

# Doing and undoing social ties. Thinking about 'distributed action' using sensor-based data.

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Big Data in the Social Sciences. Center for Reasoning,  
Kent University, 22-23 June 2017

# GEDII Project

## What's the basis of great teams?

The central question of the GEDII project is simple: what makes great (research) teams? The literature on what makes (research) teams effective is huge. GEDII will look more specifically at the relationship between gender diversity in research teams and their research performance. How do the proportion of men and women and their associated gender stereotypes [...] [Read more »](#)

### Where to meet the GEDII project

9th Biennial Gender, Work and Organisation Conference

<http://www.gedii.eu>

# How does gender diversity affect research teams?

H2020 Science with and for Society

Duration: Oct 2015 – Sep 2018



Horizon 2020  
European Union Funding  
for Research & Innovation

# Consortium



## **Spain - Coordination**

Jörg Müller, Milagros Sáinz, Julio Meneses, Sergi Fabregues, Rosa Borge, Julià Minguillon



## **German**

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## **Sweden**

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## **Germany**

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## **UK**

Anne Laure Humbert, Elisabeth Günther

# Objectives

Understand better how gendered role expectations shape team communication (detailed Case Studies)

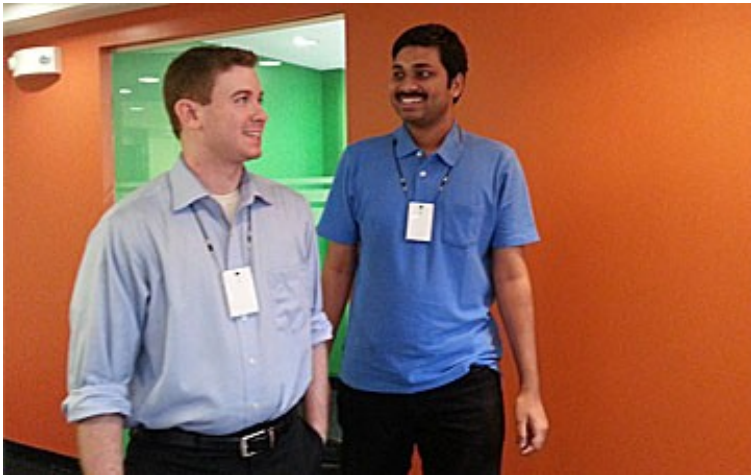
Make comparison of gender characteristics between teams more solid and sophisticated: development of Gender-Diversity-Index (GDI).

Cross-country survey: 2 sectors 5 country survey on multiple effects of gender diversity on research performance combined with bibliometric and patent indicators

# GEDII Case Studies

Understand better disciplinary context of teams,  
how excellence is conceived

Test the utility of sociometric badges for studying  
the role of (gendered) status cues during interaction



Sociometric badges  
developed at MIT, then  
Sociometric Solutions,  
Boston, MA

# Sensors & Big Data

# Environmental Sensors

Air & water quality, traffic/people flows, “Smart”-housing, -city

Citizen Sense

[Home](#)

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## Democratizing environmental data

Practices of monitoring and sensing environments have migrated to everyday participatory applications, where users of smart phones and networked devices are able to engage with modes of environmental observation and data collection. Yet how effective are these practices of citizen sensing in not just providing “crowd-sourced” data sets, but also in giving rise to new modes of environmental awareness and practice?

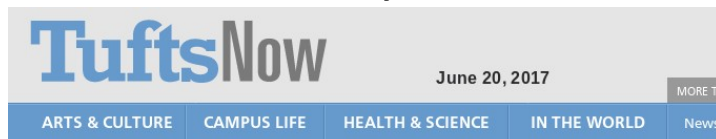




# Wearables & health sensors

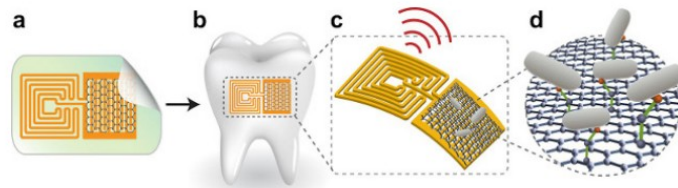
“Smart” - textiles, watches, phones, ...

