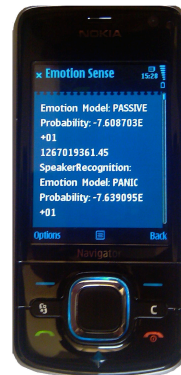


# EmotionSense: Designing a Mobile Sensing System for Social Psychology Research



**Mirco Musolesi**

Joint work with Kiran K. Rachuri, Cecilia Mascolo,  
Jason Peter Rentfrow, Chris Longworth and Andrius Aucinas

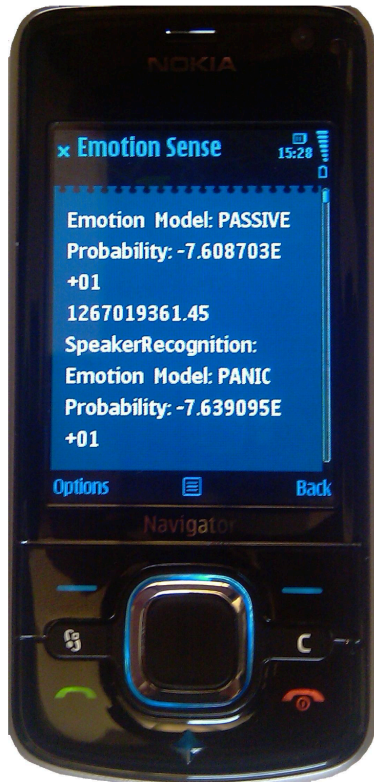
Mirco Musolesi

# Motivation

- Long-standing questions about *emotional states* in social psychology: influence of the environment, location, interactions, etc.
- Classic methods of investigation:
  - Self-reports
  - Lab-based studies
  - Wearable devices



