I had a dream

Hannu Toivonen

University of Helsinki, Finland

Symposium on Machine Learning and Computational Creativity
Ljubljana, 4 July, 2013

ICT as an amplifier of productivity

Faster, cheaper, everywhere, all the time

Burden on users, stress, lack of free time

ICT as an amplifier of mental satisfaction

Positive emotions, mental wellbeing

Support creativity, learning, meaningful leisure time

> ## *Can data be turned into a subjective, esthetic experience?*

- Given **your** data, could **you** enjoy listening to it as music?
- Could you even feel **joy of creativity**?

Data Musicalization

- Using given data as input,
- automatically compose a novel piece of music

New goals for data analysis

Traditional data analysis and representation (statistics, visualization, sonification, etc.):

- Transfer of information

- Objectivity

- (Cognitive emphasis)

Data musicalization:

- Experiences involving feelings and emotions

- Subjective

- (Affective emphasis)

Motivation for data musicalization

– Esthetic pleasure

– Joy of creativity

– Transfer of (some) information in a novel way

  – Possibly in the background, unconsciously

  – Like sonification, but musical

– Building an emotional attachment to an application

Sleep musicalization

– An application of data musicalization

– A piece of music is composed from a night's sleep

– *Goal: help and motivate users track their sleep and eventually improve their sleep*

– Two phases

1. Data analysis:
   from sensor data to sleep measurements

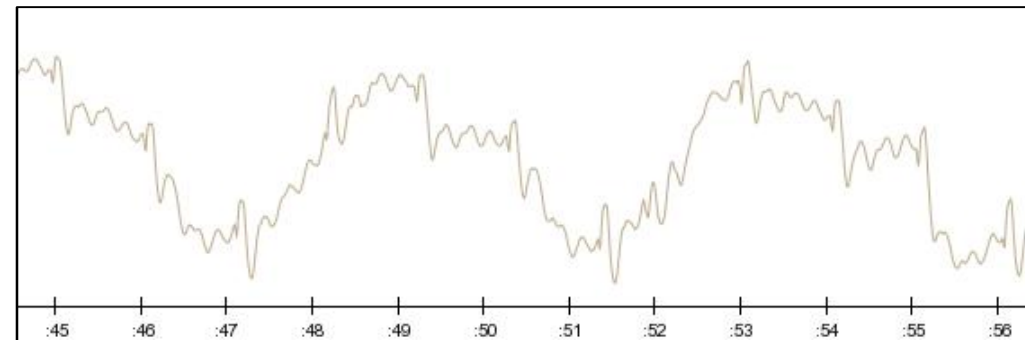2. Composition algorithm:
   from sleep measurements to music

Phase 1, data analysis
From sensor data to sleep measurements
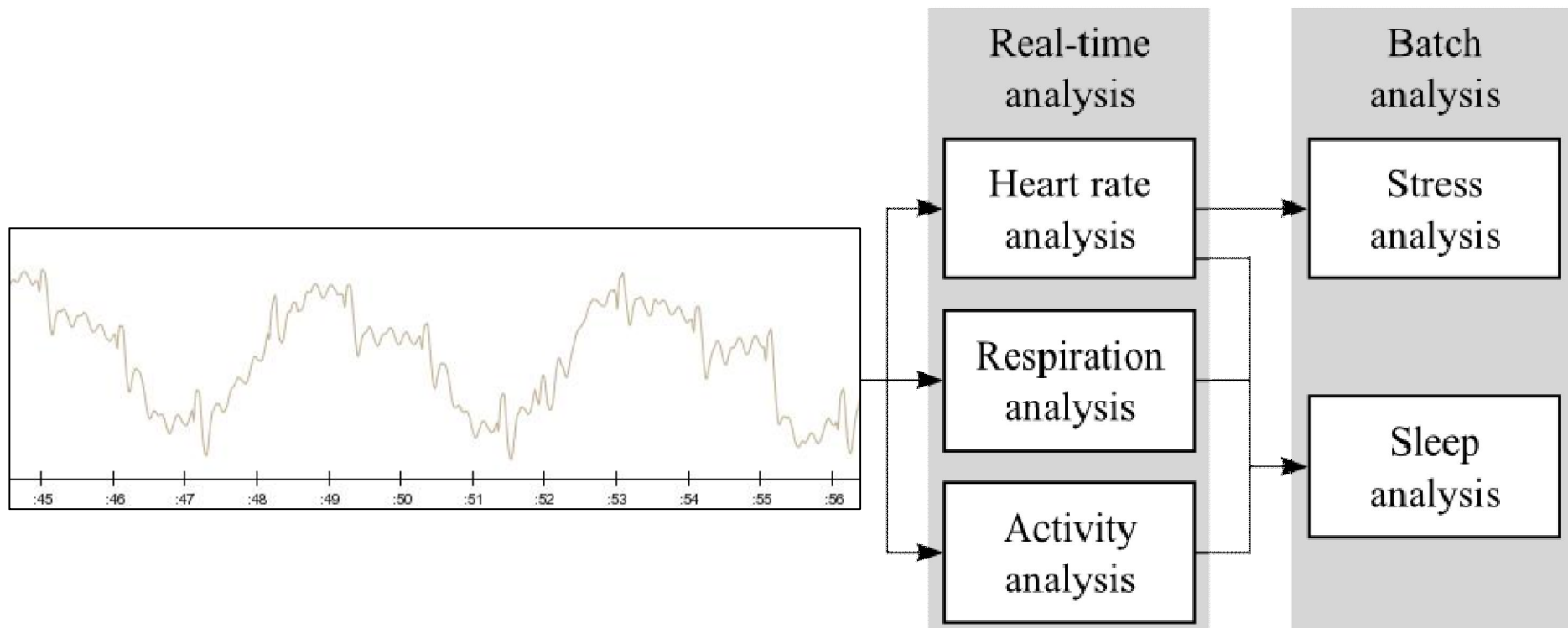
Sensor data

