sensors*, Hur et al. 2017)

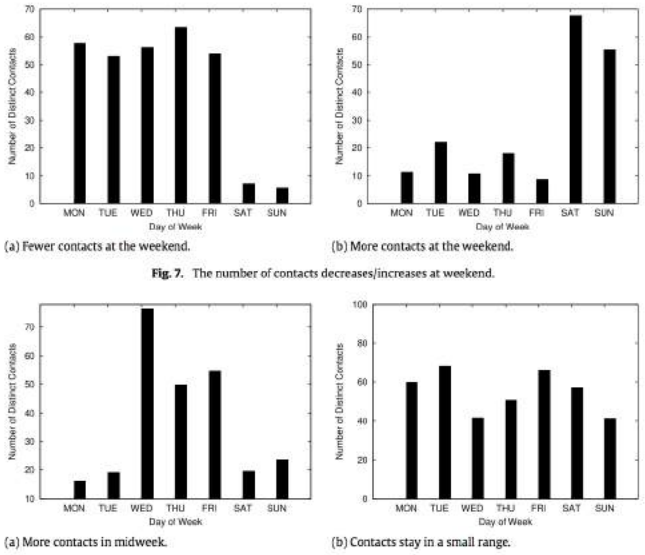


(*CHI*, Min et al. 2014)

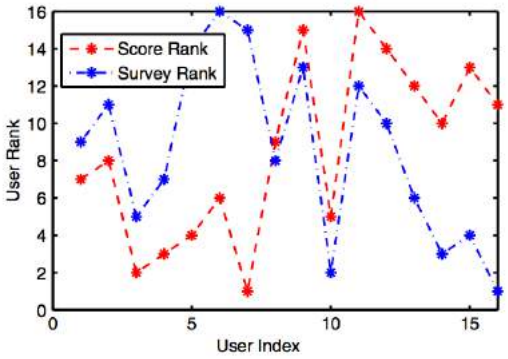


(*Nature*, Althoff et al. 2017)

Social behavior



(*Perv. & Mob. Comp.*, Vu et al. 2015)

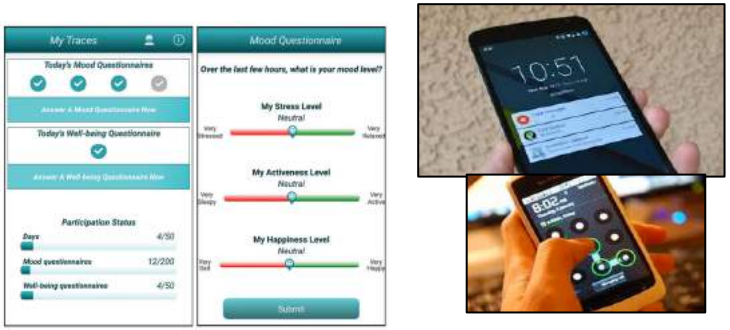


(Mobile Netw. Appl., Lane et al. 2014)

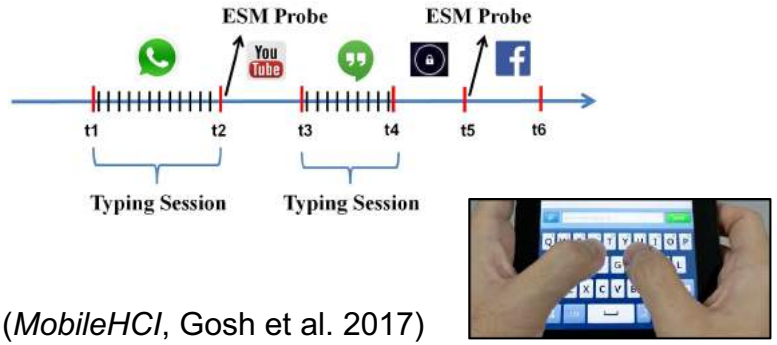
Emotional behavior

Feature	*Import*	*Correlation*	*The more bored, the ..*
time_last_outgoing_call	0.0607	-0.143	less time passed
time_last_incoming_call	0.0580	0.088	more time passed
time_last_notif	0.0564	0.091	more time passed
time_last_SMS_received	0.0483	0.053	more time passed
time_last_SMS_sent	0.0405	-0.090	less time passed
time_last_SMS_read	0.0388	-0.013	less time passed
light	0.0537	-0.010	darker
hour_of_day	0.0411	0.038	later
proximity	0.0153	-0.186	less covered
gender (0=f, 1=m)	0.0128	0.099	more male (1)
age	0.0093	n.a.	+20s/40s, -30s
num_notifs	0.0123	0.061	more notifications
time_last_notif_cntr_acc	0.0486	-0.015	less time passed
time_last_unlock	0.0400	-0.007	less time passed
apps_per_min	0.0199	0.024	more apps per minute
num_apps	0.0124	0.049	more apps
bytes_received	0.0546	-0.012	less bytes received
bytes_transmitted	0.0500	0.039	more bytes sent
battery_level	0.0268	0.012	the higher
battery_drain	0.0249	-0.014	the lower