# EmotionSense

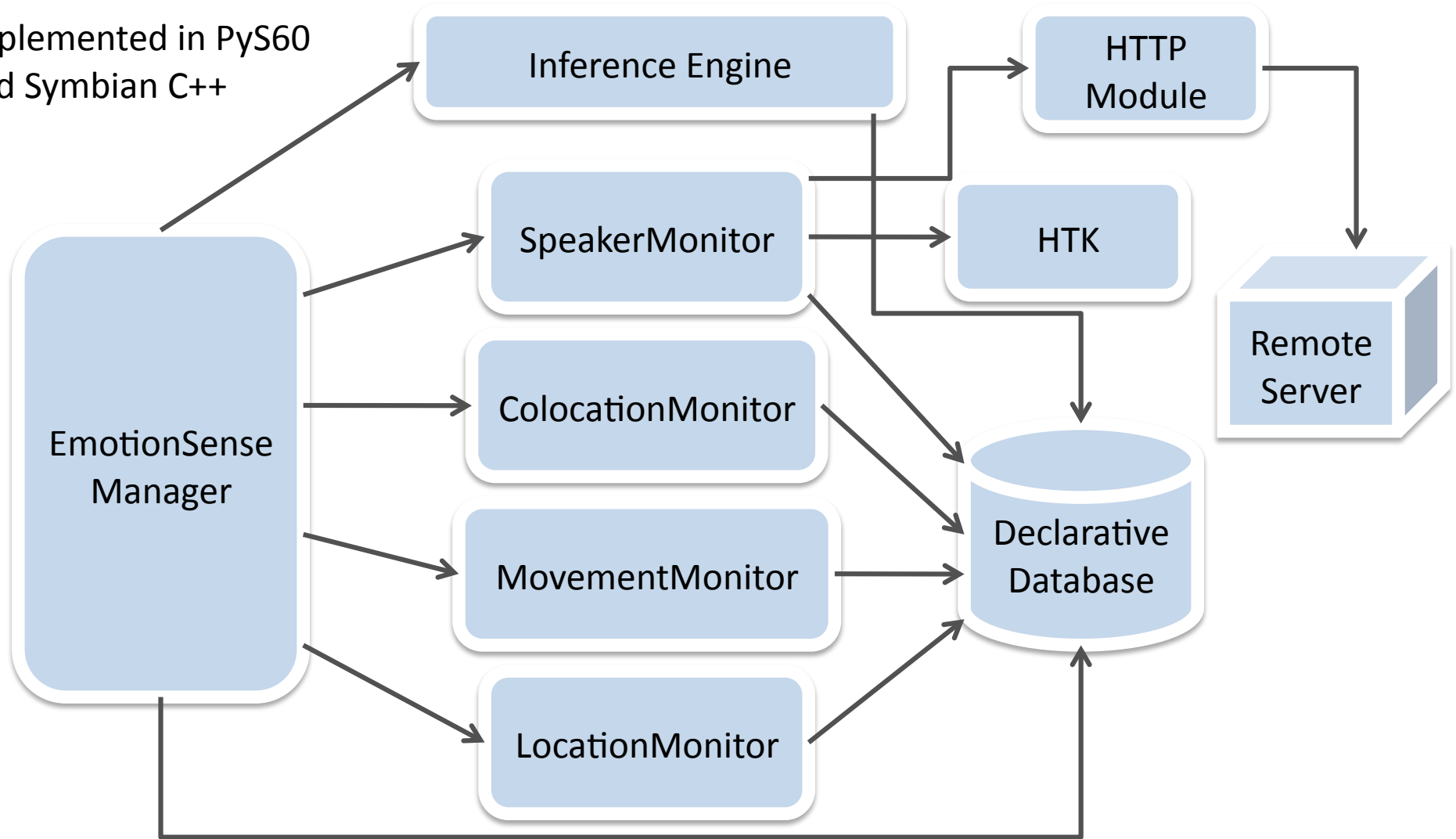


- *Unobtrusive* mobile platform for experimental social psychology
- Automatic inference of:
  - Interactions (proximity and speech dynamics)
  - Speaker recognition
  - Emotion recognition

[Kiran K. Rachuri, Mirco Musolesi, Cecilia Mascolo, Jason Peter Rentfrow, Chris Longworth and Andrius Aucinas. EmotionSense: A Mobile Phones based Adaptive Platform for Experimental Social Psychology Research. In *Proceedings of 12<sup>th</sup> ACM International Conference on Ubiquitous Computing (UbiComp'10)*. Copenhagen, Denmark. September 2010]