Medical devices, electronic tatoos, biosensors, ...



## Tooth Tattoo

Tiny oral sensor may one day help dentists assess their patients' oral and overall health



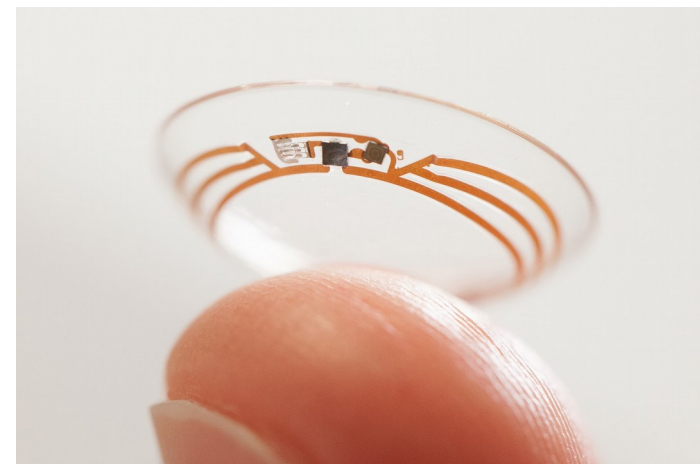
The sensor (A), attached to a tooth (B) and activated by radio signals (C), binds with certain bacteria (D).  
Illustration: Manu Mannoor/Nature Communications

Tufts Tooth Tattoo

<http://now.tufts.edu/articles/tooth-tattoo>



Eddie Codel CC BY-NC-SA



Google Smart Contact Lens

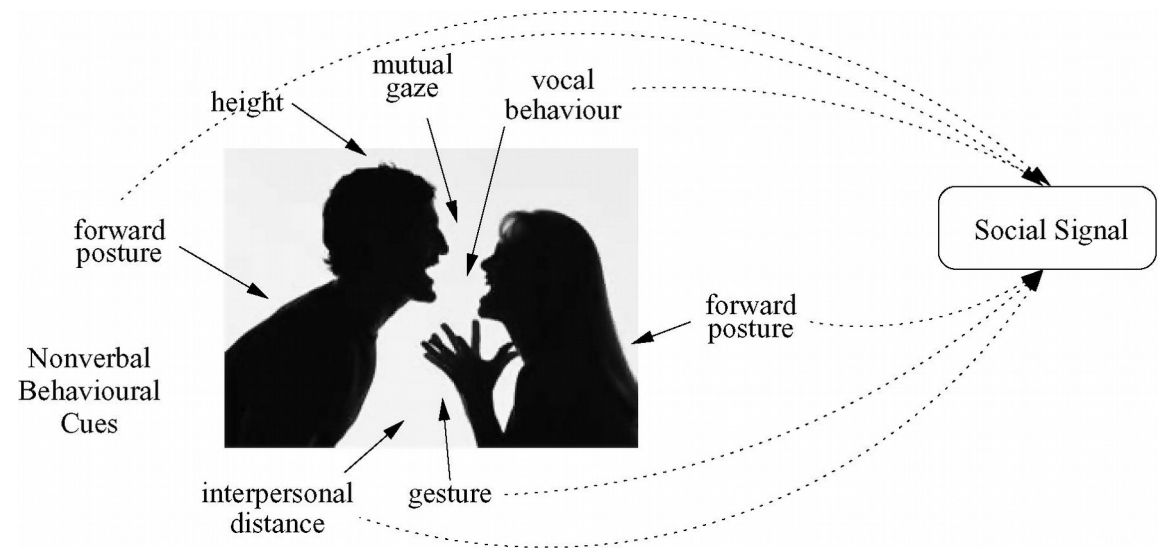
[bit.ly/2tIOwUN](http://bit.ly/2tIOwUN)

# Social Signal Processing

“Social signal processing is the new research and technological domain that aims at providing computers with the ability to sense and understand human social signals” (Vinciarelli et al. 2009)

## Behavioral cues

Physical appearance  
Gesture and posture  
Face & eye behavior  
Vocal behavior  
Space & environment



# Social signal processing examples

“Automatic fight detection based on motion analysis”

(Fu, EY et al, 2015 IEEE)

“Online feedback system for public speakers”

(Nguyen, AT et al. 2012 IEEE)

“Hire me: computational inference of hirability...”

