Methods of non verbal behaviour analysis for psychotherapy research

SPR Method Workshop

Bern 5.9.2007

Stéphane With

Overview

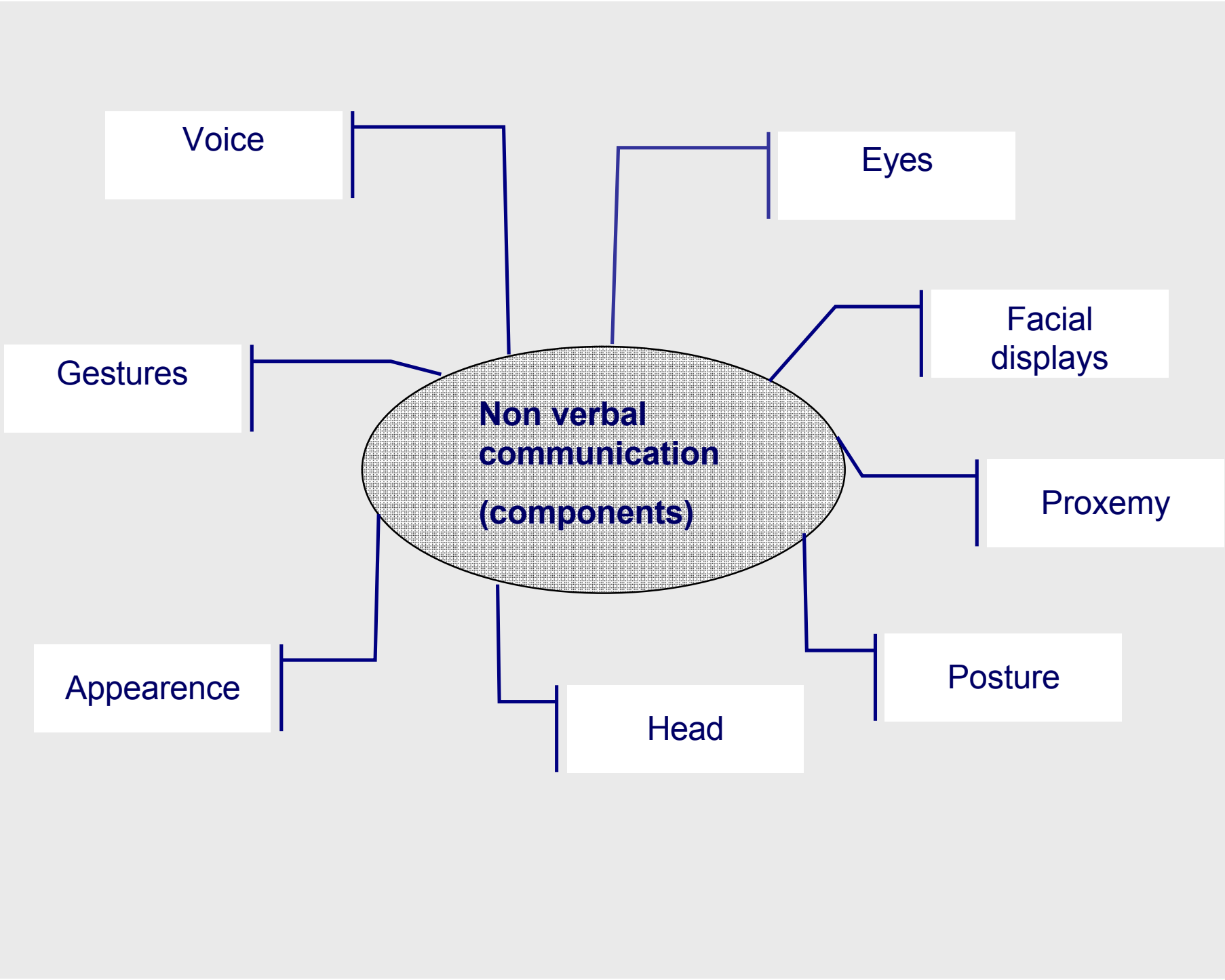
Some Theory

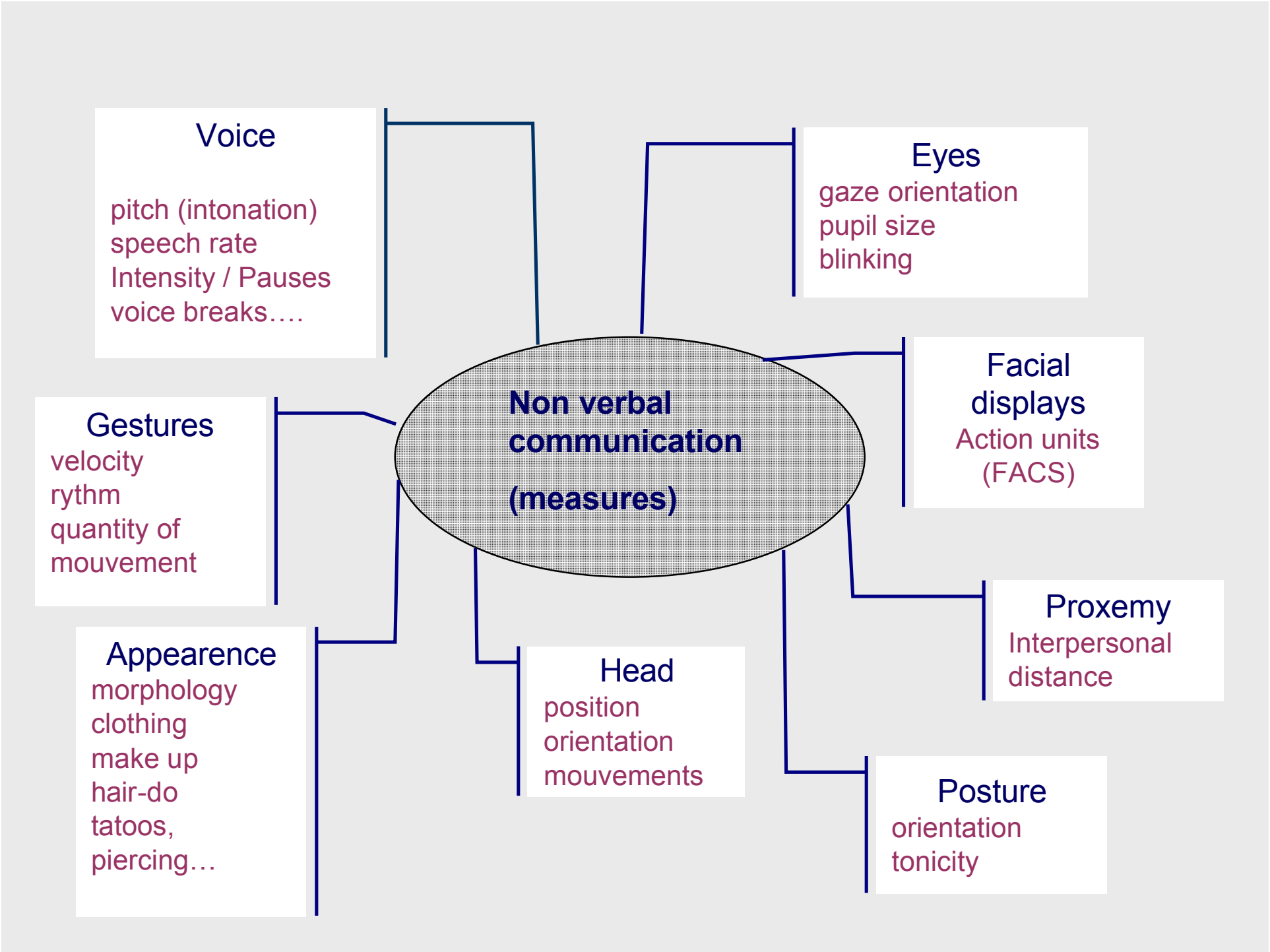
- Non verbal behavior 101
- Examples of non verbal studies in clinical settings
- A heuristic model for the study of nvb
- Facial displays

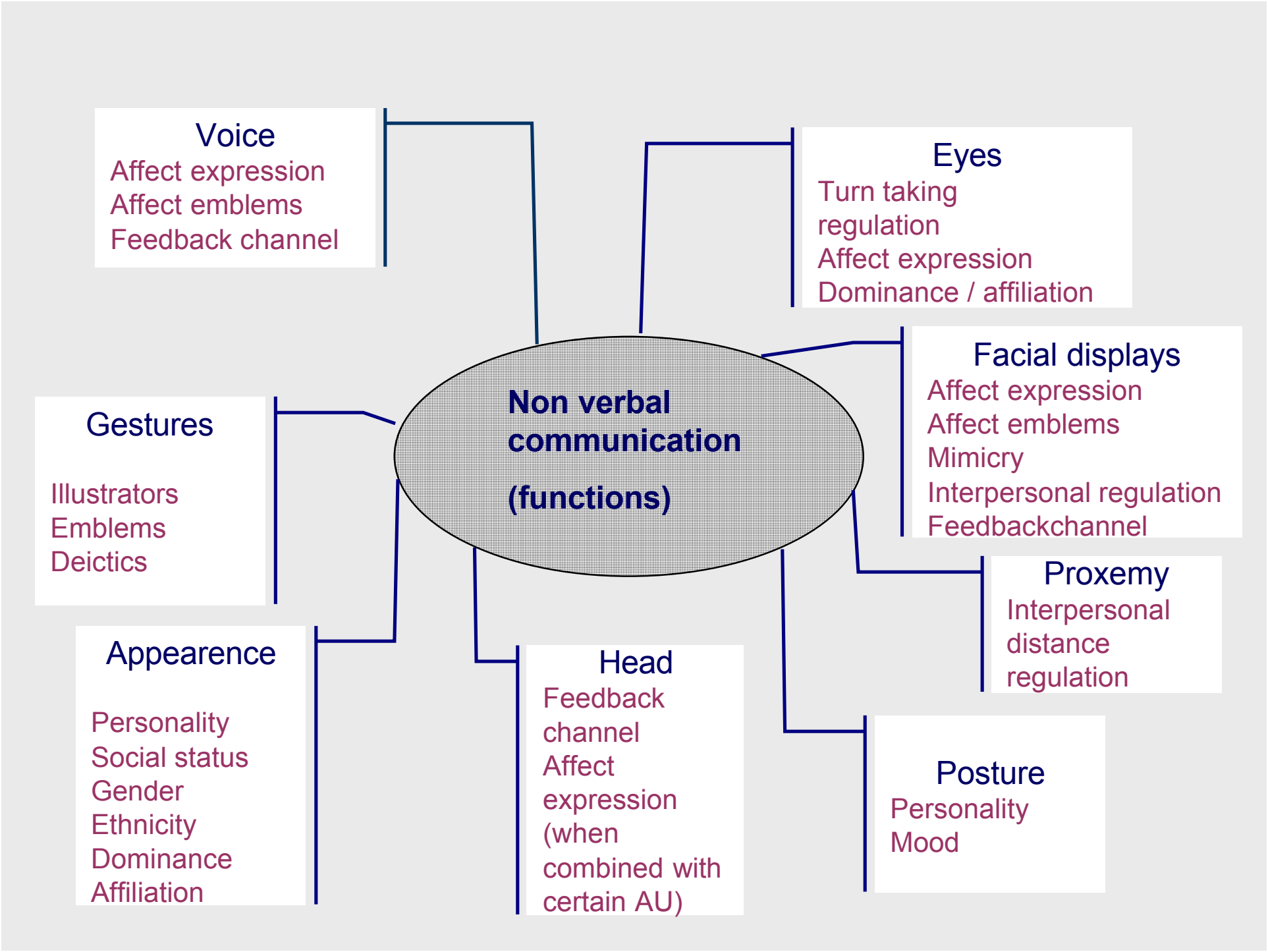
Methods

- Current and emerging methods to study facial displays
- Observer based annotation tools for nvb and multimodal research
- Judgment studies interfaces
- Patterns identification in behavioral streams

Non verbal behavior 101


Voice
Eyes
Facial displays
Gestures
Non verbal communication (components)
Proxemy
Appearence
Head
Posture


Voice
pitch (intonation)
speech rate
Intensity / Pauses
voice breaks….
Eyes
gaze orientation
pupil size
blinking
Non verbal communication
(measures)
Facial displays
Action units (FACS)
Gestures
velocity
rythm
quantity of mouvement
Proxemy
Interpersonal distance
Appearence
morphology
clothing
make up
hair-do
tatoos,
piercing…
Head
position
orientation
mouvements
Posture
orientation
tonicity


Voice
Affect expression
Affect emblems
Feedback channel
Eyes
Turn taking
regulation
Affect expression
Dominance / affiliation
Facial displays
Affect expression
Affect emblems
Mimicry
Interpersonal regulation
Feedbackchannel
Non verbal communication
(functions)
Gestures
Illustrators
Emblems
Deictics
Proxemy
Interpersonal
distance
regulation
Appearence
Personality
Social status
Gender
Ethnicity
Dominance
Affiliation
Head
Feedback
channel
Affect
expression
(when
combined with
certain AU)
Posture
Personality
Mood

Examples of non verbal studies in clinical settings

Depression and suicide faces*

- Fifty-nine adult patients (age 20-65) admitted to the emergency ward of Geneva University Hospitals after a suicide attempt

- Were excluded :
  - Patients who did not speak French;
  - who were not living in the area;
  - who presented with an acute psychotic state.

*Heller, M., Haynal, V. Depression and suicide faces. In: Eds. (1997). Ekman, P., Rosenberg, E. What the face reveals. New York: Oxford University Press.

A 20 minutes long interview using a standardized questionnaire,

Then the interviewer was asked to assess the suicide risk on a 4-point scale ("written predictions").

At 24-months follow-up :

- 11 Repeaters, who were matched with
- 11 of the 48 Non-Repeaters,

  – with respect to gender,
  – age,
  – number of previous suicide attempts.

Coding

FACS coding:

"Do you think that one day, you will commit suicide?" ("Suicide topic"),

"Could you tell me what you liked and disliked in the care you received here, at the hospital?" ("Care topic").

Comparing the facial behavior, (durations, frequencies, intensities)

- of both patients' groups:
  - Repeaters versus
  - Non-repeaters

- of the MD talking either with:
  - a Repeater or
  - a Non-repeater

Results

Numerous differences in nonverbal behavior, according to whether the interview was being held with a future Repeater or a Non-Repeater.

By the MD

Average facial activity: The number and intensities of AUs is higher when talking to a future Repeater

By the MD

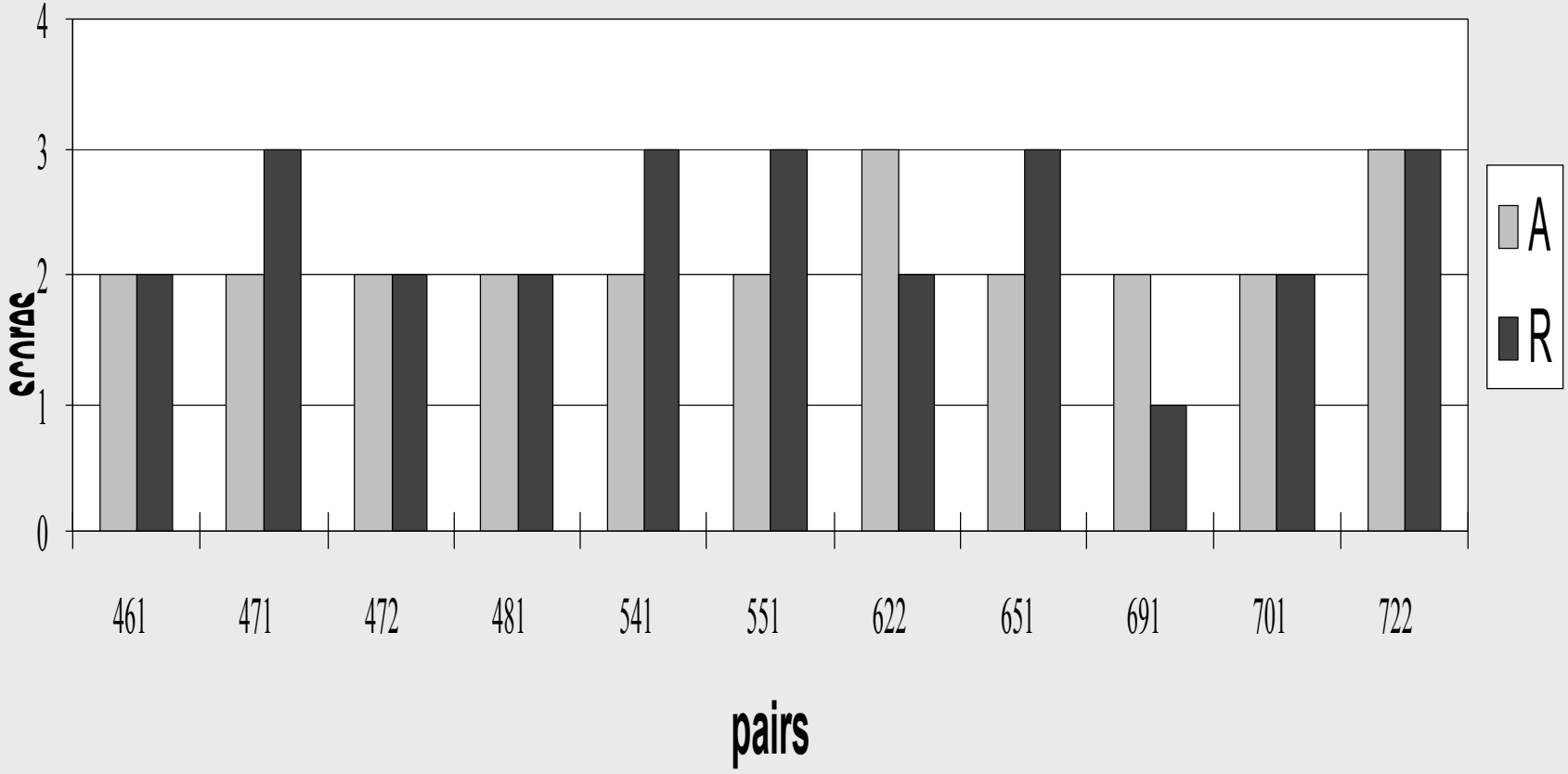
- **Peri-ocular muscular activation:** activated significantly more frequently and with greater intensity during the "suicide topic"

By the MD

- **Direction of gaze and head:** significantly longer time directly on Repeaters' face (EV: 86.4 %)

- with Non-repeaters, she looks "on" with head "off" or opposite

The MD written predictions were erroneous (EV: 22,7 %)



By the patient

- Repeaters had a significantly higher activity of the mouth (when not speaking) (EV: 90.9%).
- They looked more downwards (EV: 83%)

Three conclusions :

- confirm that nonverbal, non-intentional, and non-conscious interaction between patient and therapist does occur
- Nonverbal communication could provide important information regarding the affective and suicidal mood of the patient, even if he does not verbally disclose his intentions
- The interviewer does not seem to pay enough attention to her own nonverbal reactions and this prevents her from improving her clinical judgment.