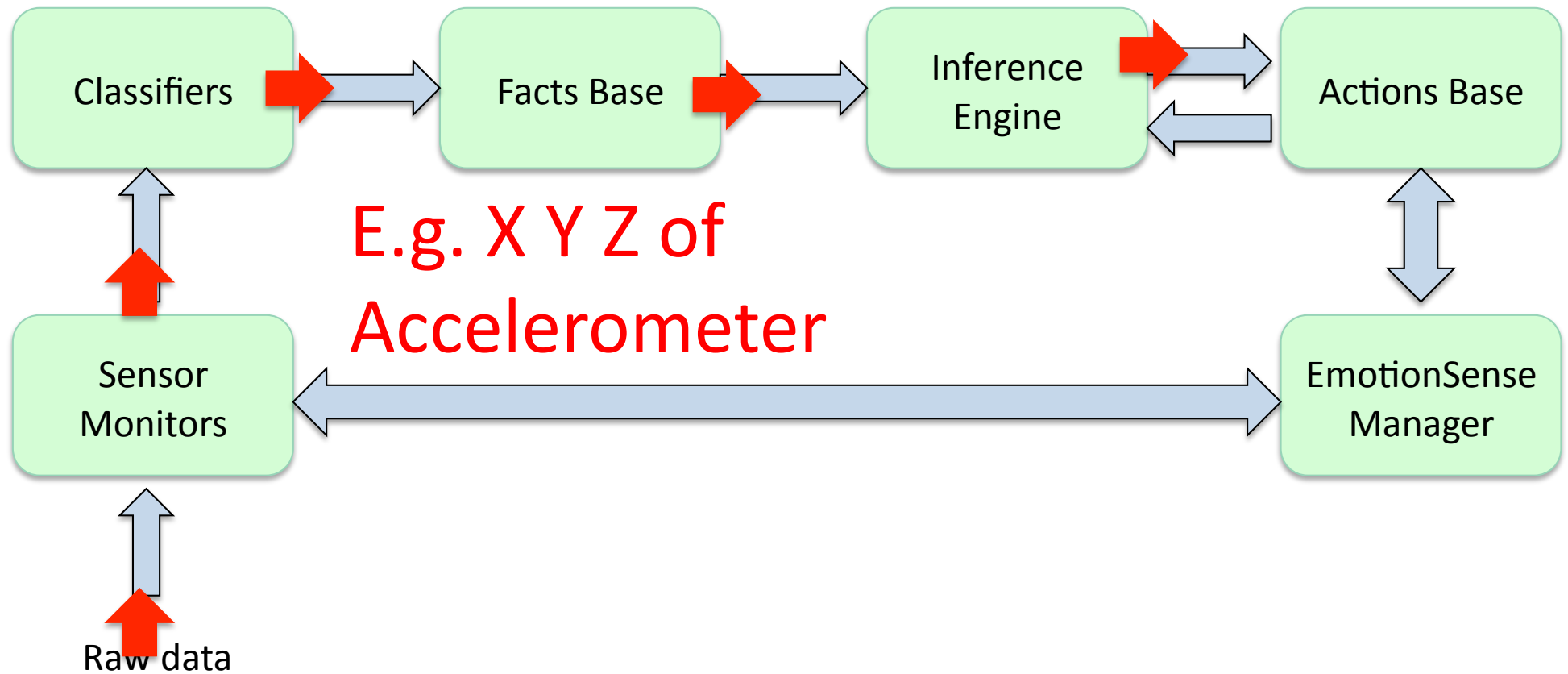
# EmotionSense - Architecture

Implemented in PyS60  
and Symbian C++



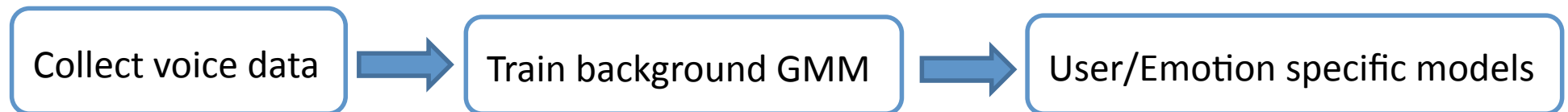
# EmotionSense – Flow of Data

E.g. fact(active, location, samplingInterval, 2)  
E.g. fact(Moving, true)



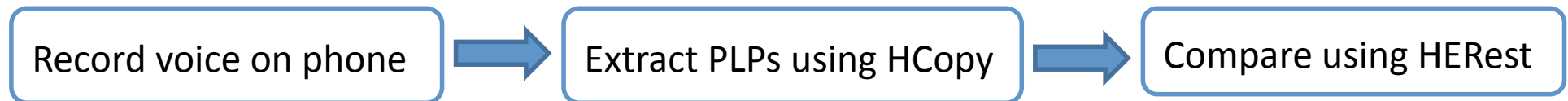
# Emotion & Speech Recognition

## Training Procedure



Speaker Recognition: Participants voice data  
Load speaker and emotion models on phone

At Runtime Emotion Recognition: from library



GMM: Gaussian Mixture Model

PLP: Perceptual Liner Prediction

Hcopy, HERest: Tools of Hidden markov ToolKit (HTK)

[1] <http://htk.eng.cam.ac.uk>

[2] M. Liberman, K. Davis, M. Grossman, N. Martey, and J. Bell.  
Emotional prosody speech and transcripts, 2002.