(*Ubicomp*, Pielot et al. 2015)

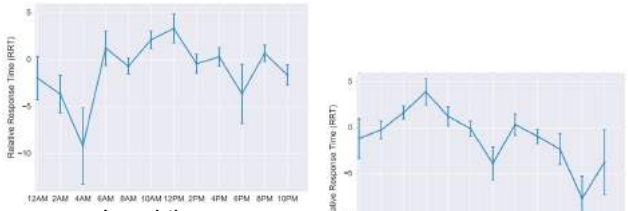


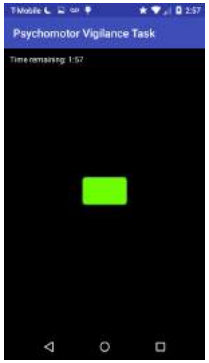
(*Ubicomp*, Mehrotra et al. 2017)



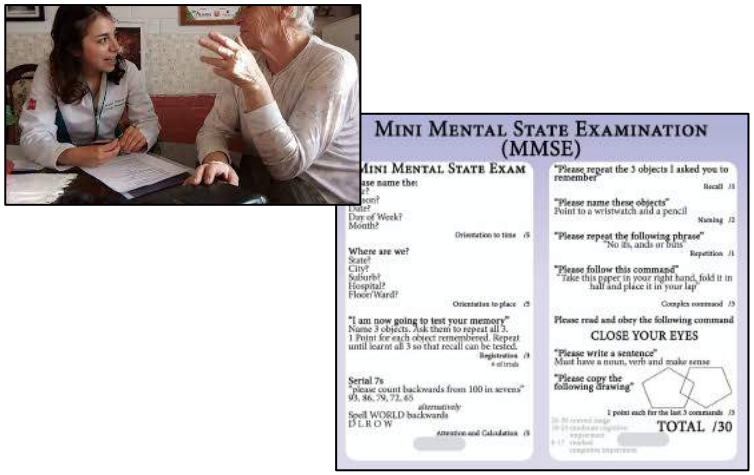
(*MobileHCI*, Gosh et al. 2017)