A thin piezo-electric force sensor placed under the mattrass topper (from Beddit Ltd)

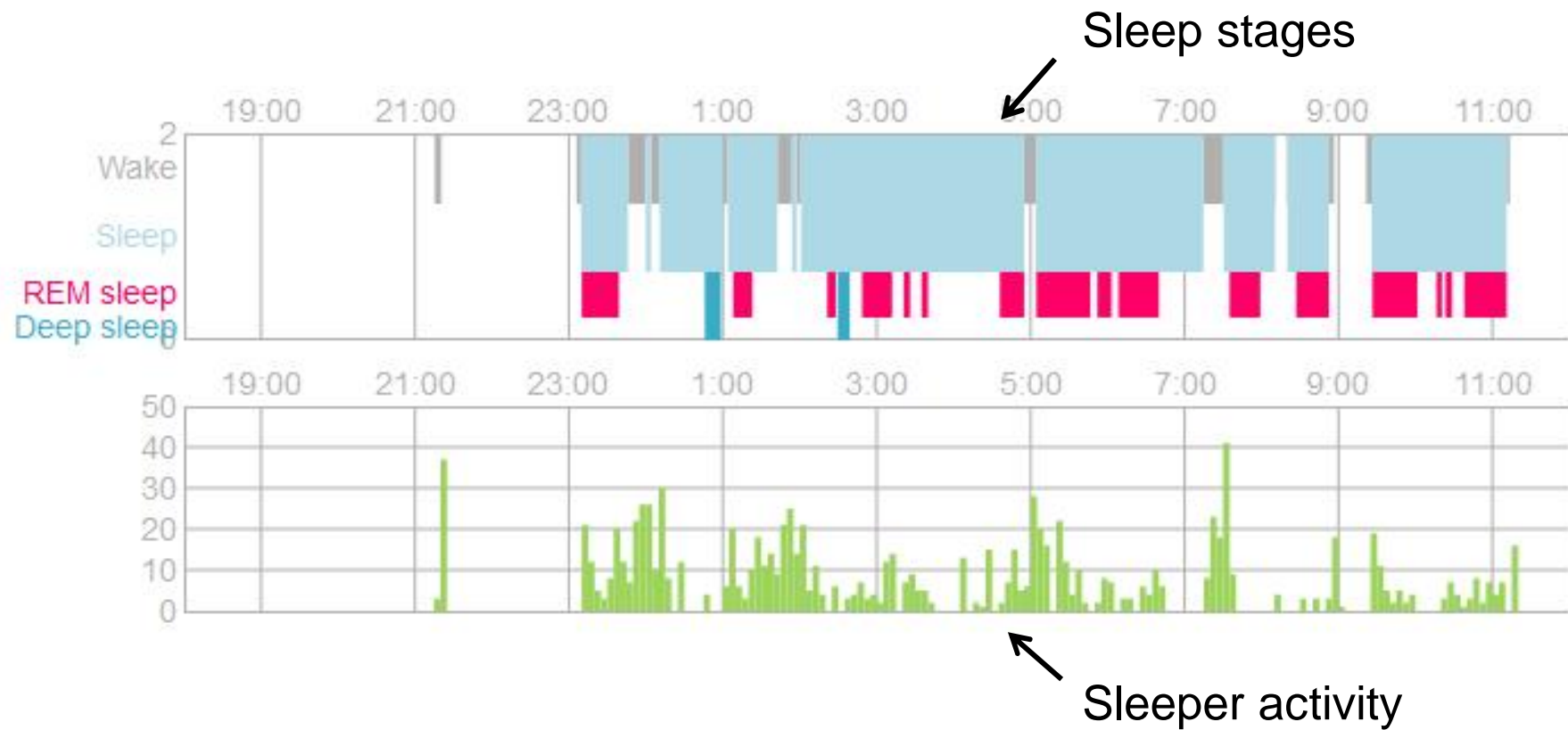Force signal with sample rate 140 Hz (here a 12-second signal excerpt)

Analysis of sensor data

Sleep analysis results

Sleep stages

Sleeper activity

Phase 2, composition
From sleep measurements to music

Composition of music from sleep

Design principles/goals:

– Compose a novel piece of music

– Use sleep measurements to guide the composition

– Produce music, not sonification

– Make the music reflect properties of sleep

– Compress 8 hours of sleep to couple of minutes

– Use simple methods, build a proof of concept

Composition in 6 steps

1. Generation of harmonic progression (chord seq.)
2. Melody generation
3. Generation of rhythm
4. Generation of accompaniment
5. Adjusting volume
6. Regulation of tempo

Correspondence between sleep and music

In a nutshell:

– Deeper sleep corresponds to calmer music

– Lighter sleep corresponds to livelier music

– Each sleep stage has a different accompaniment (and theme)

– Tempo is regulated by the heart rate

– More activity corresponds to louder music

sleepmusicalization.net

– Sleep musicalization is available as a public web service at http://sleepmusicalization.net

– You can have your sleep measurements composed into music (if you have a Beddit sleep sensor), or

– Listen to songs published by other users

sleepmusicalization.net

Sleep musicalization

Perceive your sleep as a unique musical experience!

Musicalization turns data into a genuine piece of composed music.

♫ Try it on your Beddit data!