Mirco Musolesi

# Emotion Categories

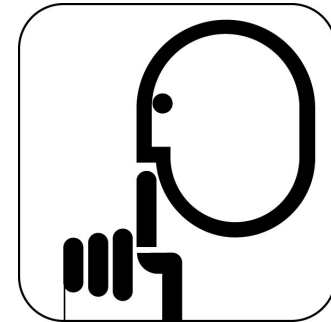
- Clustering of emotions **Why?**

**(a) Used by psychologists (b) Improves accuracy**

Broad Emotion	Narrow Emotion
Happy	Elation, Interest, Happy
Sad	Sadness
Fear	Panic
Anger	Disgust, Dominant, Hot anger
Neutral	Neutral normal, Neutral conversation, Neutral distant, Neutral tete, Boredom, Passive

# Speaker Recognition - Optimisations

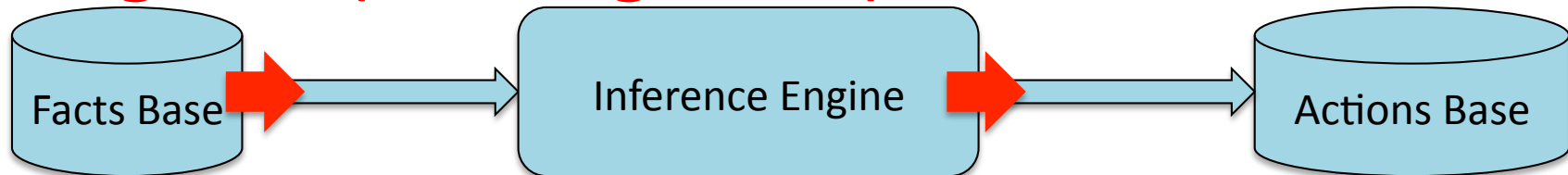
- Silence detection
  - train an additional GMM using silence audio
- Comparisons driven by co-location information
  - A recorded audio sequence is compared only with co-located users
  - This improves speaker recognition accuracy and saves energy