PAM and Traps in the therapeutic relationship*

- PAM: prototypical affective microsequences (mainly smiling)
- TRAP (non verbal role offer to the therapist)

From Bänninger-Huber (1996)

TABLE 1. Prototypical Combinations of the Therapist's Reactions in Successful and Unsuccessful Traps and PAMs

	Trap	
PAM	Unsuccessful	Successful
Unsuccessful	No smiling/laughing No verbalization	No smiling/laughing Verbal confirmation
Successful	Smiling/laughing No verbalization	Smiling/laughing Verbal confirmation

TABLE 2. Functions of Successful and Unsuccessful Trap/PAM Combinations

	Trap			
PAM	Unsuccessful		Successful	
	Classical abstinence		Reserved confirmation	
Unsuccessful	conflict	activated	conflict	deactivated
	affect (guilt feelings)	occurrent	affect (guilt feelings)	absent
	working alliance	insecure	working alliance	insecure
	Friendly refusal		Every day interaction	
Successful	conflict	activated	conflict	deactivated
	affect (guilt feelings)	occurrent (experienced)	affect (guilt feelings)	absent
	working alliance	secure	working alliance	secure

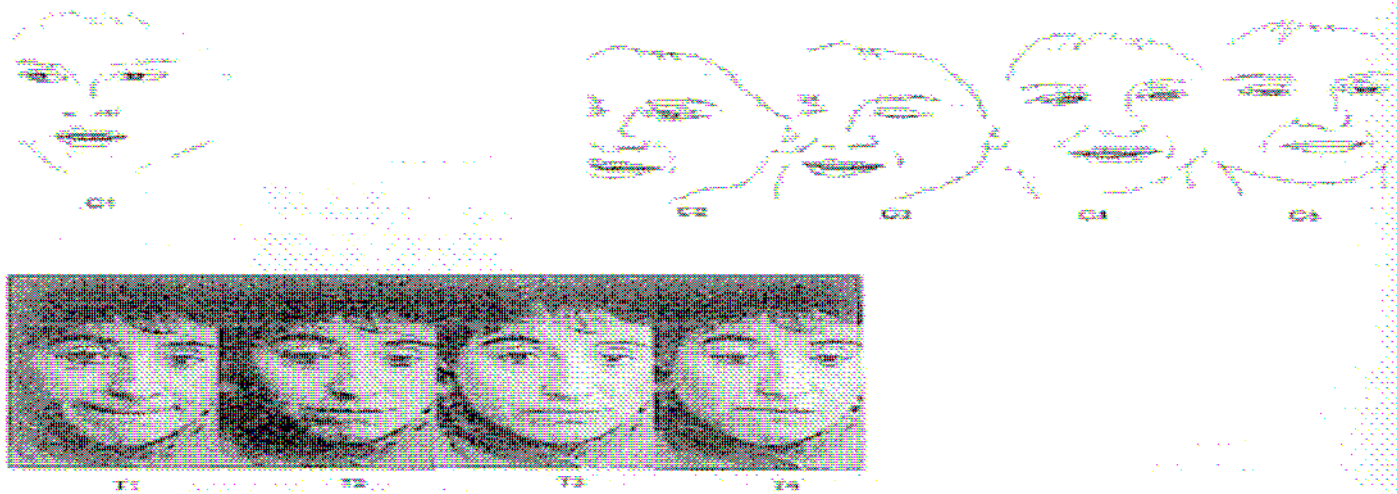


Abbildung 16.3: "Videostandbilder" der prototypischen affektiven Mikrosequenz "Whiskey sour" (Teil 1)

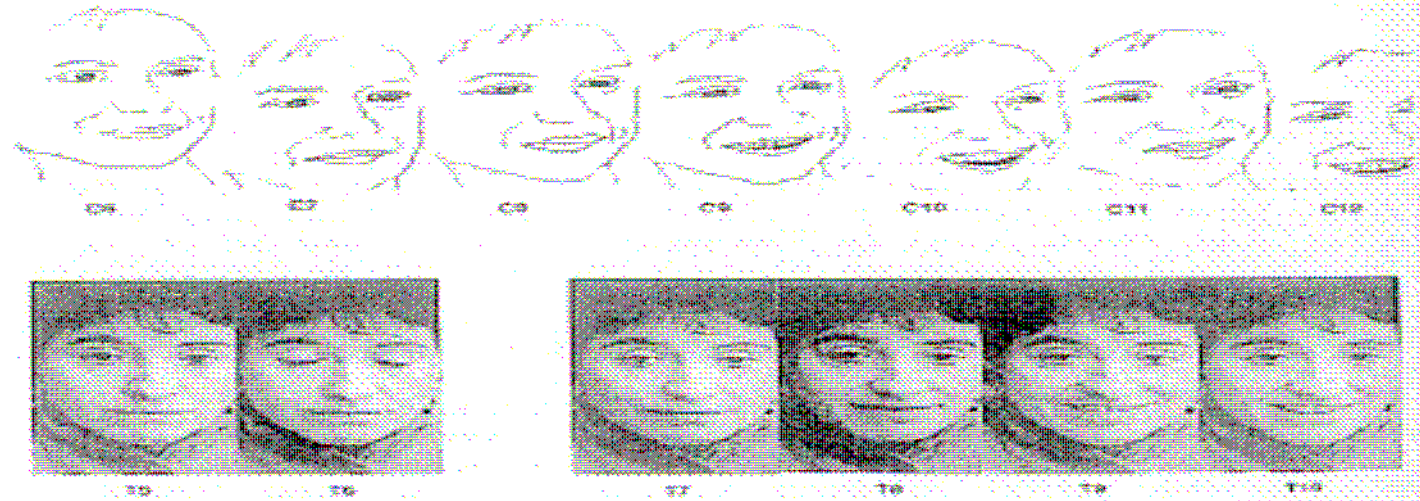
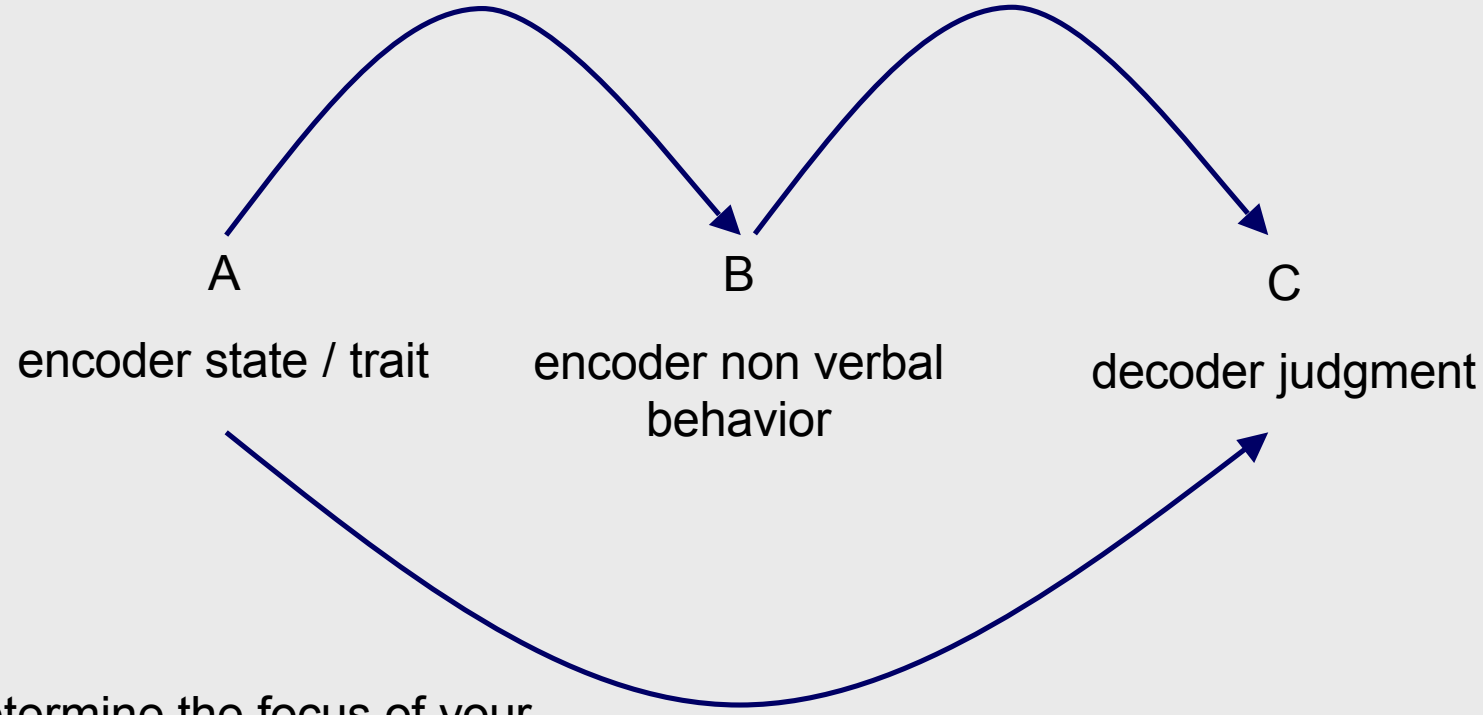


Abbildung 16.4: „Videostandbilder" der prototypischen affektiven Mikrosequenz "Whiskey sour" (Teil 2)

Heuristic model for non verbal studies

The ABC chain



Determine the focus of your study:

A or B or C

AB – AC – BC – ABC chain

adapted from Rosenthal, 2005

- ABC chain:
  - Teacher's expectation of student's performances (Harris and Rosenthal, 1985, 1986)

- AC arrows:
  - current in general diagnosis and person perception studies
  - decoder assess encoder's "true" attribute *(correlate judgments with independent measure of A)*
  - Establish individual differences among judges in degree of accuracy shown
  - individual differences of interest might be psychopathology, cognitive biaises, personnality attributes

- BC arrows:

  - are smiling faces rated more friendly?
  - are voices with greater pitch range judged more pleasant?
  - are louder voices judged more extraverted?

- AB arrows:

  - ex: empathy of a therapist for a patient / empathy = A (*independent variable*) and nonverbal behavior B (*dependent variable*)

signs vs judgment based approaches

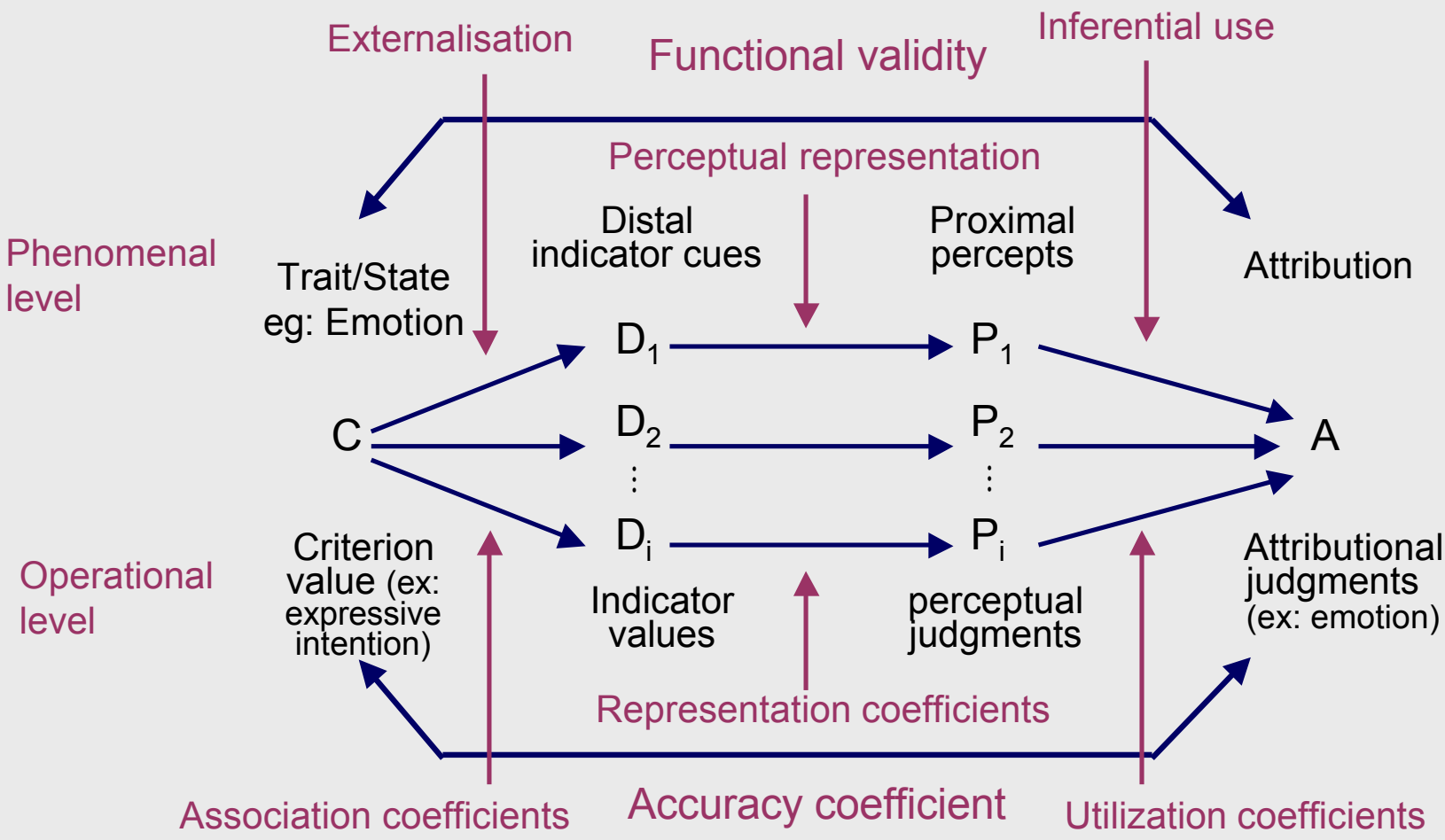
- Measuring judgments
- Measuring sign vehicule

Although both approaches can answer the same or related questions, they yield different informations