Introduction

Sleep musicalization is a novel way of perceiving and experiencing sleep measurement data. The goal is to help users understand and analyze their sleeping patterns and eventually improve their sleep.

The musicalization process follows musicological principles when composing a melody, designing the rhythm and changes in tempo, arranging the accompaniment, and playing out the music at different levels of volume. These aspects are inspired but not dictated by the data. The result of musicalization of eight hours of sleep is an origianal piece of couple of minutes of music.

Musicalization of data provides a whole new way to experience data as a music. Music has a unique capability to invoke emotions, giving users a novel opportunity to perceive their data

Listen to latest samples

Sleeper Agent
Contributed by UFOPOLI
Listen

Wild Trances
Contributed by UFOPOLI
Listen

Deep dreams
Contributed by discovery
Listen

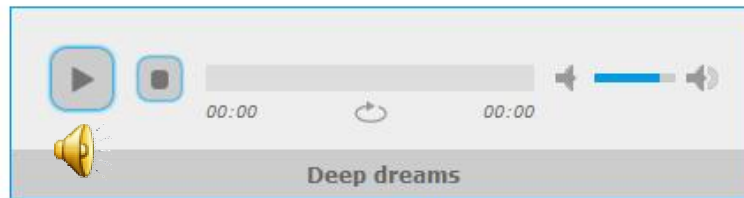**Hannun viime yö**
Contributed by discovery
Listen

eva 09/11/12
Listen

Listening to sleep music

▶ ■   00:00   ↻   00:00   🔇 ▬▬ 🔊

Deep dreams

Deep dreams

Share this song
Copy-paste the following link to email, discussion, etc:

http://sleepmusicalization.net/song/wOqbL1icfDNE
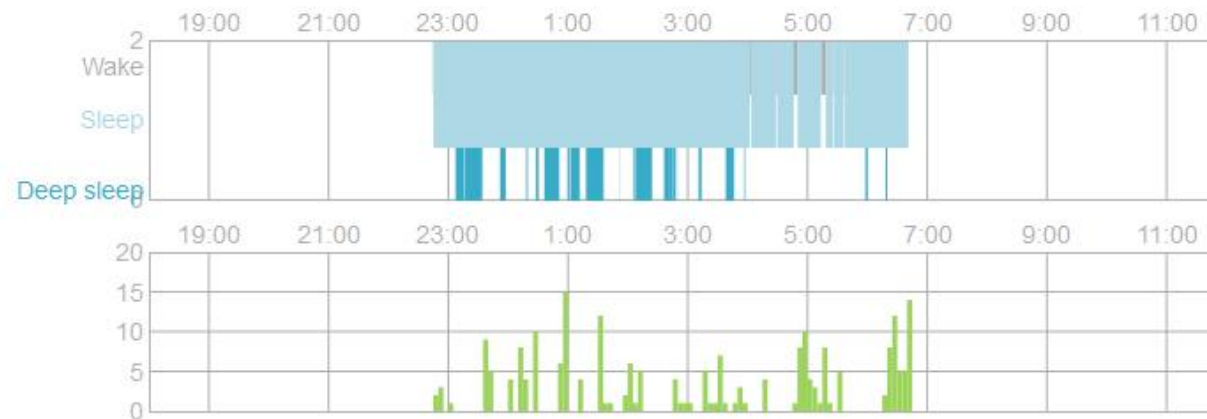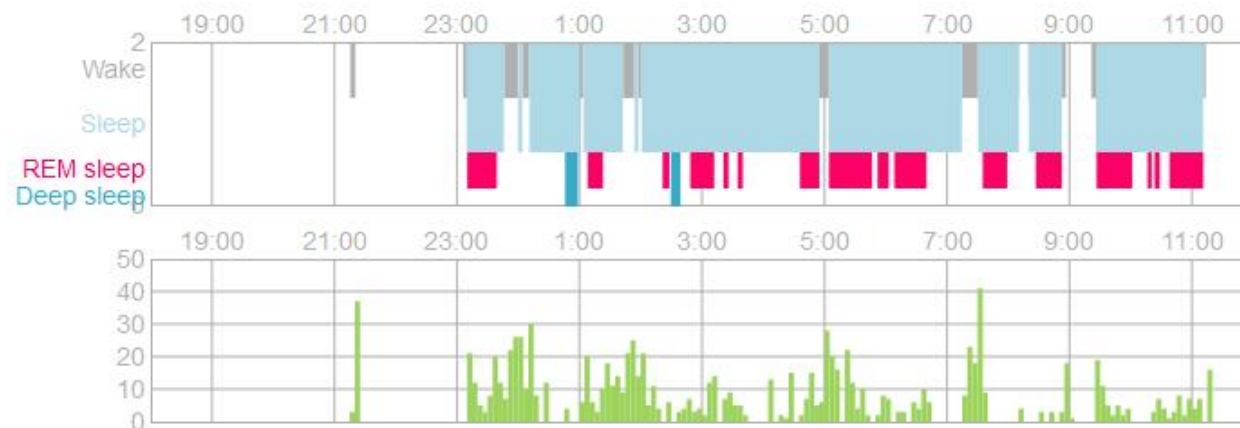
Sleep stages visualized
The hypnogram on the left shows visualized sleep stages.

Movements during the sleep
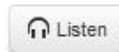The actigram on the left shows the amount of movements during the night.

My songs
There are no songs yet

Latest songs

Sleeper Agent
Contributed by UFOPOLI

🎧 Listen

Wild Trances
Contributed by UFOPOLI

🎧 Listen

A different example

Independent reviews

"[The songs] do have a uniquely personal and (dare I say it?) dreamlike feel"

— Leslie Katz, CNET

"[…] these songs left me with a sense of incompletion, as if the piano-dominate music would be an inadequate representation of my dreams."