(Son Nguyen, L et al. 2014 IEEE)

“Vocal Analysis Software for Security Screening...”

(Elkins, A 2012)

“Modeling dominance in group conversations...”

(Jayagopi et al., 2009 IEEE)

“Analysis of pedestrian behaviors...”

(Yoshimura et al., 2017)

# Social-/behavioral research

“Beyond Contagion”

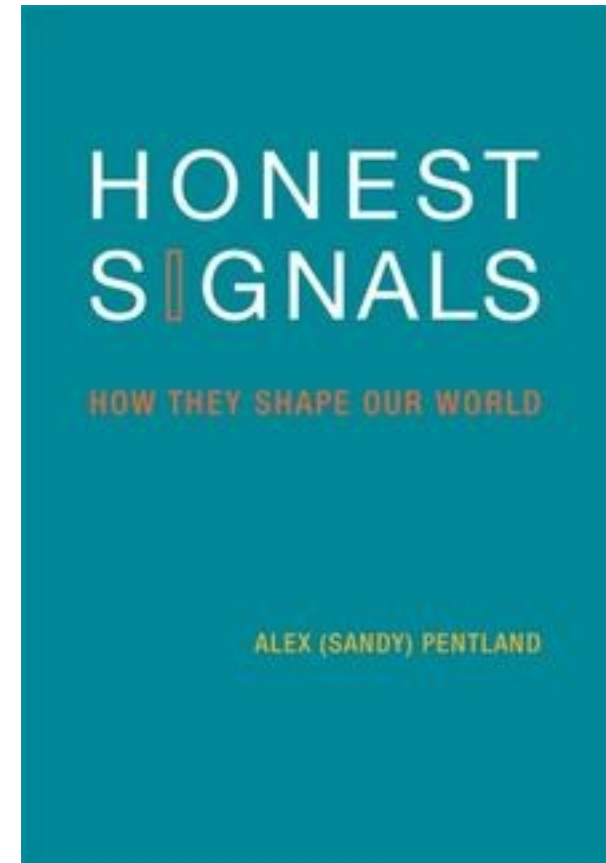
(Alshamsi, A et al. *PLOS ONE* 2015)

“Using sociometers to quantify social interaction patterns”

(Onnela, JP et al. *Sci. Reports* 2014)

“Evidence for a collective intelligence factor”

(Woolley, A *Science*, 2010)



# Sociometric data features

## Social network analysis

Proximity detection, face-2-face interaction

## Social signal analysis / nonverbal comuni.

Speech and body movement: influence, mimicry, activity, consistency

## Turn taking analysis

Un-/successful interruptions, average speaking length, etc.

→ Dimensions of social interaction that are conditioned by gender

# Data features, detail

## Proximity (Bluetooth)

Receive Signal Strength  $-90 < x < -60$ . 1-4 meters desirable. Every 25 secs.

## Infrared (f2f)

Cone of 30° angle, 1-1.5 meter. Every 60 seconds.

## Audio (speech)

8kHz Volume, voice pitch.

## Body movement

Accelerometer energy magnitude. Sampled 0.1-0.5 seconds

All data timestamped: speech participation, turn-taking, synchronicity of body language.

# From “Raw” Data to Higher Level Concepts

# Nonvocal behavior

“Raw” audio signal, volume, frequency band

Prosodic voice features provide powerful behavioral cues

Distinguish between sexes, indicates personality traits, stress, hierarchy, or “hot spots” in conversations

Basis for higher level constructs such as turn-taking: speaking time & interruptions is a strong indicator of dominance.