One can not know exactly what respondants **react** to when making judgments

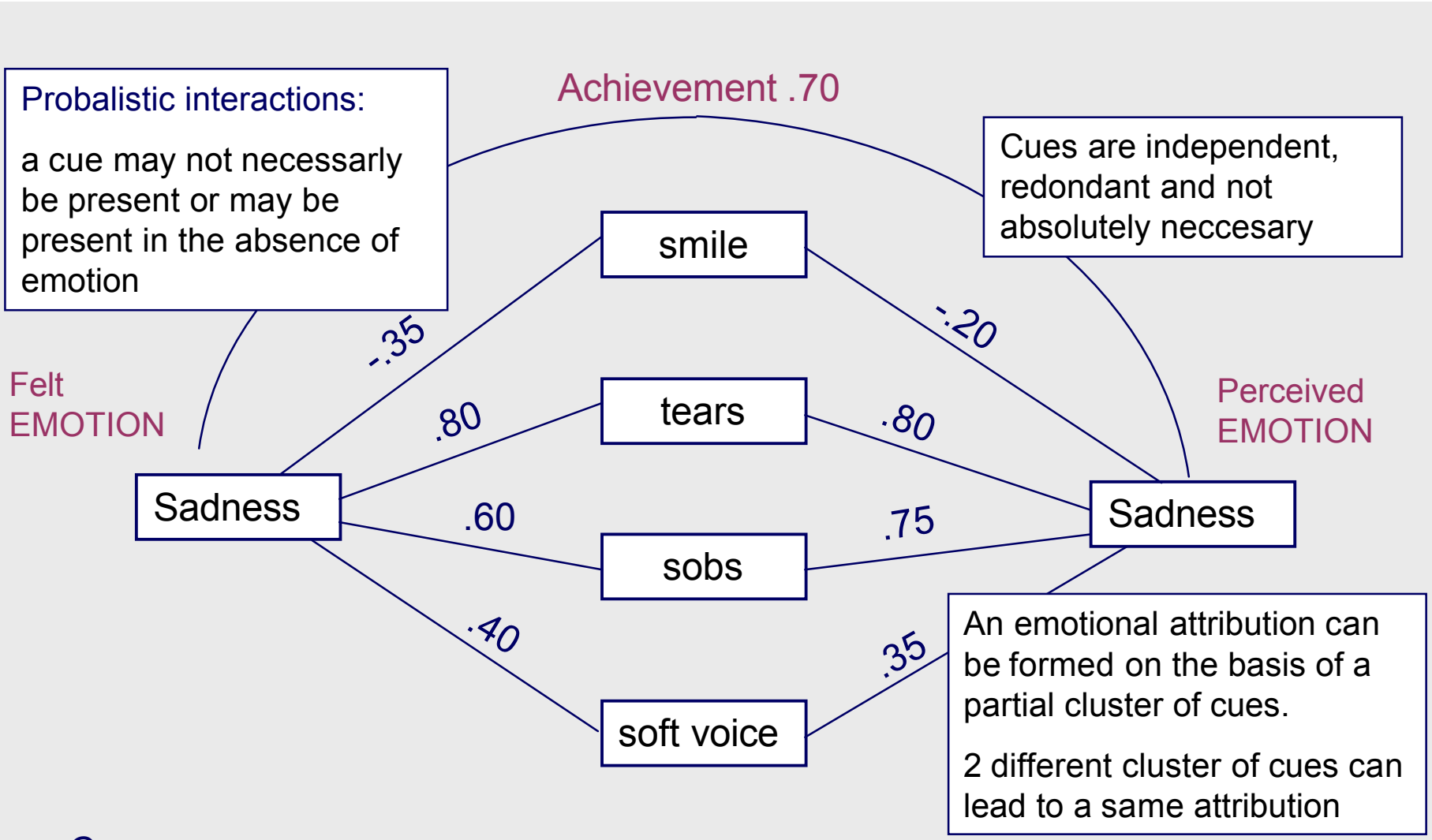
- Negative findings with message judgments and positive findings with sign vehicule judgments
- Positive findings with message judgments and negative findings with signs measurement
- Negative finding with both

Brunswik, E. (1956) - Lens model (adapted by Scherer, 1978)



Scherer, K.R. (1978). Personality inference from voice quality: The loud voice of extraversion. *European Journal of Social Psychology, 8, 467-487.*

Brunswik, E. (1956). *Perception and the representative design of psychological experiments*. Berkeley: University of California Press.



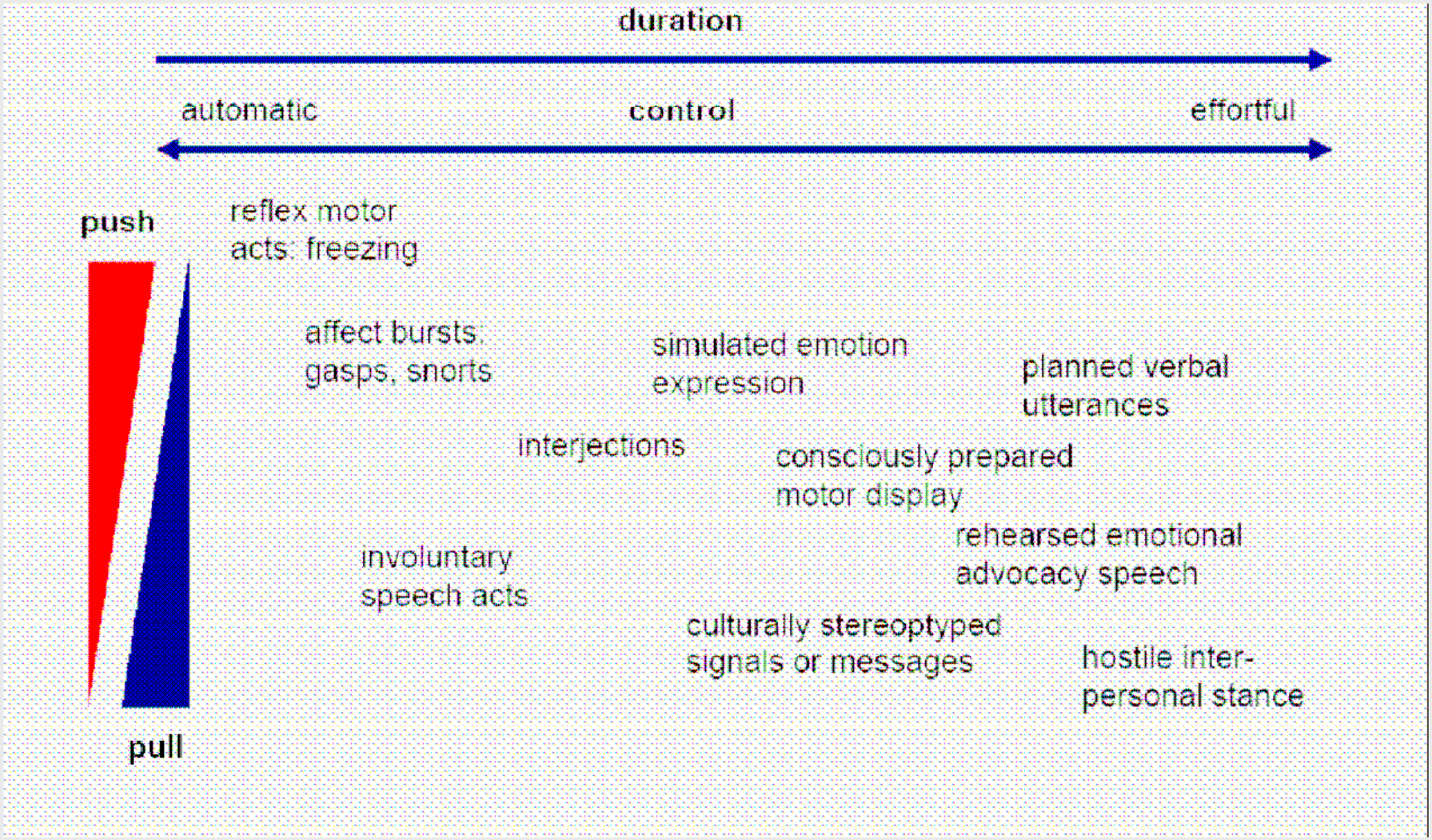
Cues:

facial, vocal, gestural or postural signal/features

Push vs. Pull mechanisms

- **Push:** biologically determined externalization of naturally occurring internal processes of the organism, particularly information processing and behavioral preparation
- **Push:** socioculturally defined templates for instrumental behavior or communicative acts, controlled by strict production rules and contextual expectations

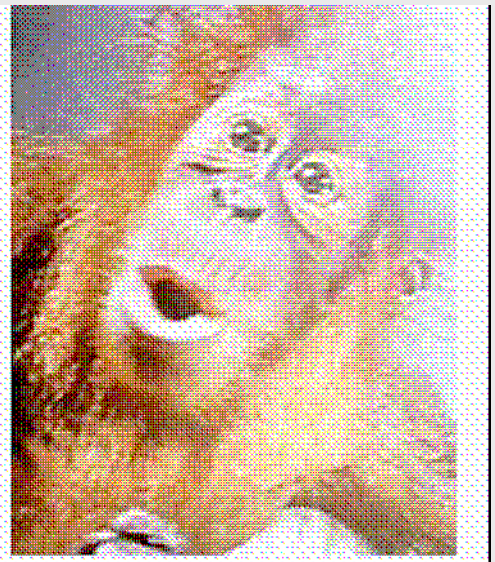
Push vs Pull effects



Push effects

Examples for pure push effects:

- animal expressions
- infant grunts
- affect bursts
- sudden, uncontrolled emotions



Facial displays

- Why is precise efficient measurement of facial expression important?
- What are the two leading methods?
- What potentially combines the best of both?
- How close are we to implement it?

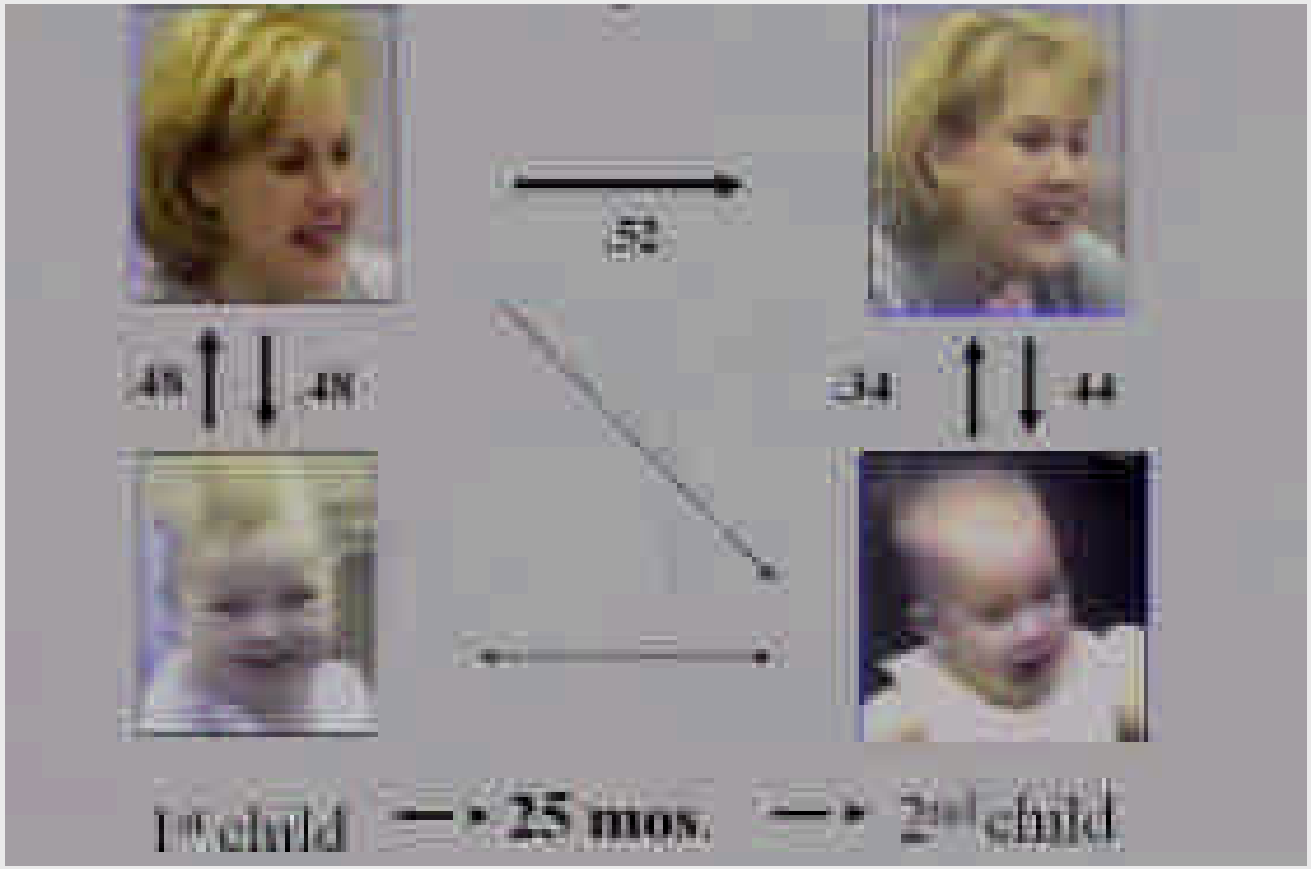
Communicates emotions

Pain

Regulates social interactions

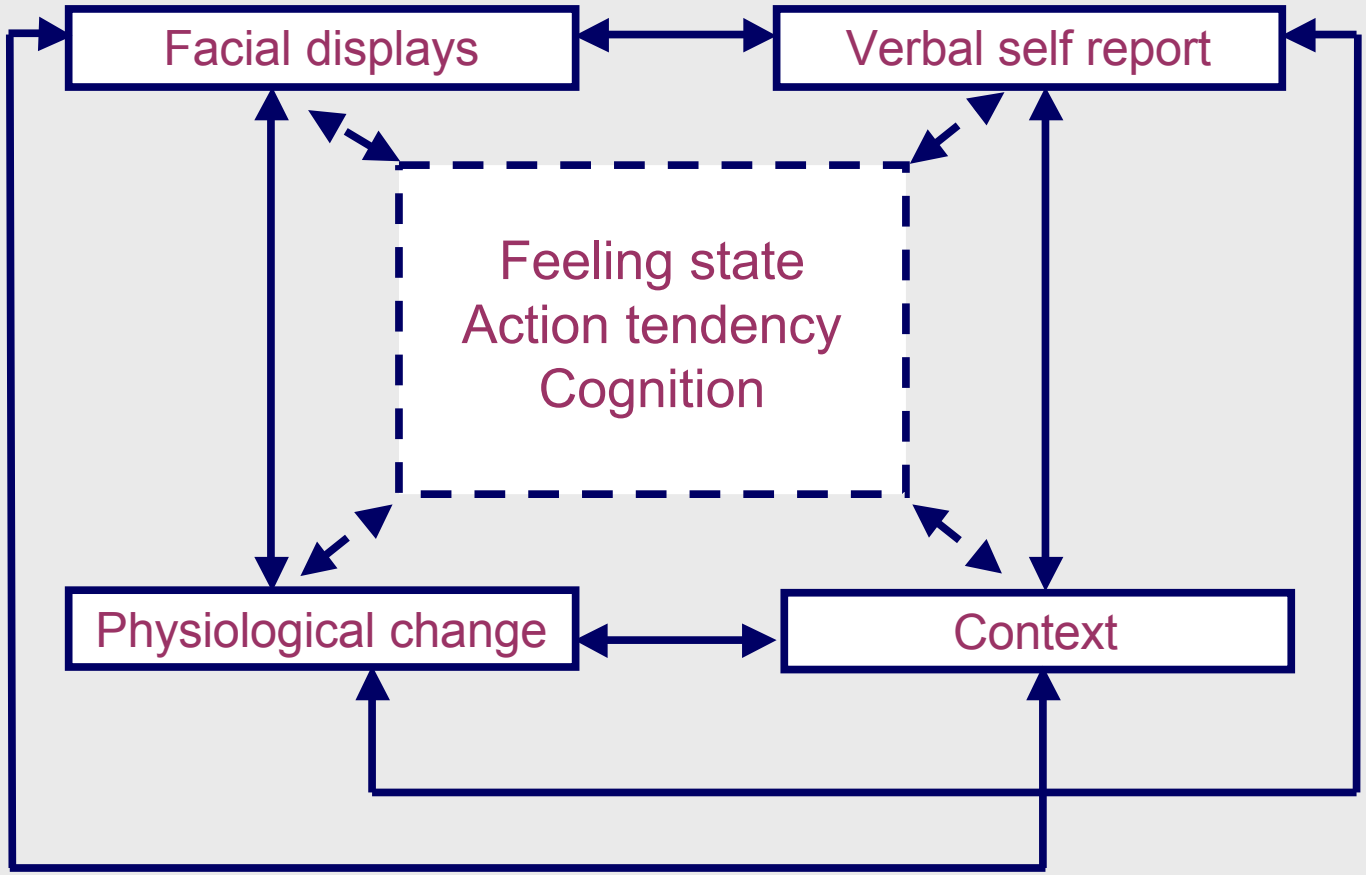
Forbes and Cohn, 2000

Shows both stability and bidirectional influence



Moore, Cohn, Campbell, 1997

Facial expressions are correlated with other emotion components



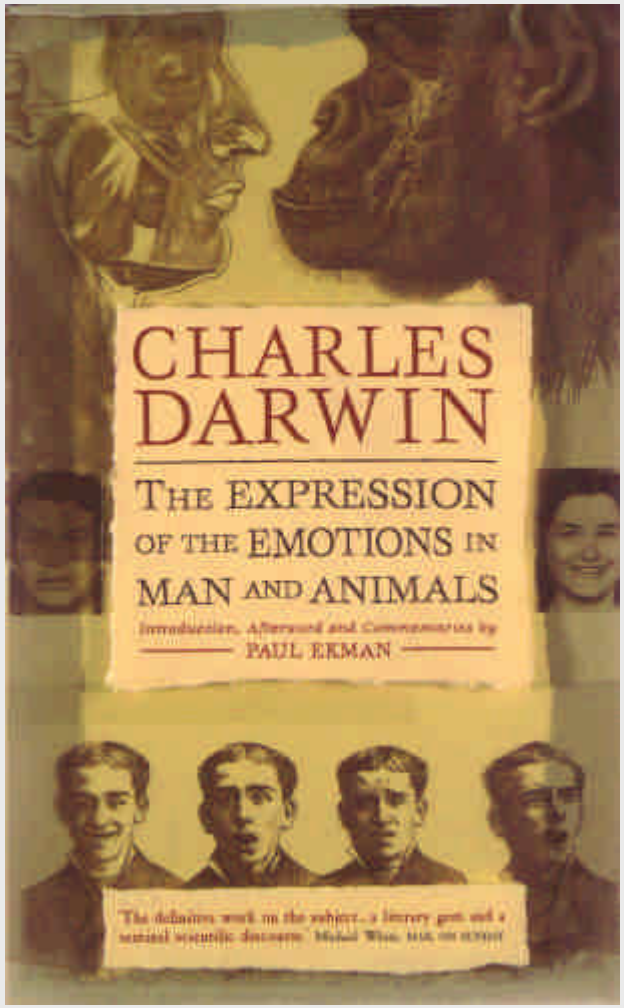
- Criterion validity for self reported emotion
- Stability
- Efficiency