— Nic Halverson, Discovery News

Modular musicalization?
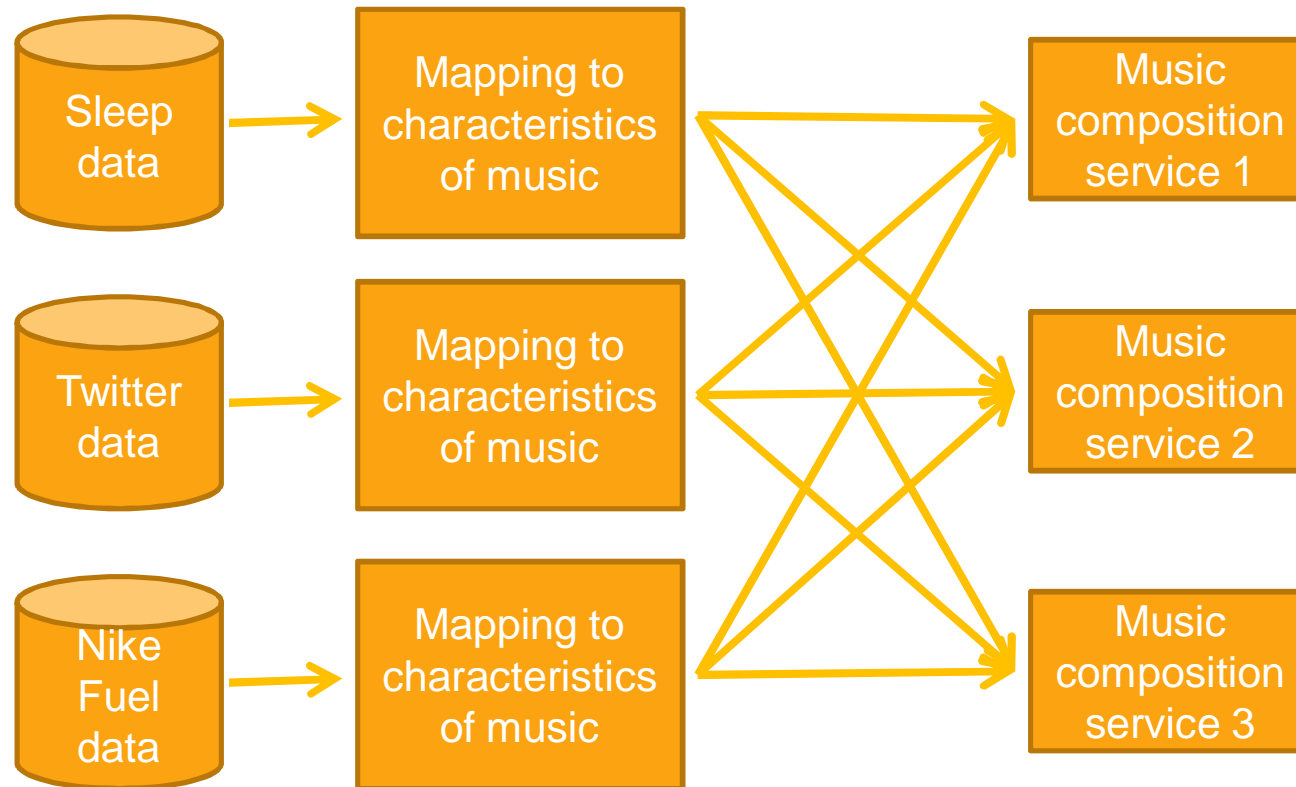
Musicalization protocol
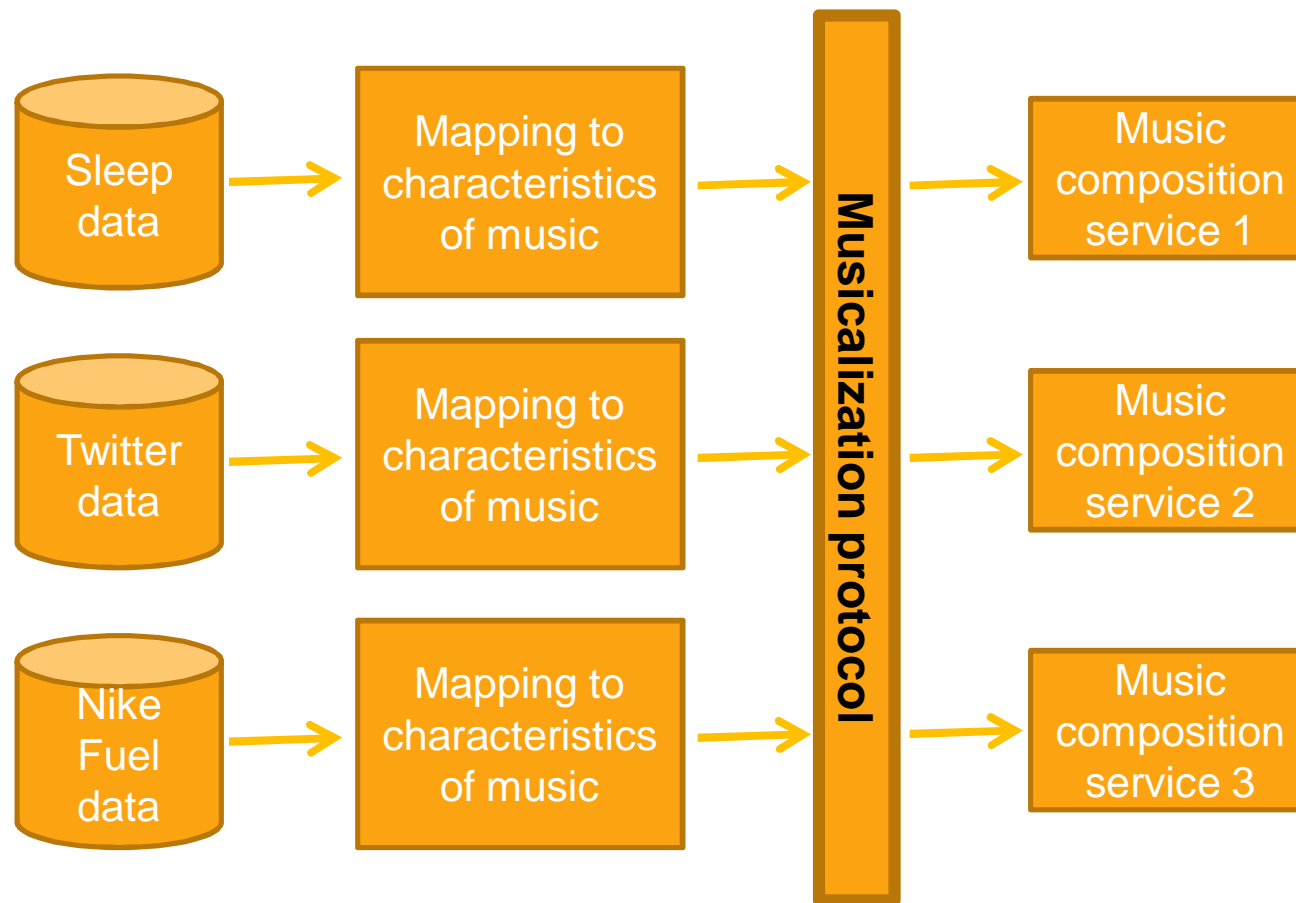
Musicalization protocol