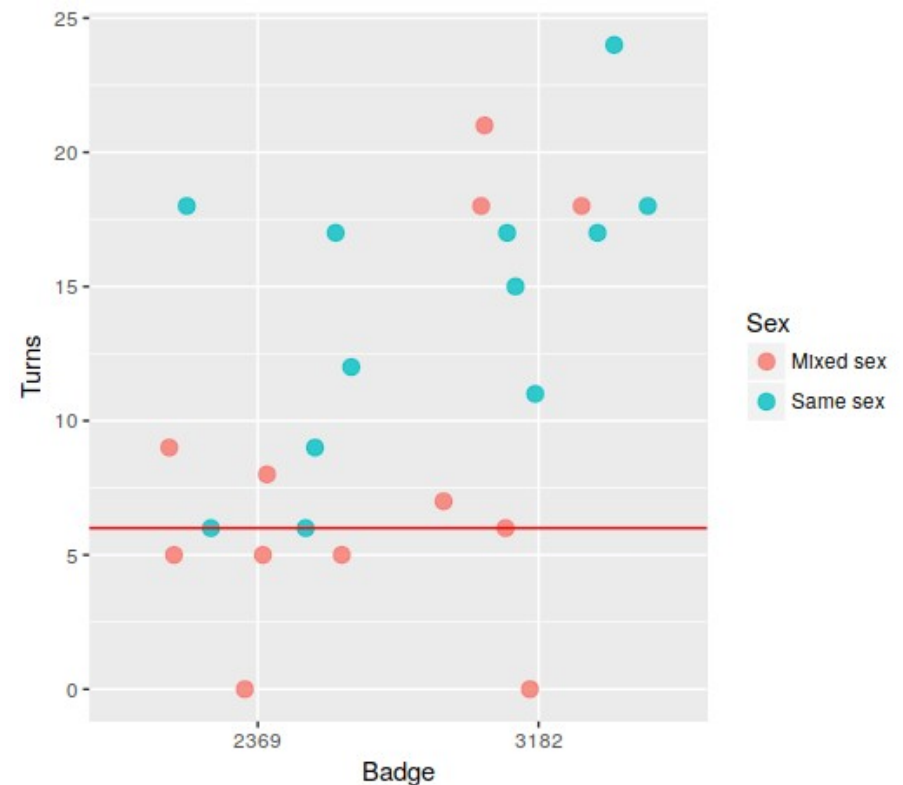
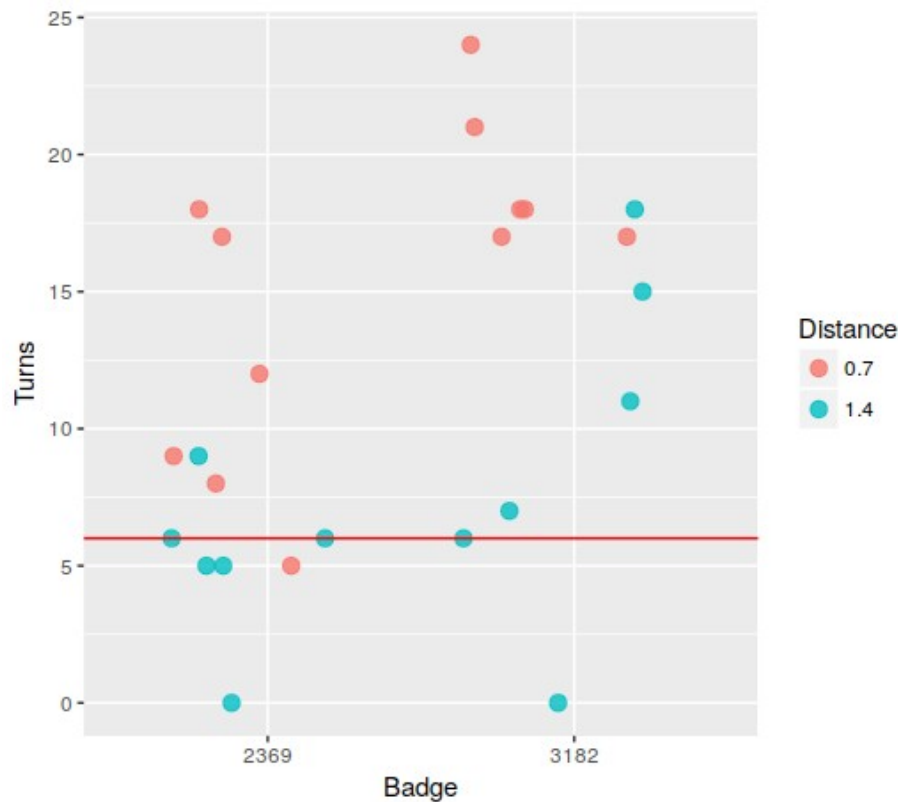
# Measurement accuracy: audio