	Visit 1		Visit 2	
	Self-reported emotion	*Zygomatic* EMG	Self-reported emotion	*Zygomatic* EMG
Visit 1 Self-reported emotion	—	.36*	**.56***	.32*
Visit 1 *Zyg.* EMG		—	.14	**.58***
Visit 2 Self-reported emotion			—	.31*

Cohn et al, 2002

Global judgments may not capture subtle meaningful differences between members of a category

Evolutionary hypothesis of emotions (Darwin, 1872)



Detailed descriptions

Evidence for evolutionary origins

Universality

Principles of expression

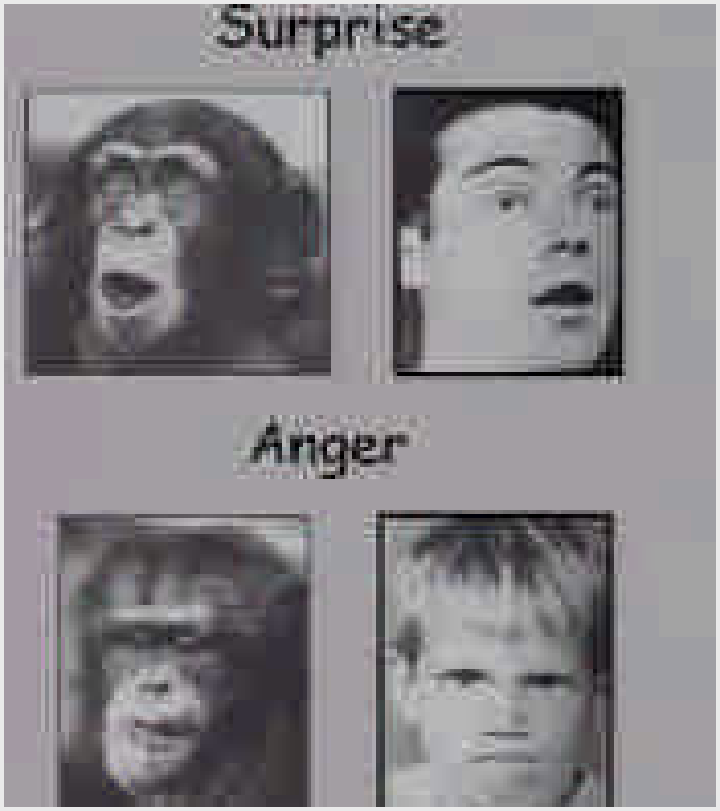
Evidence for universality: percent agreement across cultures

Country	Happy	Surprise	Sadness	Fear	Disgust	Anger
USA	95	92	92	84	86	81
Germany	93	87	83	85	81	71
Sumatra	69	72	91	70	73	70
Hong Kong	92	91	91	84	65	73
Japan	90	94	87	65	60	67

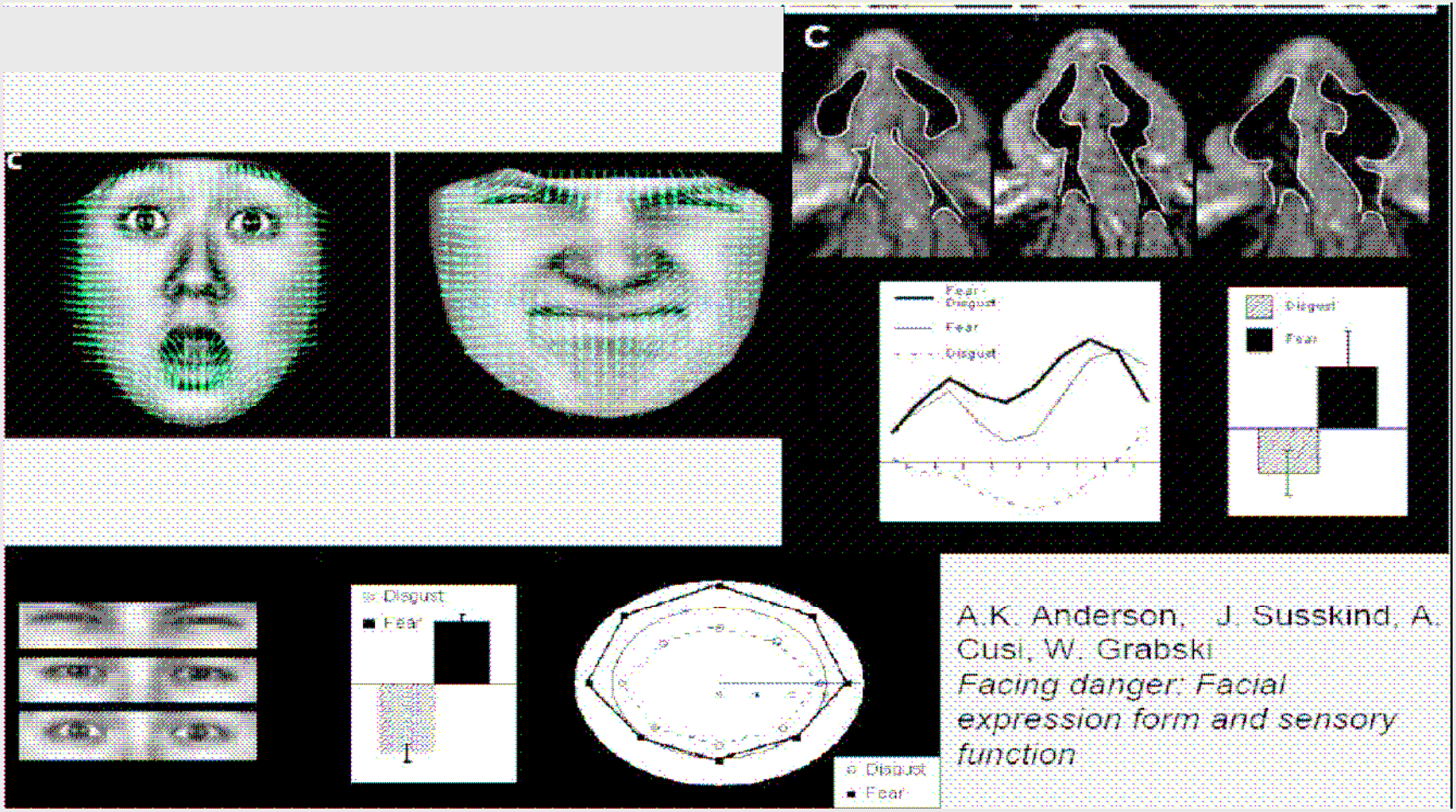
from Ekman, 1987


Surprise
Anger
Sadness
Disgust
Fear
Happiness

And homology among human and non human primates



Evolutionary origins of affect expressions - Darwin confirmed



Static vs dynamic
Two Conceptual Approaches

Configuration

Dynamics

Motion

Sequence

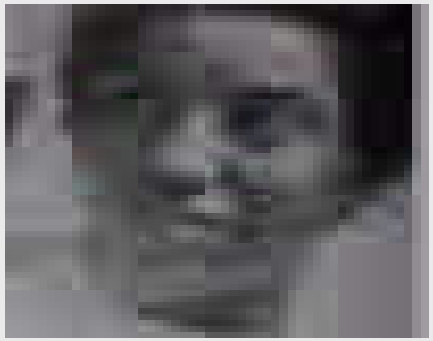
Timing

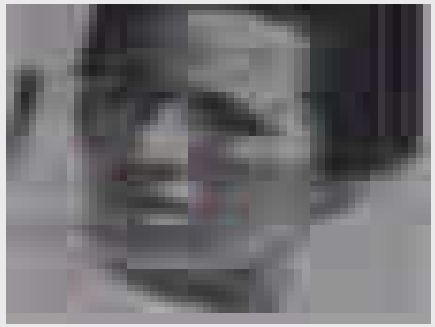
- Velocity
- Acceleration

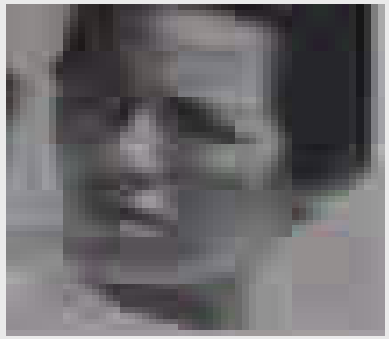
Correlations among the parameters

"Only the dynamics of a mouvement is unambiguous and convincing"
(Flach, 1921)

Sequence informs meaning



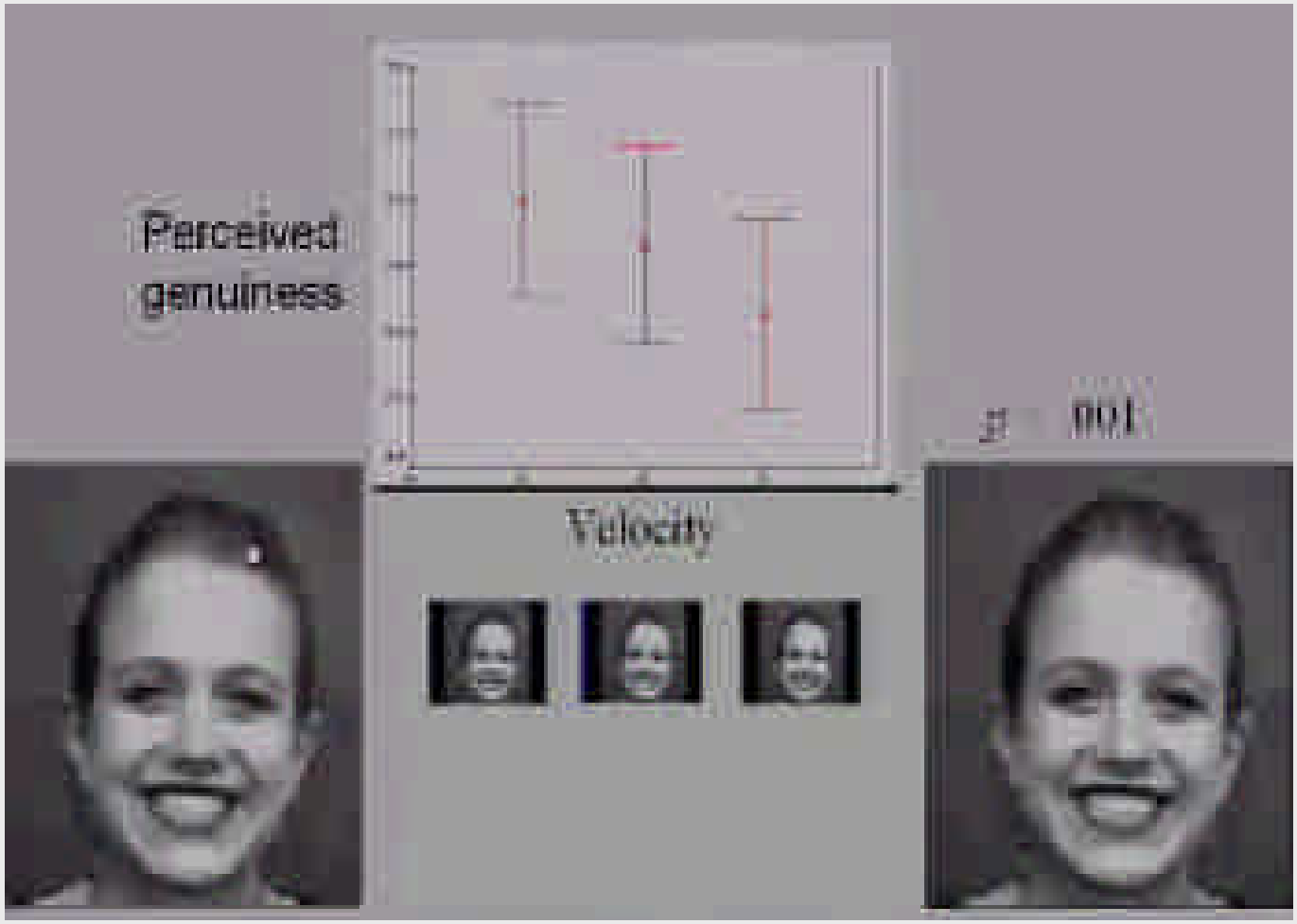




Adapted from Eibl-Eibesfektt, 1989

Context informs meaning

Motion and Velocity

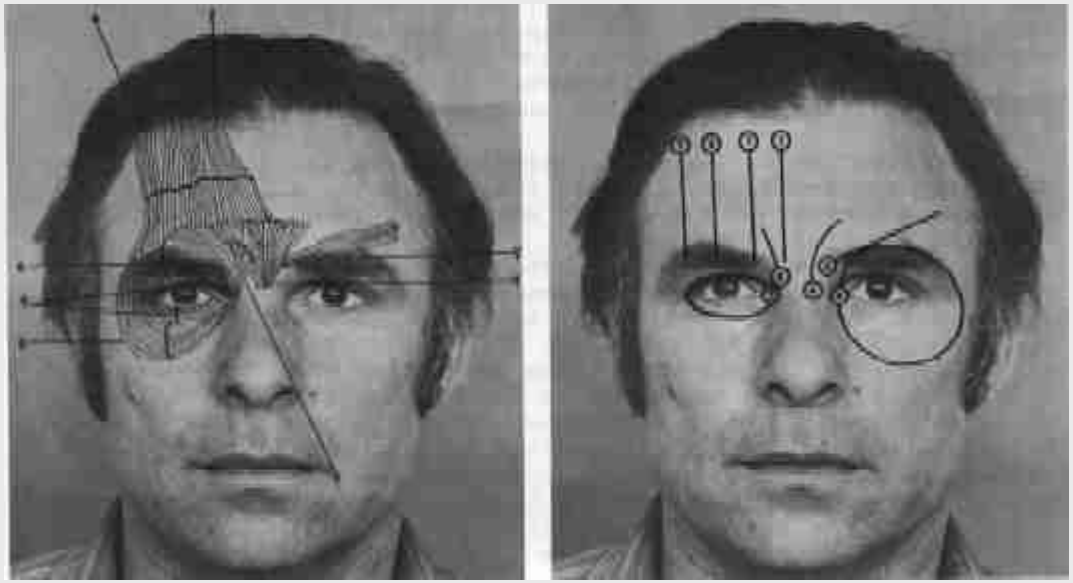


Current and emerging methods to study facial displays

- Given the importance of facial expression, reliable precise, and efficient measurement is critical