– **Real-time instructions to an independent composition module**

Turning voices on and off

– `sound on/off`

– `global volume 1-127`

– `voice volume 1-10 (voice) and 1-127 (volume)`

Musicalization protocol

Instructions for "composition"

— scale type major, natural minor, harmonic minor, dorian, phrygian, lydian, mixolydian, locrian

— harmony 1-10

— rhythm density 1-10

— phrase length 2-24 (how many bars per phrase)

— notice phrase ends on, off (are phrase ends noted with a pause/long note)

— tempo 11-450

Musicalization protocol

Instructions for "orchestration"

- voices 1-9 (number of voices)
- instrument 1-10 (voice) and instrument name
- voice role 1-10 (voice) melody/
  accompaniment/bass (role)
- accompaniment pattern all/1-13
- drums on/off
- drum pattern all/1-16

Musicalization protocol

More specific instructions to control the music

- `scale base C, Cs, D, Ds, E, F, Fs, G, Gs, A, As, B`

- `chord type major, minor, major7, major maj7, minor7, minor maj7, augmented, diminished, augmented7, diminished7, augmented maj7, diminished maj7, major6, minor6`

- `sudden note 1-127 (pitch) and 0.01-4 (lenght) (force a note to play now)`

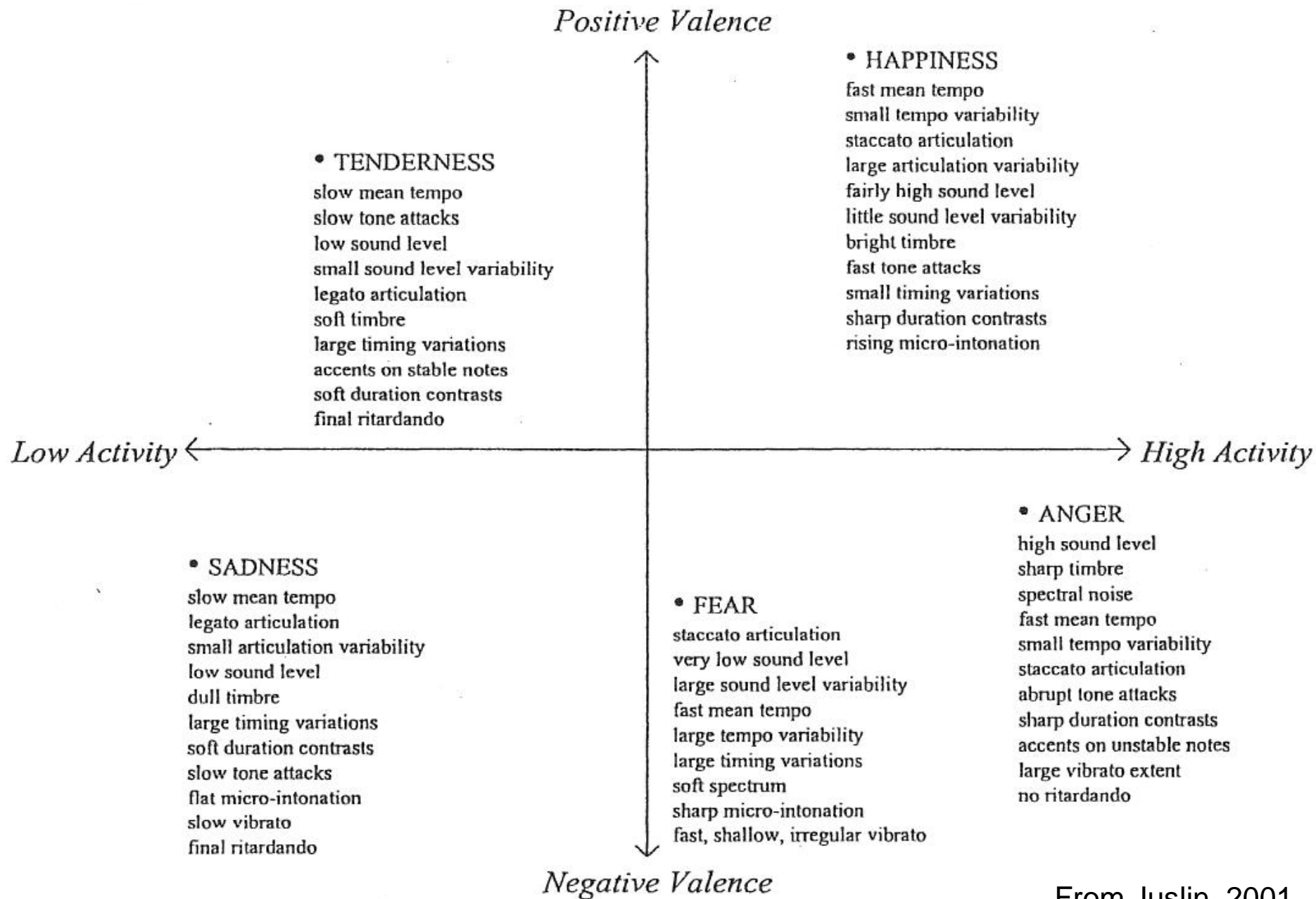- `bad sound 1-120 (pitch) and 0.01-4 (lenght) (instant bad discord, parameter is for pitch)`