## Turn-taking experiment - conditions

Two persons: same sex, mixed sex

Sitting close together (0.7m) and further away (1.4m)

3 x times reading the same text (< 2 min, no interruptions)



# Dyadic tie formation in networks

*Rivera et al., (2010) "Dynamics of dyads in social networks"*

## Assortative Mechanisms

Similarity between actors is indicator for their propensity to form a connection (homophily)

## Relational Mechanisms

Shape and structure of network itself at prior moment predicts ties in the future (reciprocity, repetition)

## Proximity Mechanisms

Spatial and geographic proximity predict tie formation

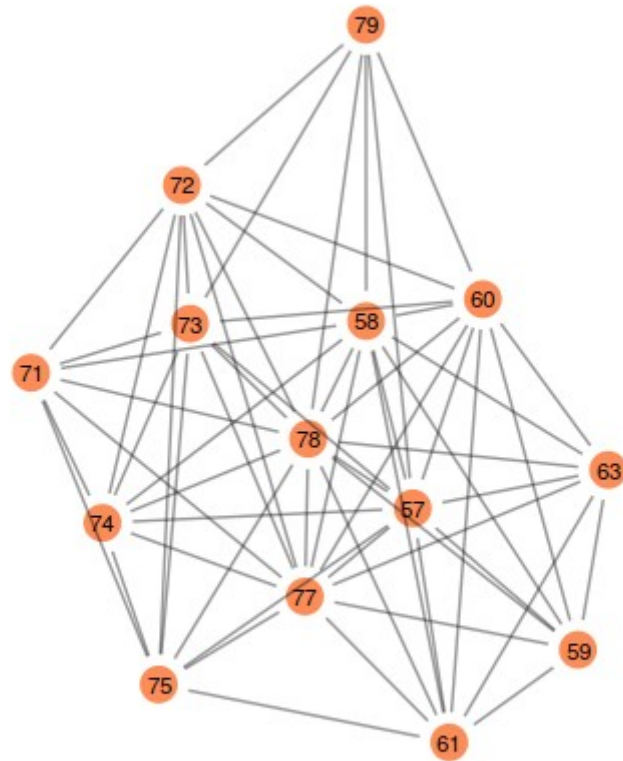
"Shared path to the lab" (Kabo 2014)

"Human mobility networks" (Wang et al. 2011)