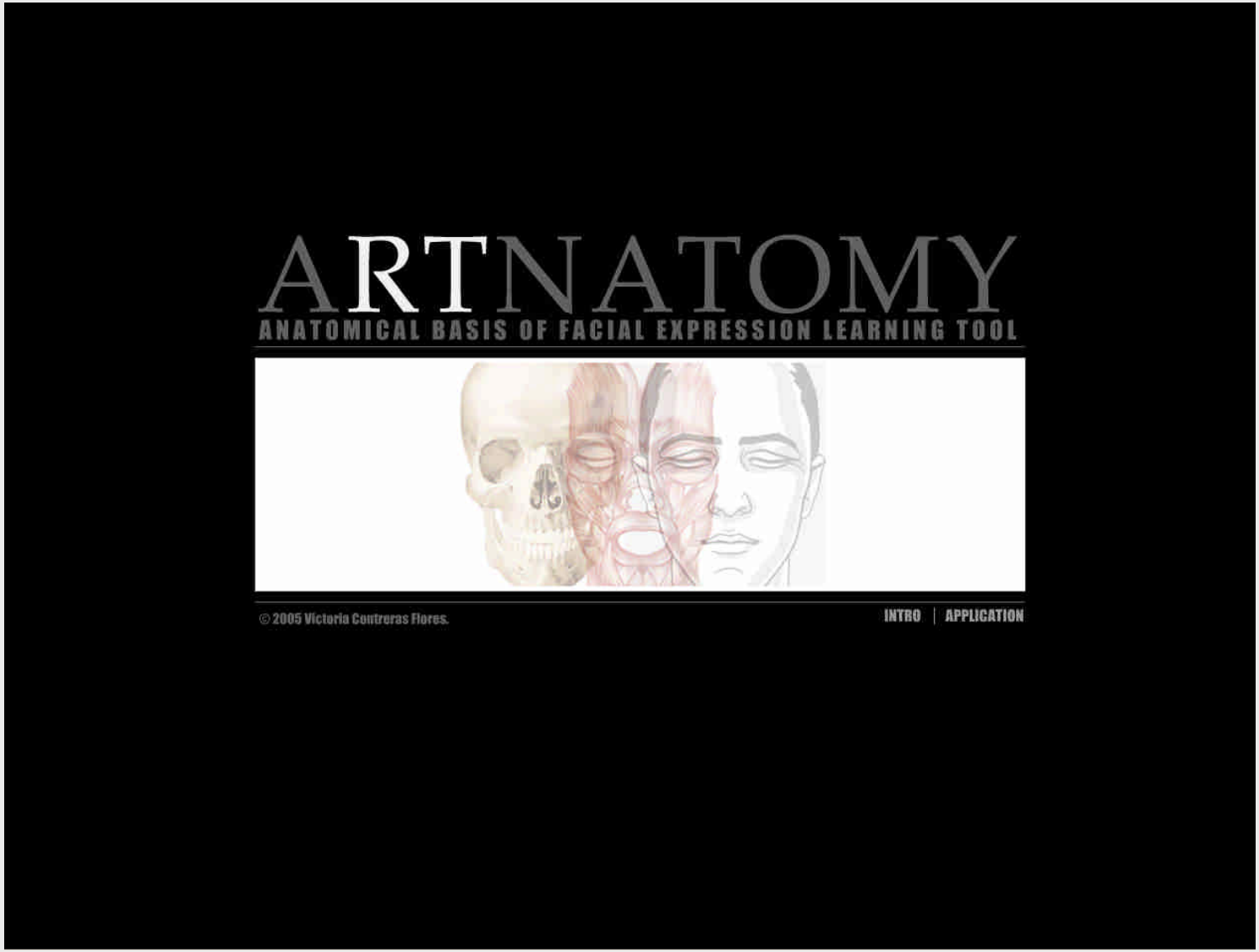
- What methods are available?
  - FACS
  - Facial EMG

Facial Action Coding System (FACS, Ekman and Friesen, 1978, 2002)



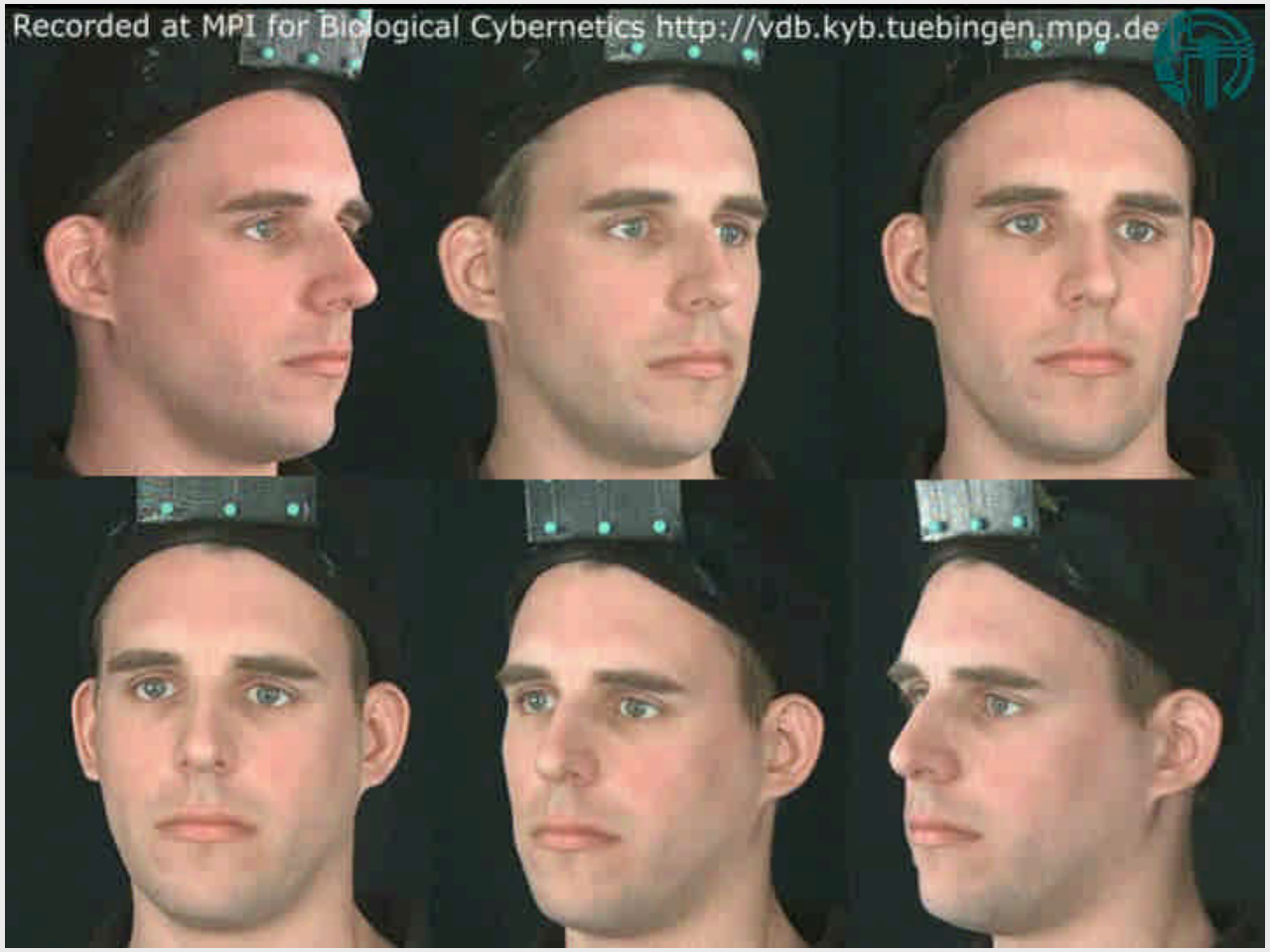
- Anatomically based changes in facial features
- Action units (AU) (n=44)
- Action descriptors (AD) (n=14)
- Comprehensive
- Descriptive – No emotional labels

http://face-and-emotion.com/dataface/general/homepage.jsp
http://face-and-emotion.com/dataface/facs/manual/TOC.html



www.artnatomia.net/es/artnatomy.html

FACS Action Units



FACS advantages

- Standardized methodology, including certification
- Comprehensive
- Descriptive
- Valid for:
  - Self reported emotions
  - Dyadic interactions
  - Change with development
  - Individual differences (*including biometrics*)

FACS disadvantages

- Labor and time intensive
- Difficult to implement
- Problems inherent to subjective measurement
  - temporal resolution
  - unknown anchors
  - inter-observer reliability

Kappa for temporal precision*

Tolerance window *(seconds)*

AU	1/30th	1/6th	1/3rd	1/2
10	0.69	0.76	0.79	0.81
12	0.67	0.71	0.74	0.76
15	0.54	0.65	0.69	0.72
20	0.38	0.47	0.54	0.60

**Note: adapted from Sayette et al. (2001)*

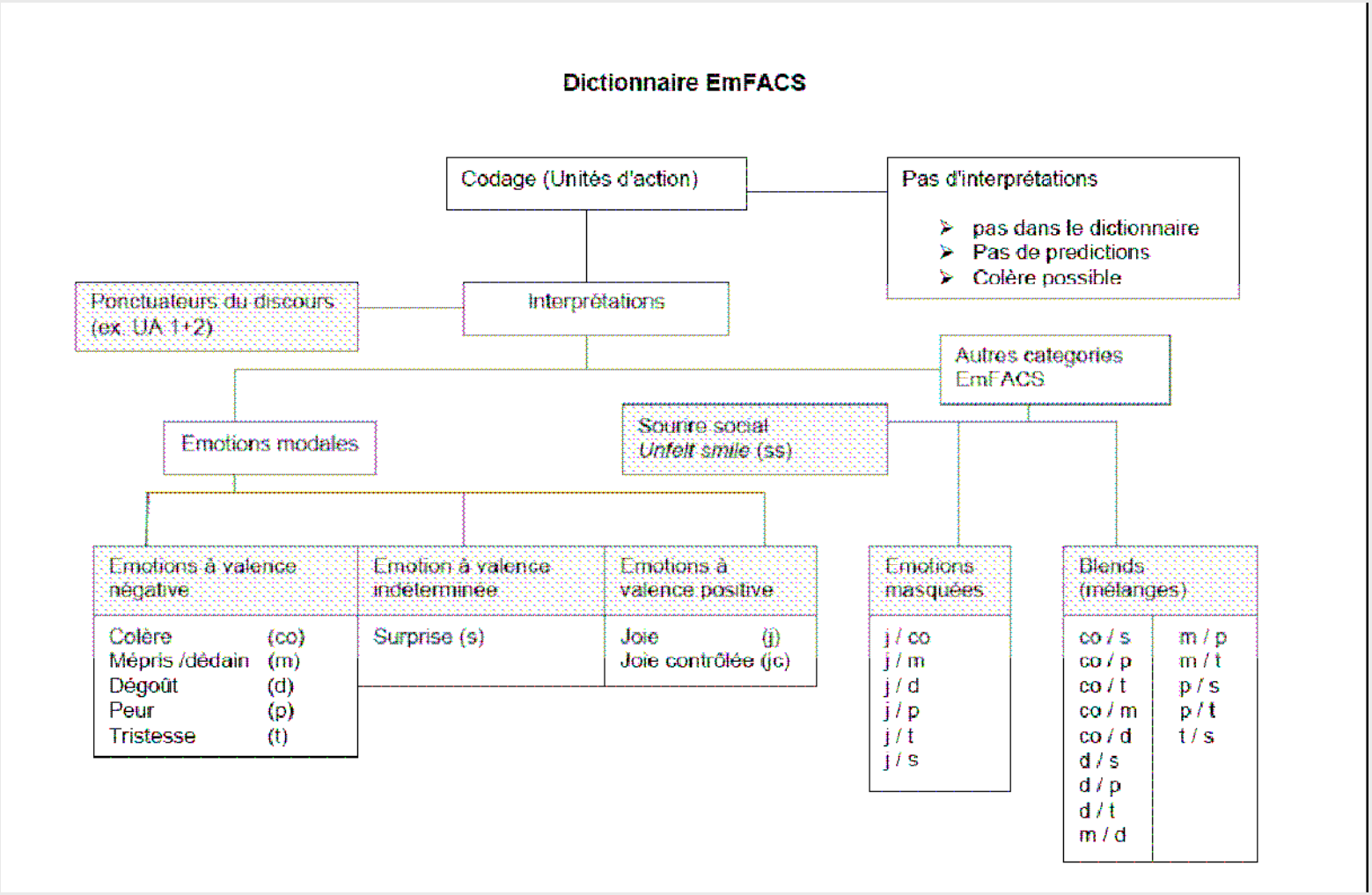
Emotional FACS (EMFACS)

Refers to:

- A modified and simplified version of FACS coding rules
- An emotion prediction dictionary of AUs combinations

Anger	Fear
17A-E 23	**1 2 4**
17CDE 24CD 58	**1 2 5E**
17CDE 24E	**1 2 5CD 20AB**
4 5A-E 10A-E	**1 2 20AB**
4 7 10A-E	**20A-E**
22 23 25	
4 5A-E 7	
23	

EMFACS dictionnary structure



EMFACS

Advantages

Less time consuming than comprehensive FACS coding

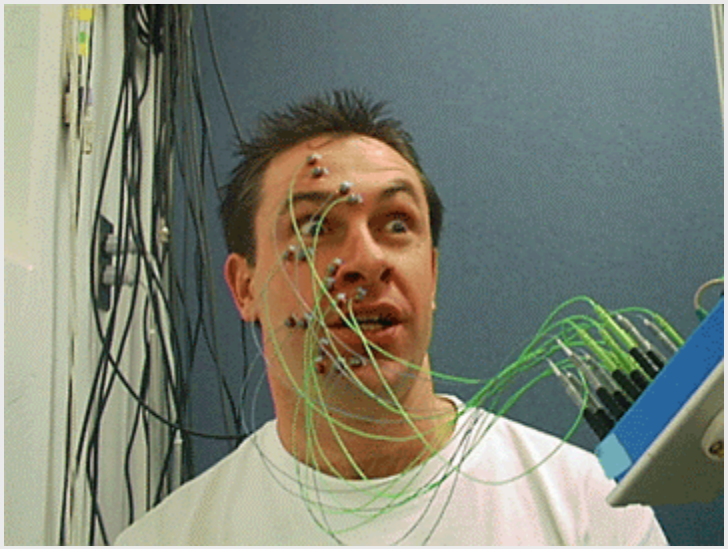
Focus on AUs restricted to emotional behavior

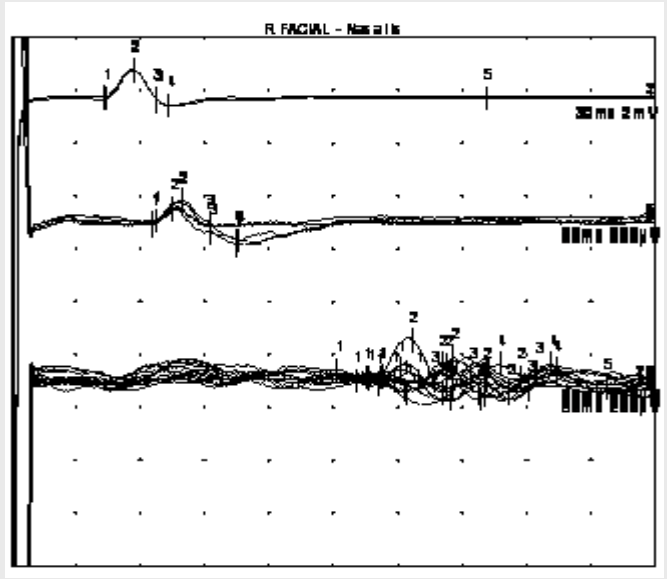
Disadvantages

Top down approach *(interpretative)*

Several dictionnaries are used *(never published)*

Alternatives to FACS - EMG





Measures electrical activity of motor units

Standardized procedures for electrode placement and signal processing (Fridlund & Cacioppo, 1986)

EMG Advantages

- High temporal resolution
- Precision even for occult actions

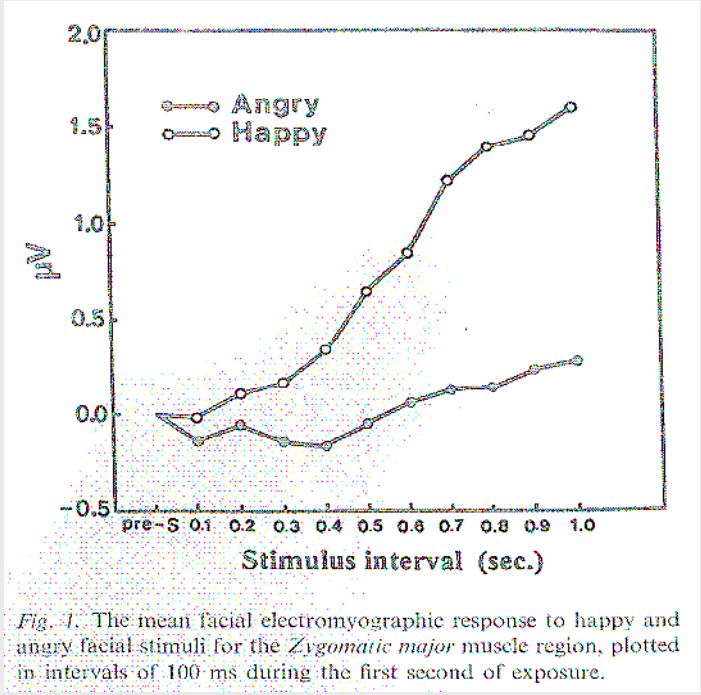


Fig. 1. The mean facial electromyographic response to happy and angry facial stimuli for the *Zygomatic major* muscle region, plotted in intervals of 100 ms during the first second of exposure.