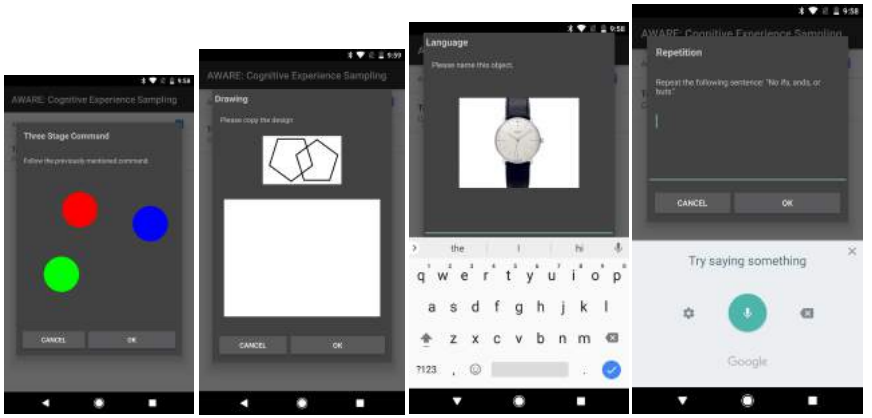
Cognitive behavior





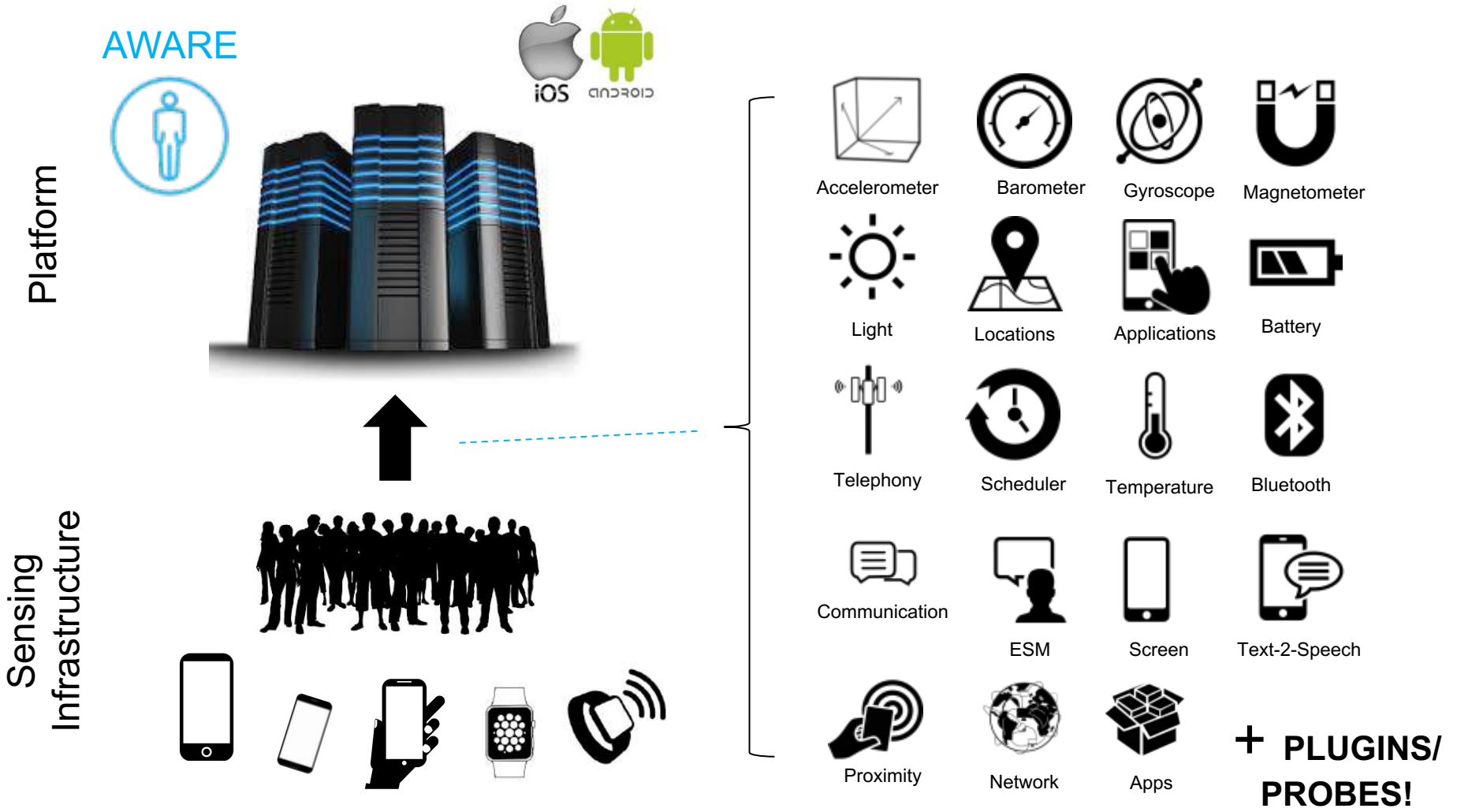
(*Ubicomp*, Abdullah et al. 2016)





(-, Wohlfahrt-Laymann et al. 2017)

HoliBehave: Holistic Monitoring and Analysis of Human Behavior

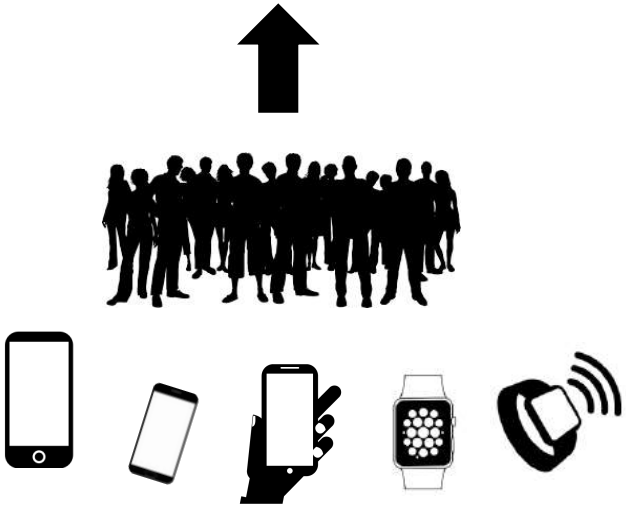


HoliBehave: Holistic Monitoring and Analysis of Human Behavior

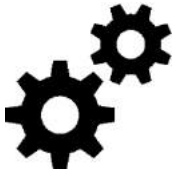
Platform

AWARE

Sensing Infrastructure



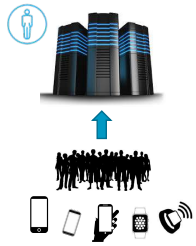
(1) Create new sensing campaign



(2) Select sensors of interest (and/or plugins)