# Adaptation Framework

E.g. `fact(Moving, true)` → `fact(action, GPS, ON)`

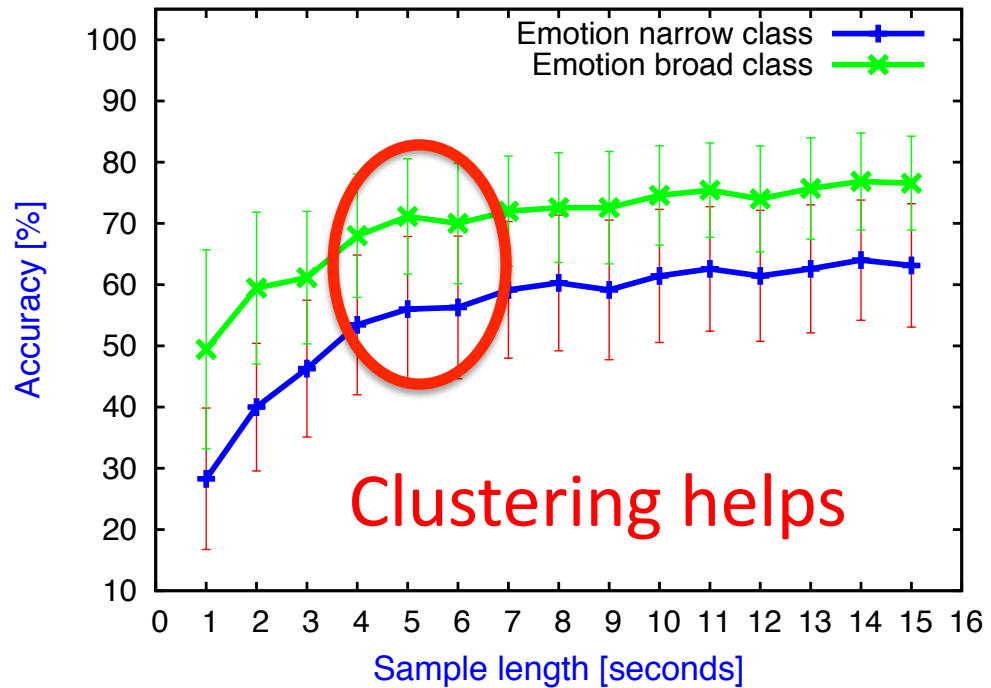


- Implemented using Pyke, a knowledge based inference engine [<http://pyke.sourceforge.net/>]

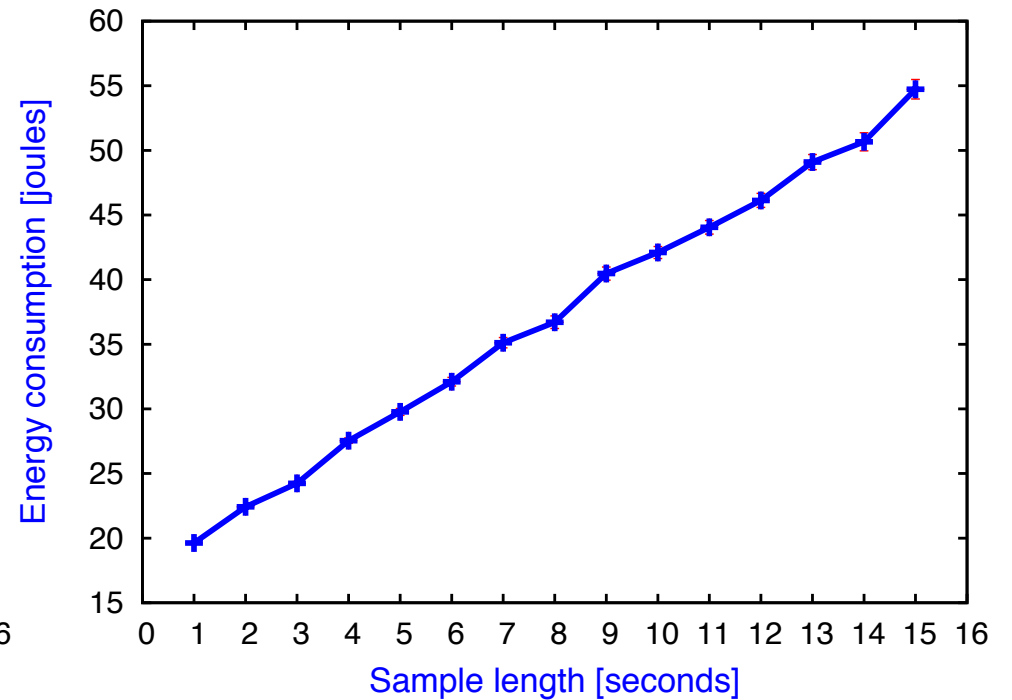
**Activate GPS only when user is moving**

```
set_location_sampling_interval
foreach
  facts.fact($factName, $value)
  check $factName == 'Activity'
  facts.fact($actionName, $currentInterval)
  check $actionName == 'LocationInterval'
  $interval = update($value, $currentInterval)
assert
  facts.fact('action', 'LocationInterval', $interval)
```