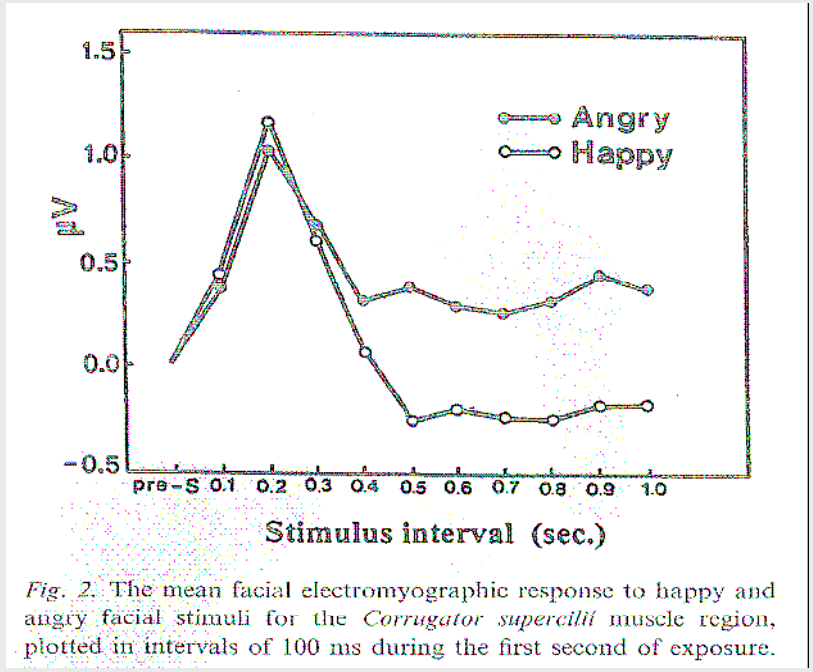


Fig. 2. The mean facial electromyographic response to happy and angry facial stimuli for the *Corrugator supercilii* muscle region, plotted in intervals of 100 ms during the first second of exposure.

Dimberg and al. 1998

EMG Disadvantages

- Specialized equipment and training
- Not suited for use with young children
- Restriction on movement and context of use
- Invasive
- Possible reactivity

Combining best features of FACS and EMG

EMG:

- Temporal resolution
- Efficiency

FACS:

- Comprehensive
- Non obstructive

Automatic Facial Analysis (AFA)

Computer vision

- finding the face in an image *(good algorithms for face detection)*
- track the motion of the head
- separate rigid and non rigid movements *(potential confounds)*
- head motions are communicative in their own right

Extract features from the face

- Identify FACS Aus
- Emotion prototypes

Two leading groups in AUs detection

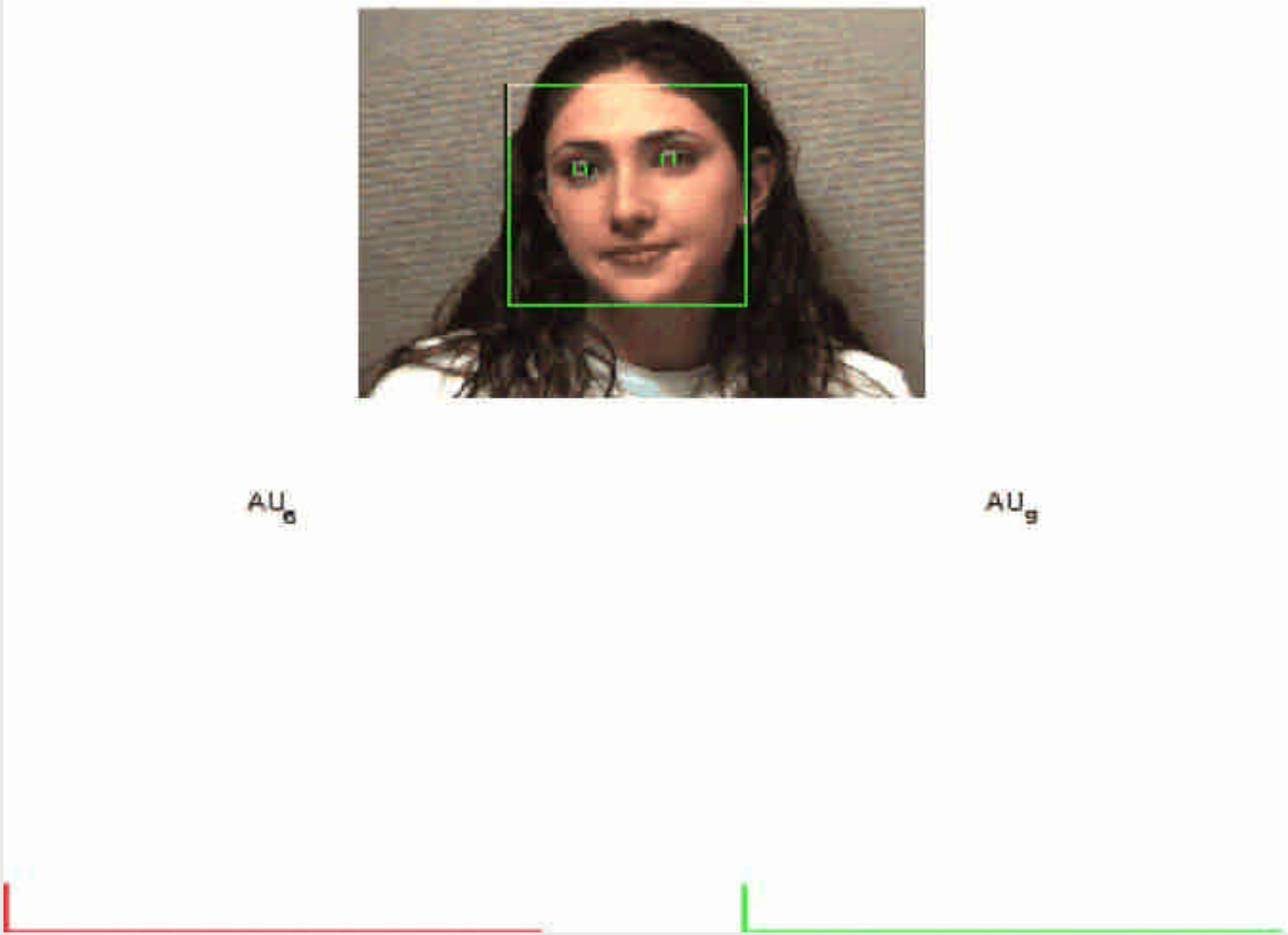
- Machine perception laboratory http://mplab.ucsd.edu/wordpress
- Affect Analysis Group http://www.pitt.edu/~emotion/

MPL sample videos

MPL sample videos

MPL sample videos

MPL sample videos



Advances and remaining challenges with AFA

- Aus detection: well advanced
- Babies are really tough *(the older the better)*
- Head rotations out of plan (*solutions: AAM*)
- Obstructions (*glasses / gestures in front of the face*)
- Gender and ethnicity is not a problem

What to avoid : systems that detect *« emotions »* in the face

Ex:

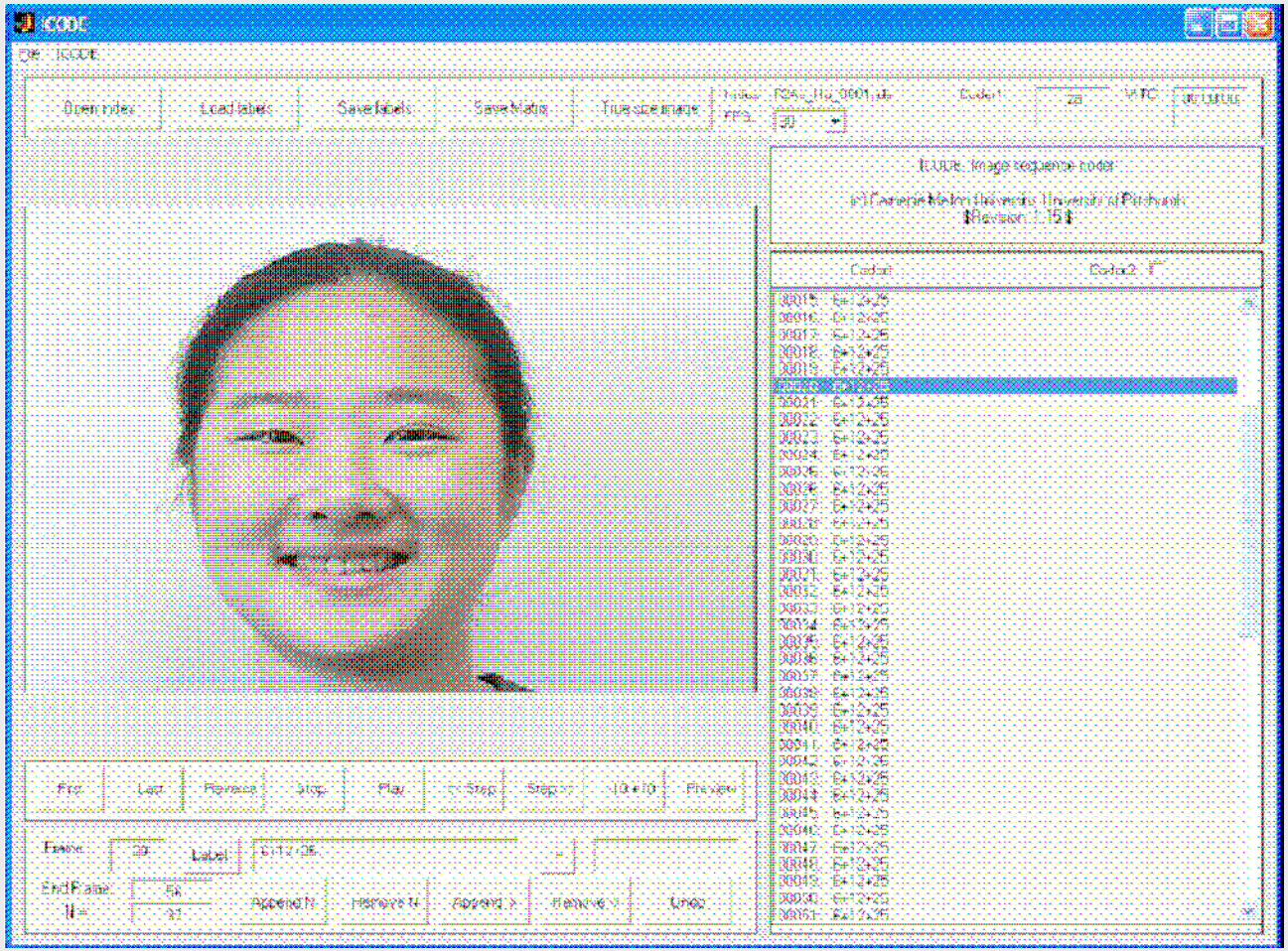
FACEREADER

Noldus Technology (2007)

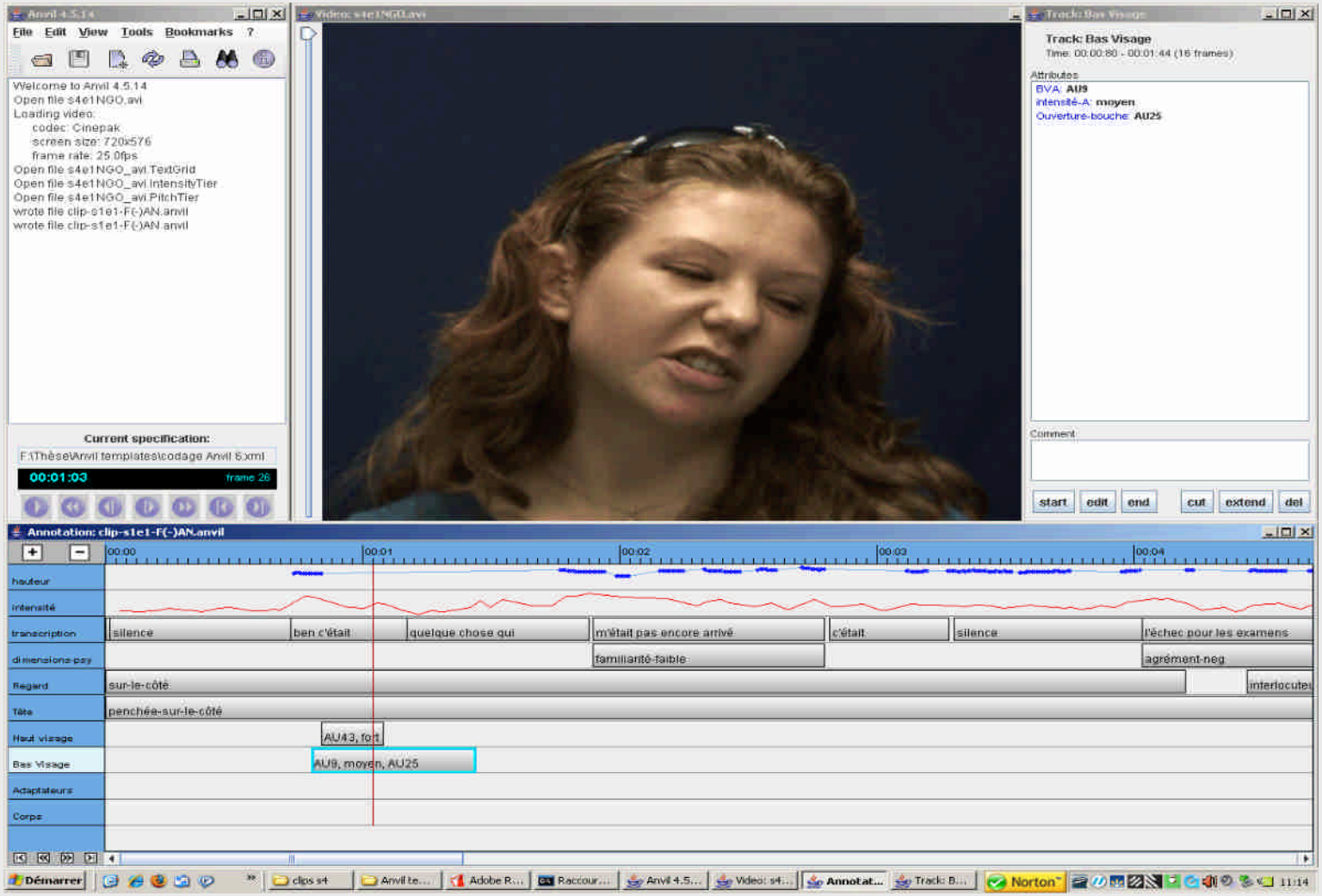
Software tools for annotating oberver based behaviour

- Icode (face only)
- Mediatags (face only but further developpment will allow other behavioural coding)
- Anvil (multimodal)
- Elan (multimodal)
- Observer (multimodal)

ICODE: Xuhui Zhou (Carnegie Mellon University)

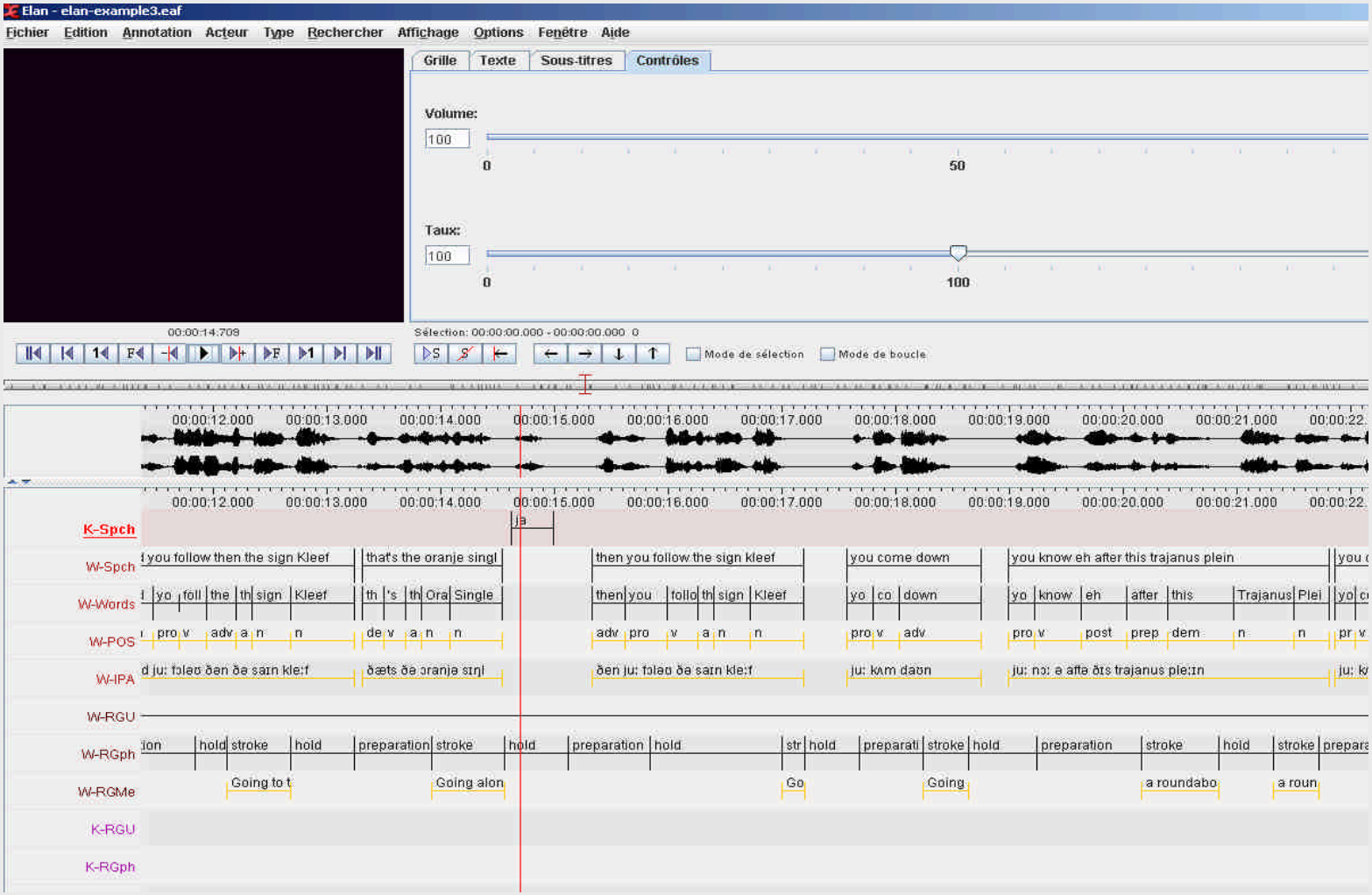


Anvil (Kipp, M. 2001)