Musicalization protocol

Abstract instructions

- love

- joy

- fear

- anger

- surprise

- sadness

Can be implemened by mapping to lower level instructions

Positive Valence

• TENDERNESS
slow mean tempo
slow tone attacks
low sound level
small sound level variability
legato articulation
soft timbre
large timing variations
accents on stable notes
soft duration contrasts
final ritardando

• HAPPINESS
fast mean tempo
small tempo variability
staccato articulation
large articulation variability
fairly high sound level
little sound level variability
bright timbre
fast tone attacks
small timing variations
sharp duration contrasts
rising micro-intonation

Low Activity ← → High Activity

• SADNESS
slow mean tempo
legato articulation
small articulation variability
low sound level
dull timbre
large timing variations
soft duration contrasts
slow tone attacks
flat micro-intonation
slow vibrato
final ritardando

• FEAR
staccato articulation
very low sound level
large sound level variability
fast mean tempo
large tempo variability
large timing variations
soft spectrum
sharp micro-intonation
fast, shallow, irregular vibrato

• ANGER
high sound level
sharp timbre
spectral noise
fast mean tempo
small tempo variability
staccato articulation
abrupt tone attacks
sharp duration contrasts
accents on unstable notes
large vibrato extent
no ritardando

Negative Valence

From Juslin, 2001

Alternative sleep musicalizations

Sleep data → Mapping to characteristics of music → **Musicalization protocol** →

Music composition service 1 — Perceptualization of sleep measurements; Tulilaulu et al, IDA 2012

Music composition service 2 — Expression of sleep stages using emotions; Monteith et al, ICCC 2010