Proximity → social relations

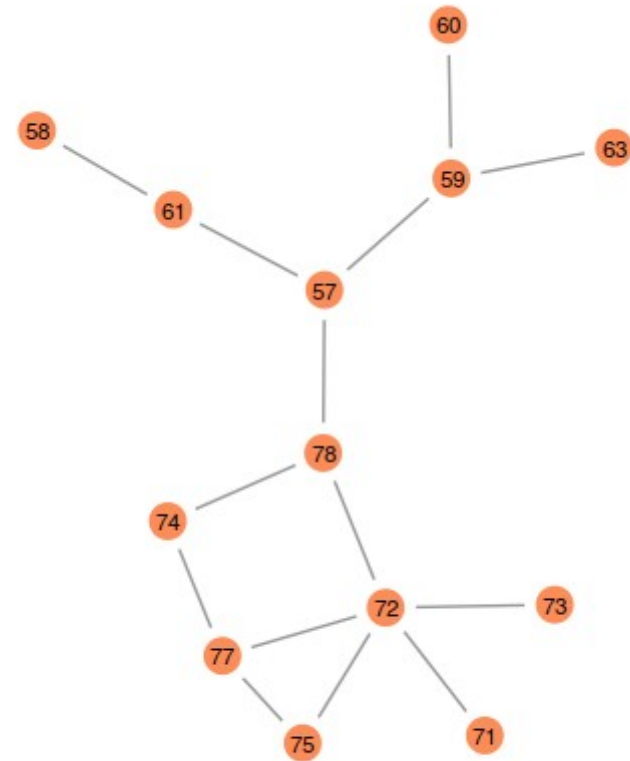
# Measurement thresholds: proximity

Bluetooth Signal Strength -80



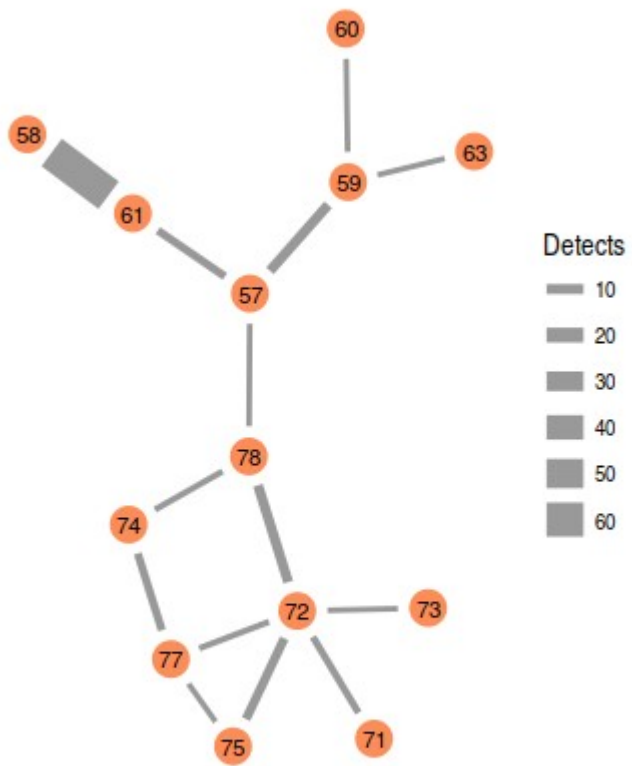
RSSI -80

Bluetooth Signal Strength -50



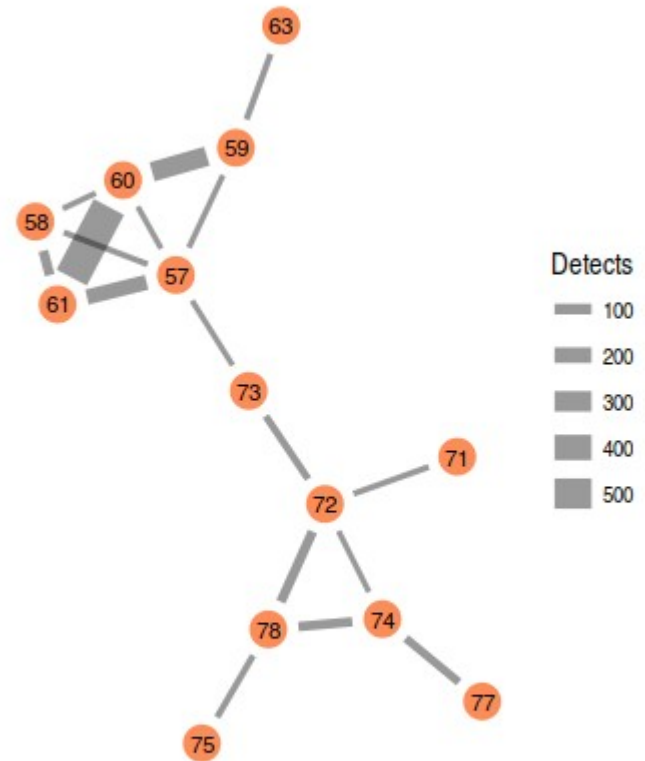
RSSI -50

## Bluetooth Signal Strength -50



*RSSI -50*

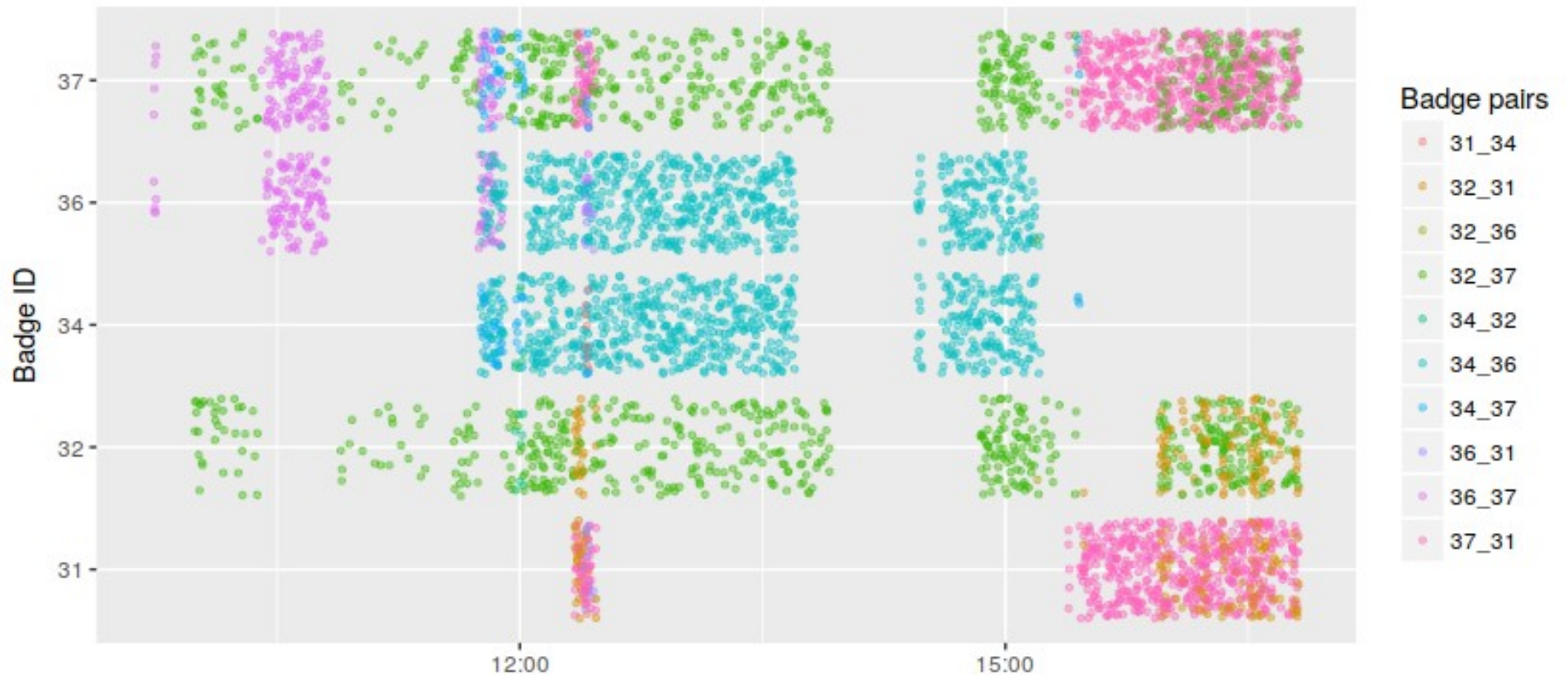
## Face to Face /Infrared Detects



*Face to face*