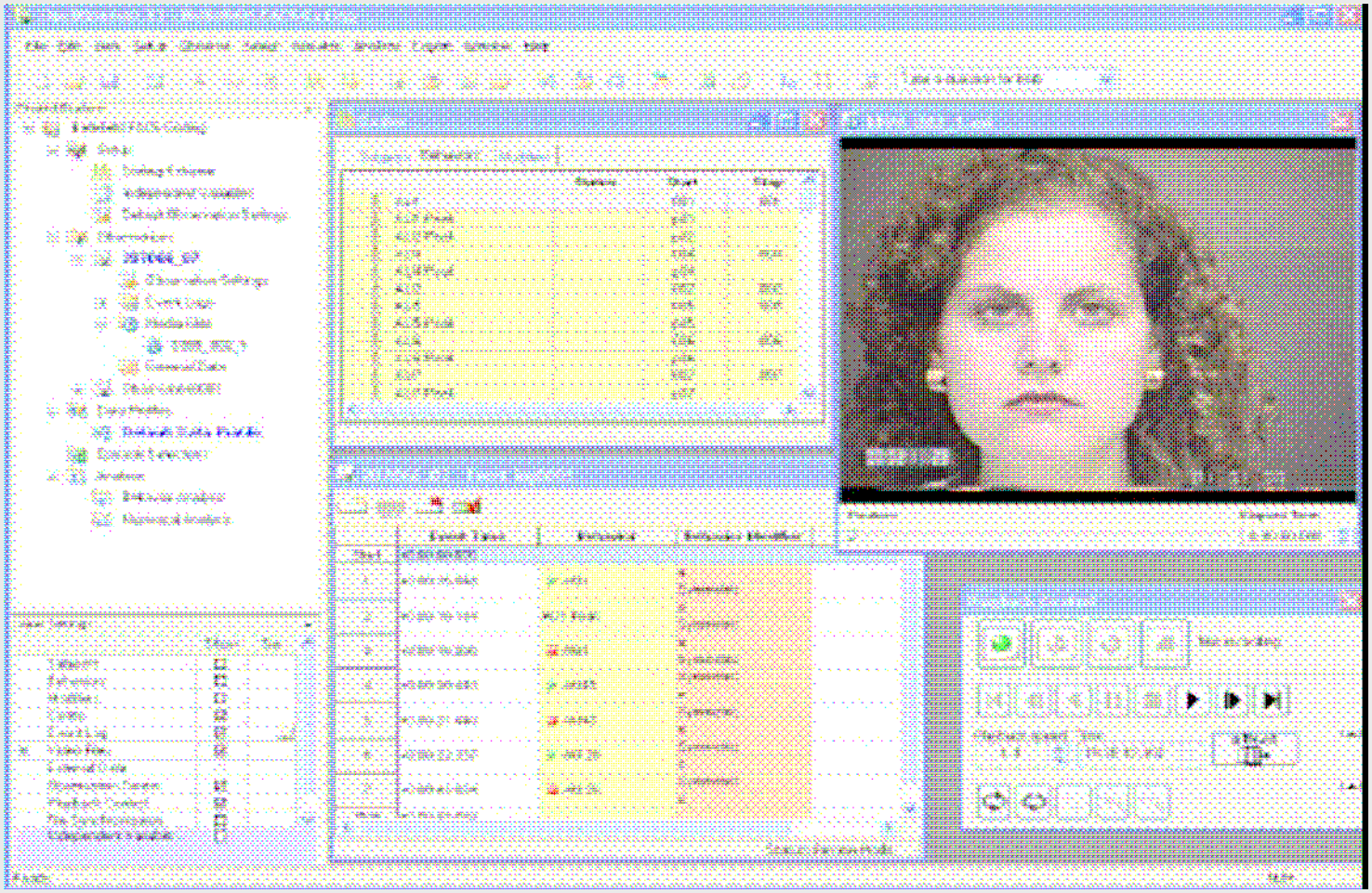
http://www.dfki.de/~kipp/anvil/

Elan (Max Planck Institute for psycholinguistics)



www.lat-mpi.eu/tools/elan/download

The Observer (Noldus technology)

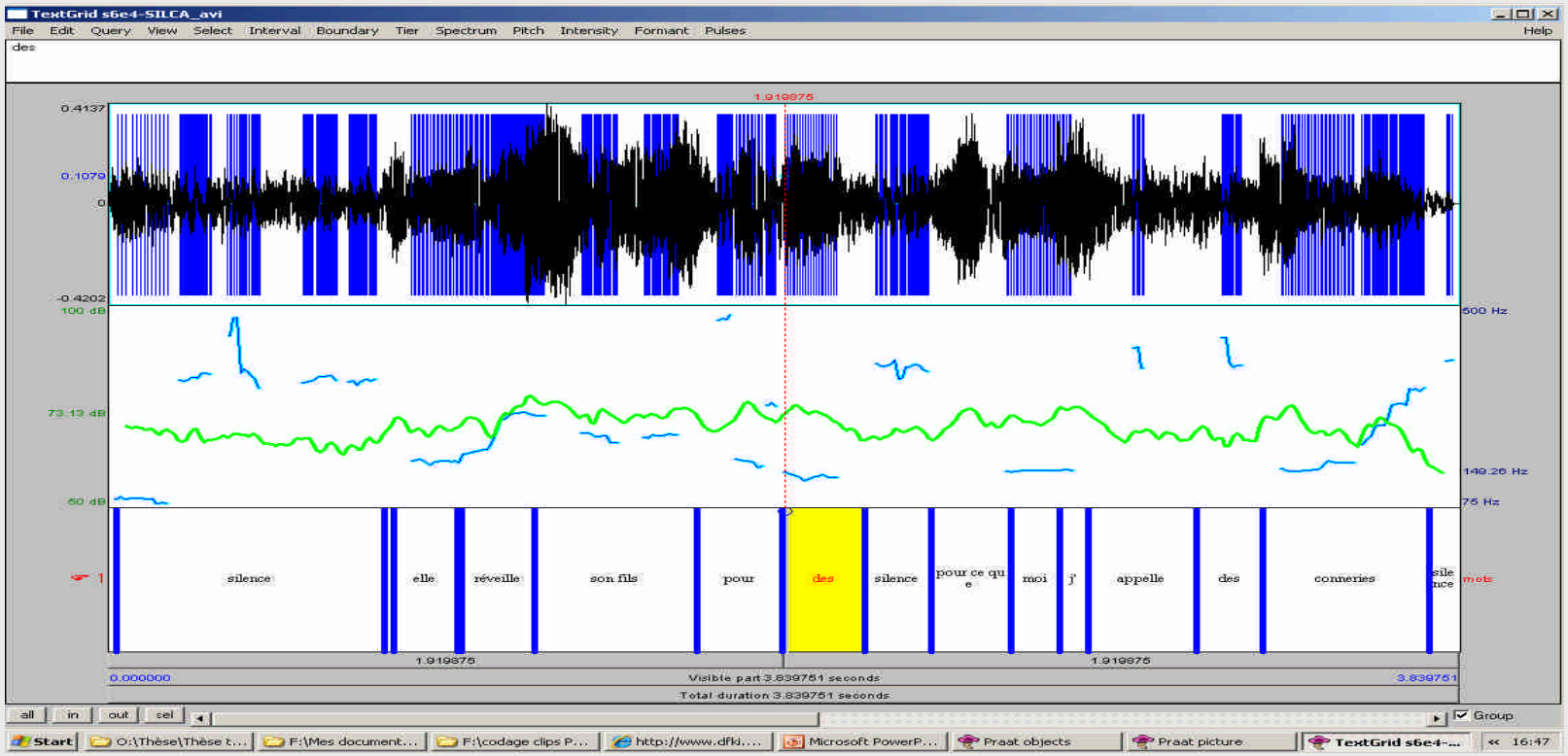


www.noldus.com

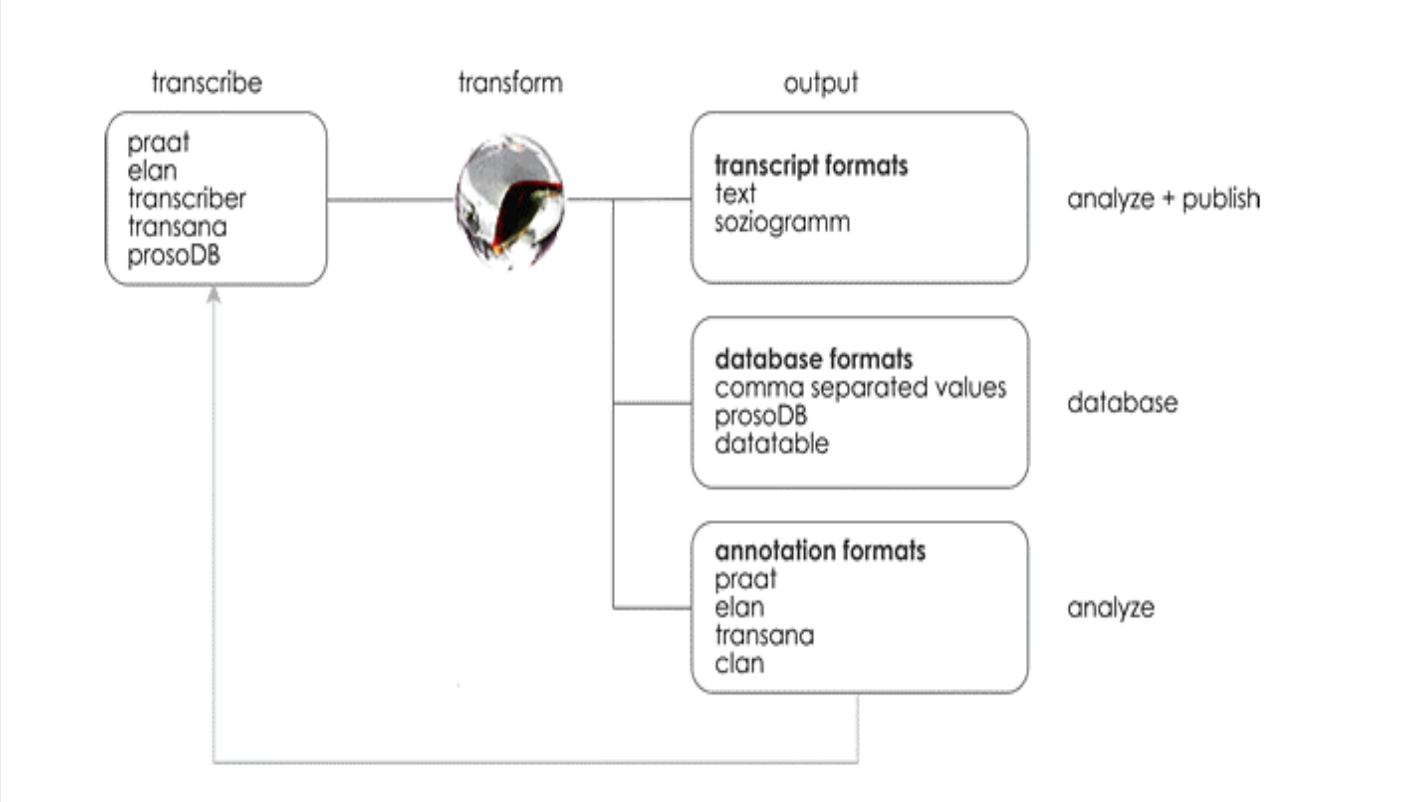
And for the voice : Praat

- Excellent tool for acoustic analysis
- Freeware
- Compatible with Anvil and Elan

www.fon.hum.uva.nl/praat/



Files Migration (Transformer)