Music composition service 3 — Melody extracted/ inspired by the sleep measurement signal; Smith et al, ICCC 2012
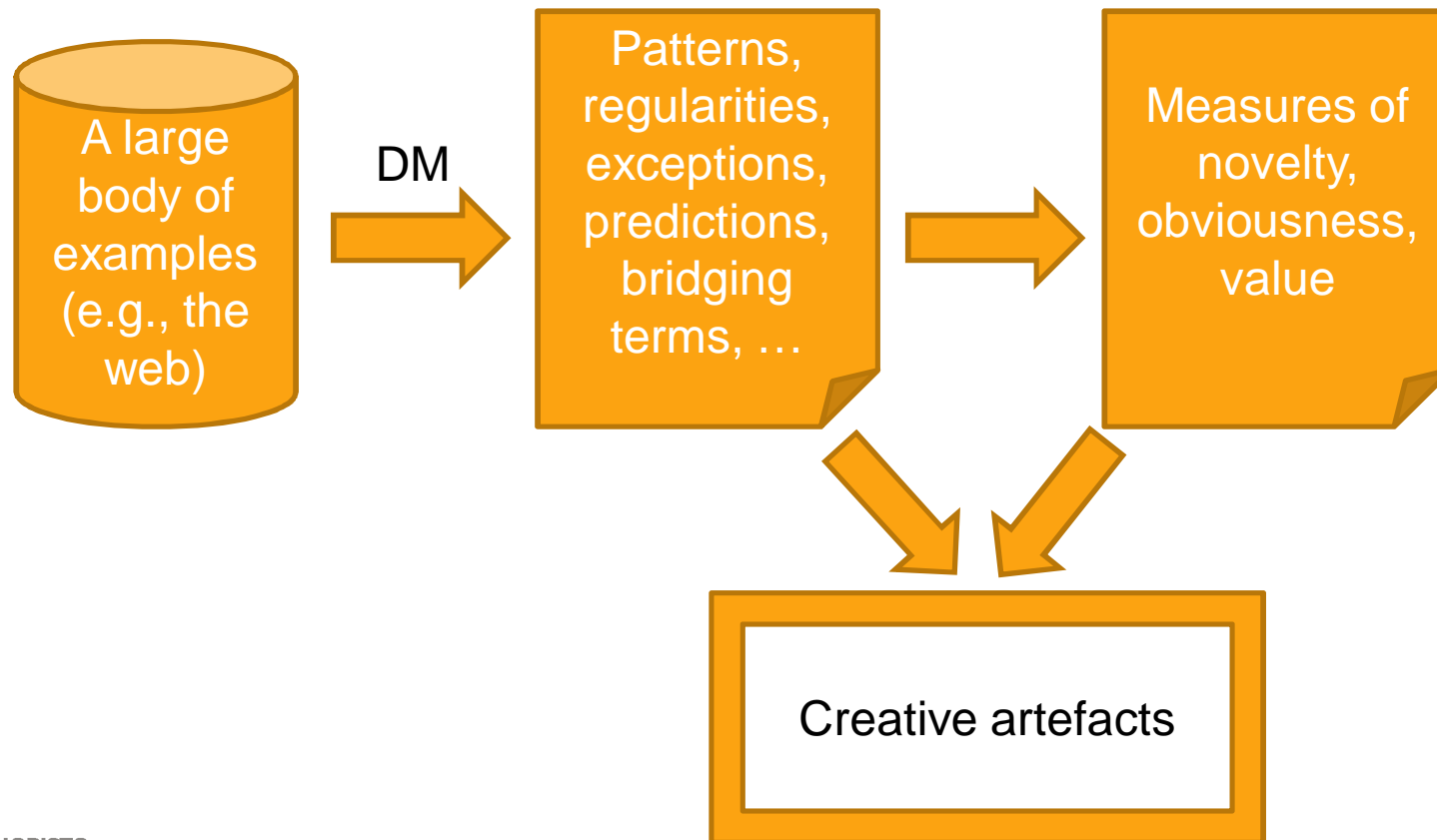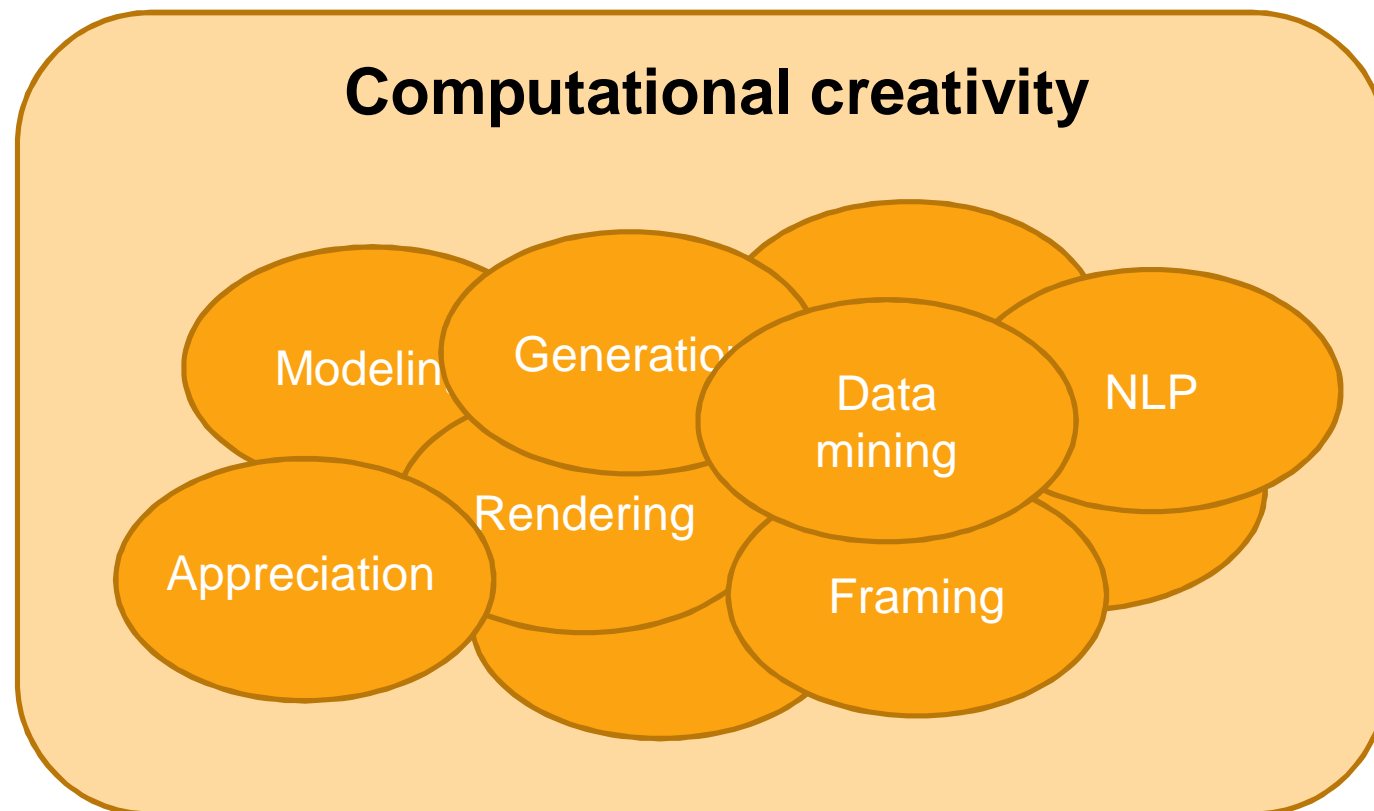
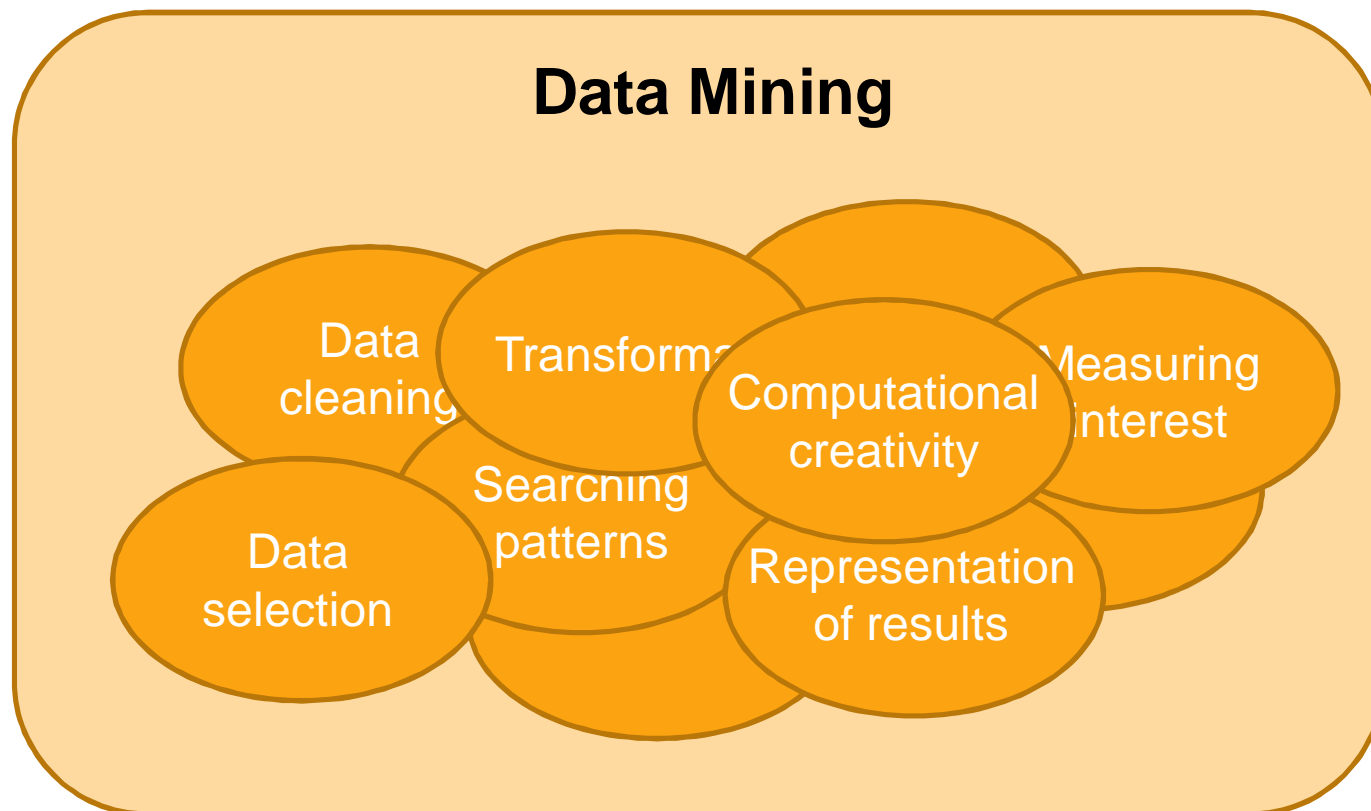# Conclusions