# Emotion Recognition - Benchmarks



Accuracy



Energy consumption

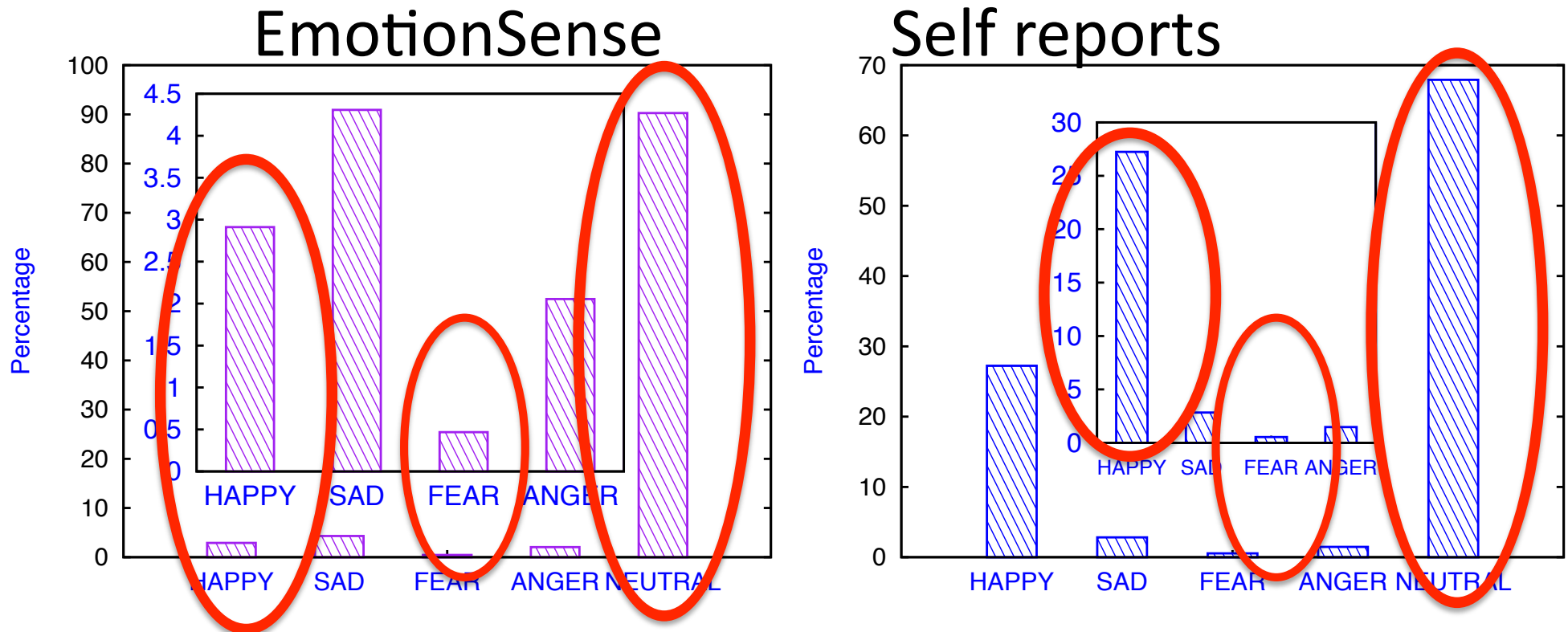
# Social Psychology Experiment

- Nokia 6210 Navigator mobile phones
- 18 participants, 10 days
- Users filled in daily diary questionnaire
- Voice data is discarded immediately
- All computation performed locally on phone