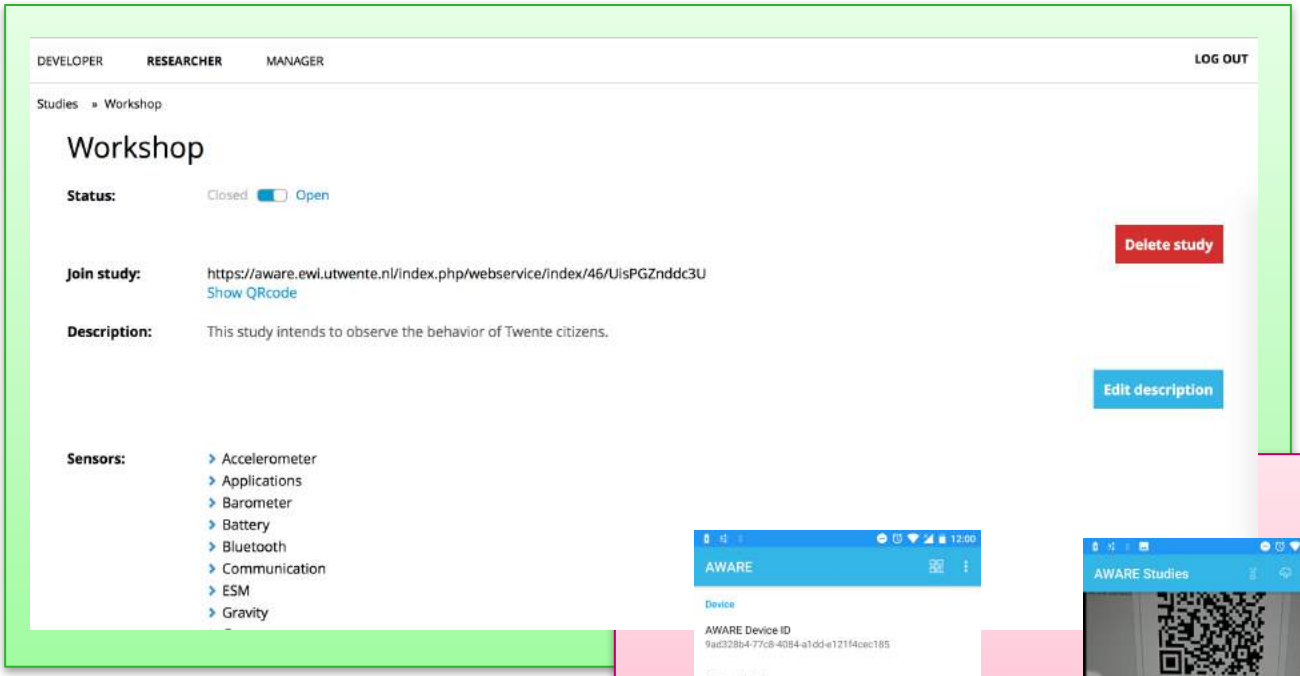
(3) Users join the campaign (informed consent)

(4) Digital data is collected, uploaded and persisted into the platform



HoliBehave: Holistic Monitoring and Analysis of Human Behavior

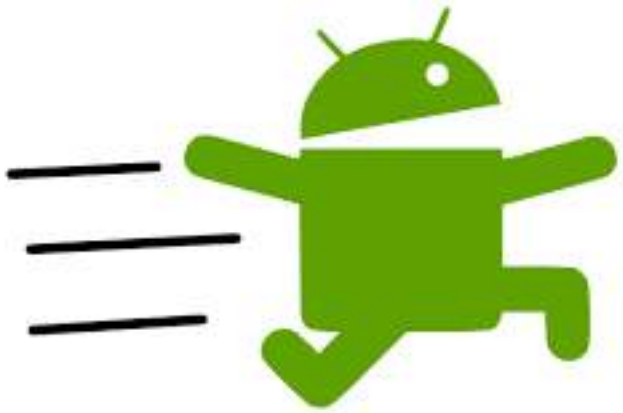
Server



Client

Challenges

- Battery
- Data plans
- Availability
- Privacy



Take home messages

- Smartphones provide an enormous set of opportunities to observe and measure behavior unobtrusively, in the wild, at large-scale and in a holistic fashion

- Smartphones should not be replaced by wearables but combined into super-sensing platforms

- Stronger efforts needed to cope with the challenges constraining user willingness

Thank you!