Data mining for creativity

Data mining for creativity

Creativity for data mining

Summary

- *Emotional/sensational data mining:*

Use computational creativity to produce
a subjective, emotional sensation of data

- A modular architecture, with a musicalization protocol
- **Your data + CC tools = do it yourself CC**

01net.

Recherchez sur 01net.com   OK

pressetex   DIARIO de PERNAMBUCO
com.br

Home   Produk
Hightech   Busines

MedLi+e
în direct cu medicii

scientias.nl

NASLOVNA

Datanomiksi Ota ICT-ala haltuun. – Lu

Digitointia Kaikki video/äänityypit DVD

mälaseista Oletko sopiva silmäleikkauk

Sleep M
μετατρέ

0   Posted

Date

THE IDA 2012

FRONTIER PRIZE
is awarded to

A. TULILAULU *and* J. PAALASMAA
and M. WARIS *and* H. TOIVONEN

for the most novel and visionary contribution, titled
"SLEEP MUSICALIZATION: AUTOMATIC MUSIC
COMPOSITION FROM SLEEP MEASUREMENTS"
presented at
THE ELEVENTH INTERNATIONAL SYMPOSIUM ON
INTELLIGENT DATA ANALYSIS (IDA 2012)
held in Helsinki, Finland, during 25th to 27th October 2012

27.10.2012
SPONSOR   DATE
                              JOÃO GAMA
                              FRONTIER PRIZE CHAIR

has squirrel-like ancesto

ANIMALS | HISTORY | ADVENTURE

What Your Dreams Sound Like

SOUN

yle TV2

传感器
传感器
压缩成一首

cbcradio

Acknowledgments

- Aurora Tulilaulu, Mikko Waris,
  University of Helsinki, Finland

- Joonas Paalasmaa;
  University of Helsinki and Beddit Ltd

- Dan Ventura, Daniel Johnson
  Brigham Young University, Utah, USA :

Autumn School on Computational Creativity

November 18-22, 2013

Porvoo, Finland

- The 2nd International School on CC
- Organized by the Prosecco network

- http://www.cs.helsinki.fi/ascc2013

Congratulations

In the words of our computer humorist [Valitutti et al, ACL 2013]:

Congratulations to the authors of the book
on my fart. I mean "part"

Let everything turn well in your wife. Oops. "life"