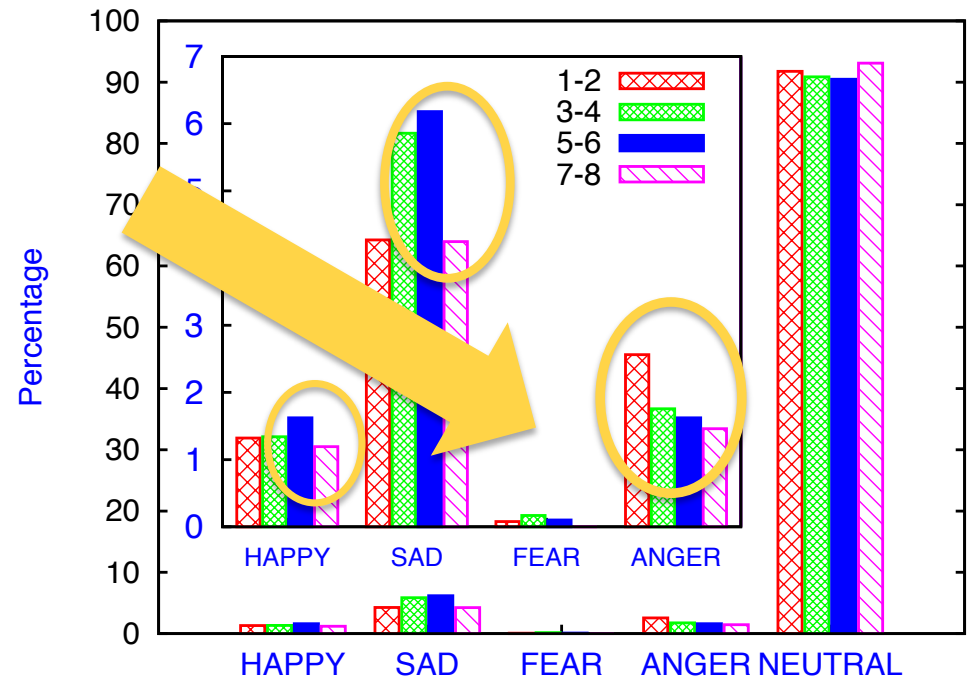
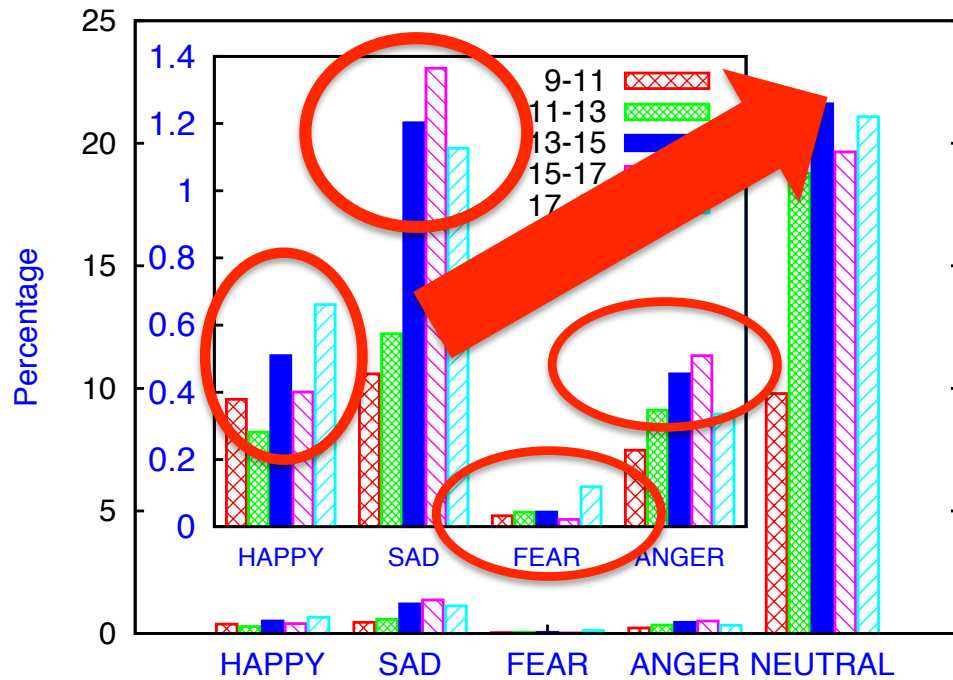
# Social Psychology Experiment - Results

## Emotion distribution similarity



Users indicated "happy" emotion to represent their mental state, and not necessarily verbal expression

# Social Psychology Experiment - Results



Correlation with time of day and co-location

# Questions?

EmotionSense Project webpage:

<http://www.cl.cam.ac.uk/research/srg/netos/emotionsense/>