# Proximity detects – Office

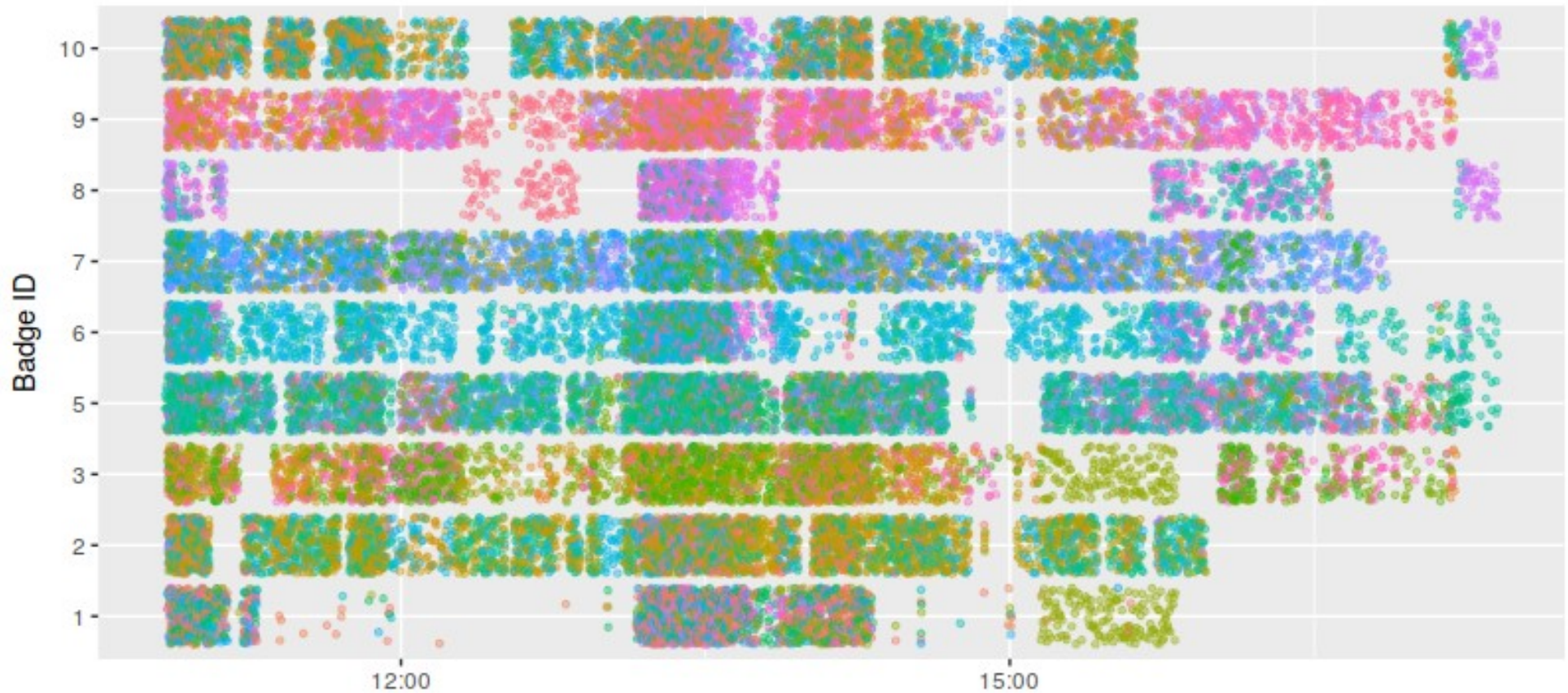
Signal strength -80





# Proximity detects – Research lab

Signal strength -80



# Proximity as indicator of... what?

## Significant indicator

Chance encounters

Information sharing /  
spreading

## Limited indicator

Research collaboration  
inside the team

Knowledge as  
“practice”

Ephemeral encounters ↔ Durable social relations

# Outlook / challenges

Time based analysis of microlevel interaction processes

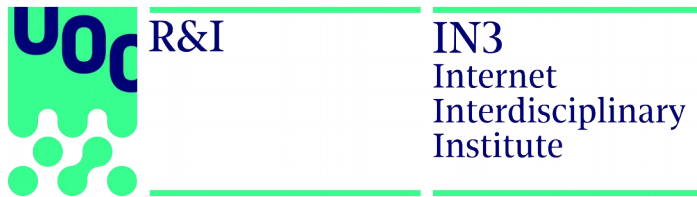
Behavioral data – access to otherwise “hard to observe” processes

Governance effects of behavioral data?!

Need of quality / decision criteria for thresholds and measurements



# Thank you!



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<http://www.gender-ict.net>

<http://www.gedii.eu>

<http://www.genderportal.eu>