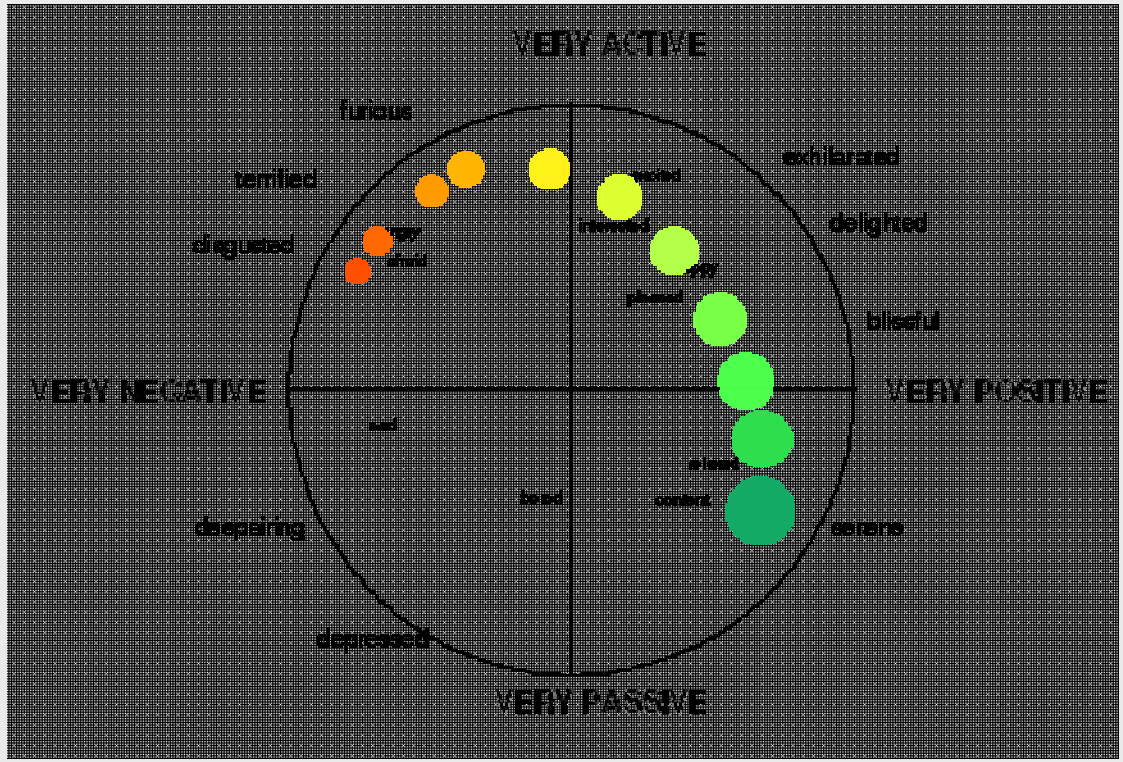


http://www.oliverehmer.de/transformer/

Rating interfaces

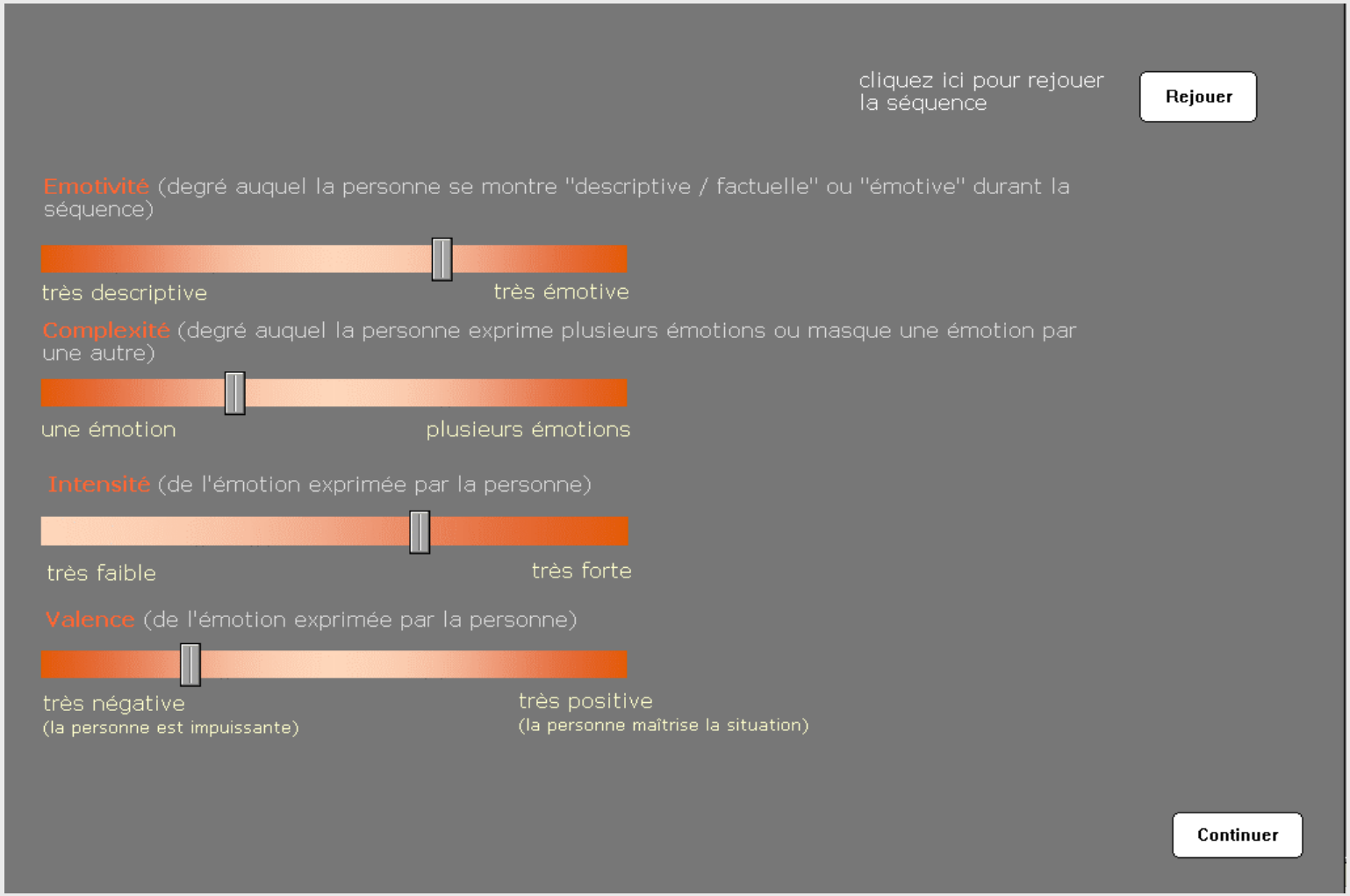
Online Judgment rating

Feeltrace http://www.dfki.de/~schroed/feeltrace/



Cowie, R., Douglas-Cowie, E., Savvidou, S., McMahon, E., Sawey, M., & Schröder, M. (2000). 'feeltrace': an instrument for recording perceived emotion in real time. *Proceedings of the ISCA Workshop on Speech and Emotion* (pp. 19–24). Northern Ireland.

Authorware


cliquez ici pour rejouer
la séquence
Rejouer
Emotivité (degré auquel la personne se montre "descriptive / factuelle" ou "émotive" durant la séquence)
très descriptive
très émotive
Complexité (degré auquel la personne exprime plusieurs émotions ou masque une émotion par une autre)
une émotion
plusieurs émotions
Intensité (de l'émotion exprimée par la personne)
très faible
très forte
Valence (de l'émotion exprimée par la personne)
très négative
(la personne est impuissante)
très positive
(la personne maîtrise la situation)
Continuer

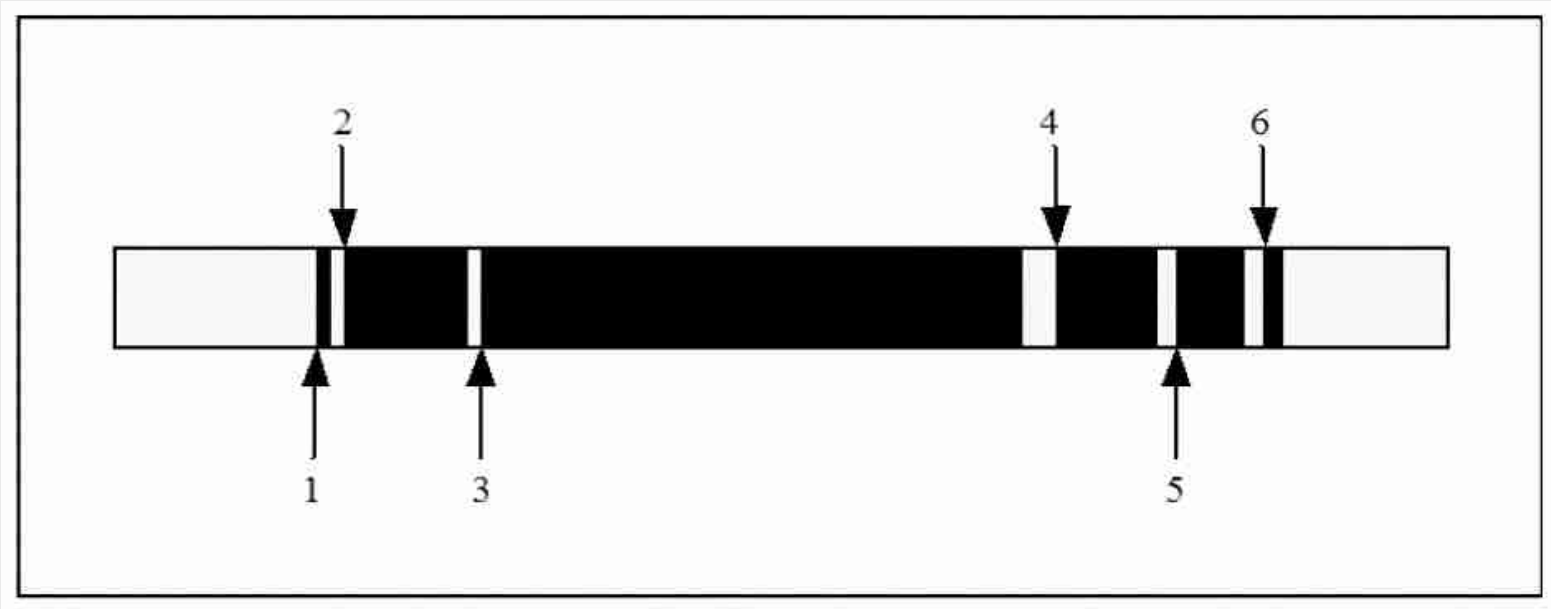
Pattern identification in behavioral streams

The study of behavioral patterns

"**Behavior** consists of **patterns in time**. Investigations of behavior deal with **sequences** that, in contrast to bodily characteristics, are **not always visible**."

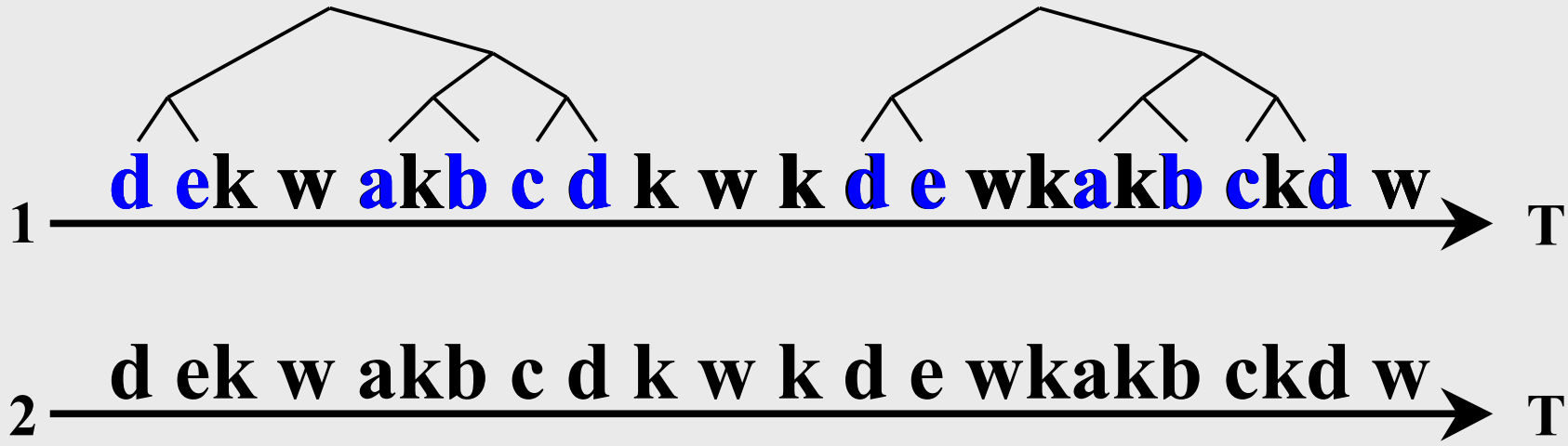
Opening words of Eibl-Eibesfeldt's Ethology: The Biology of Behavior, 1970, p. 1.

What's a pattern?

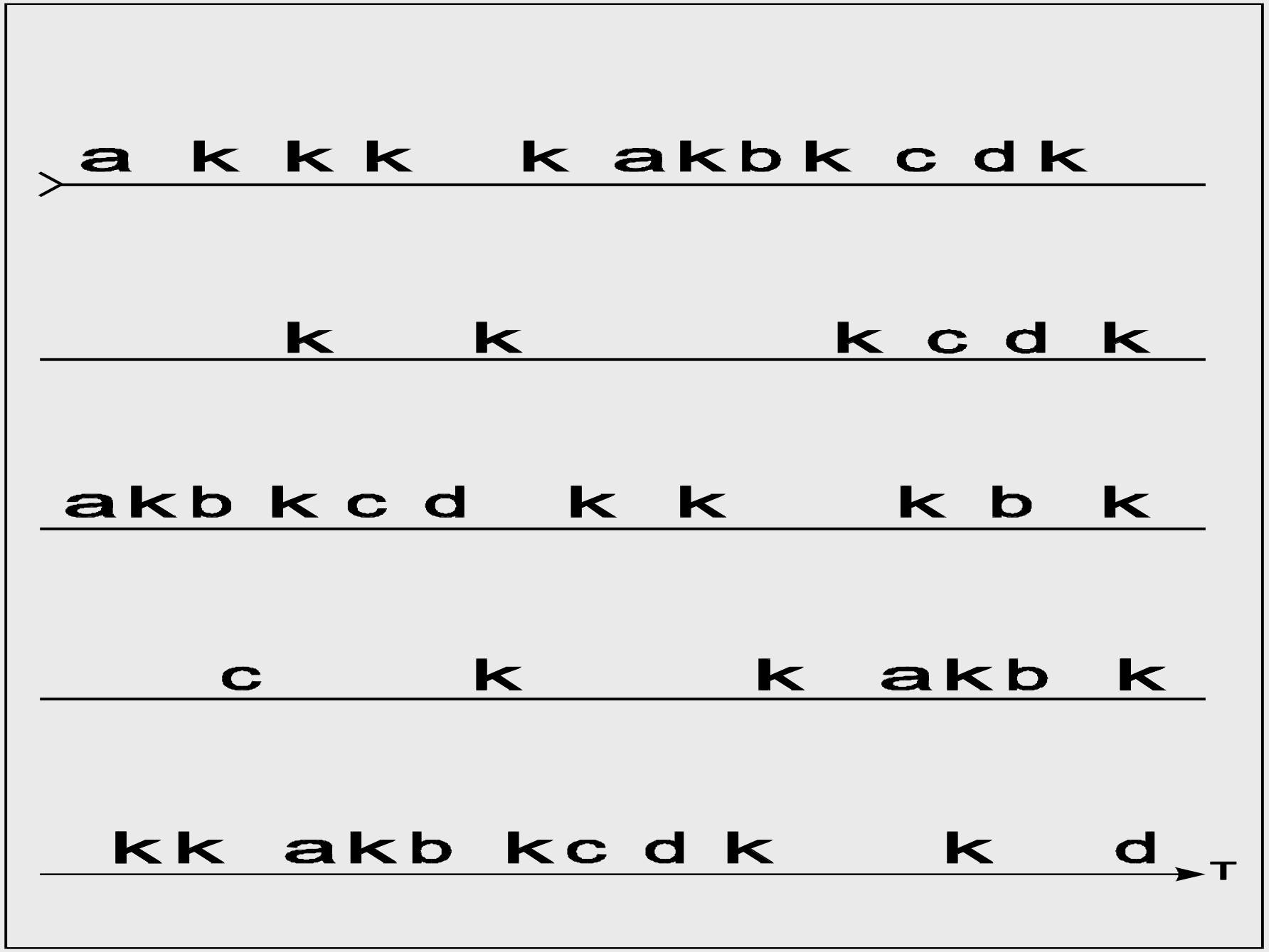


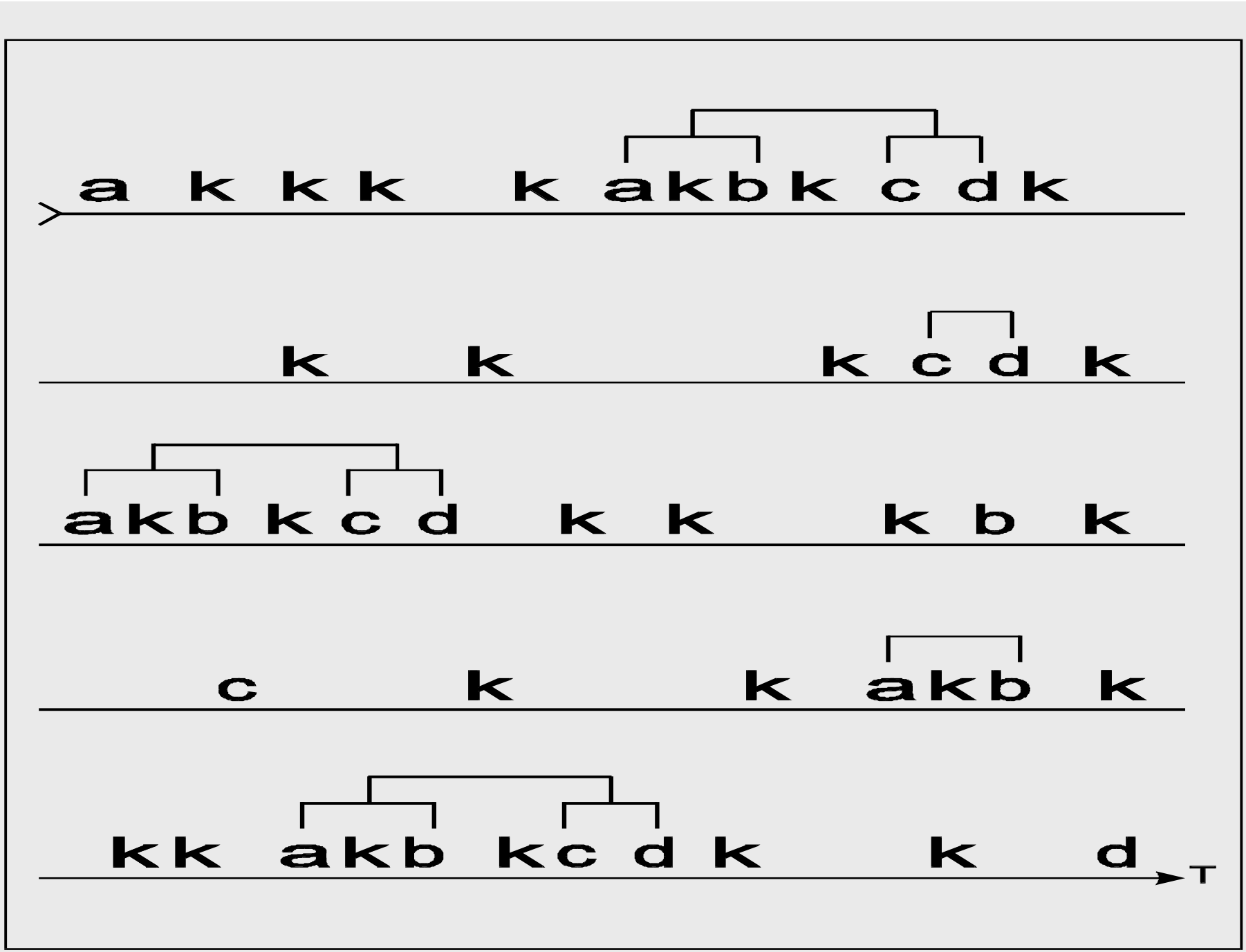
- **Meal:** sit down…... order … eat main course … dessert…have a coffee...pay…get up

Patterns are often difficult to identify



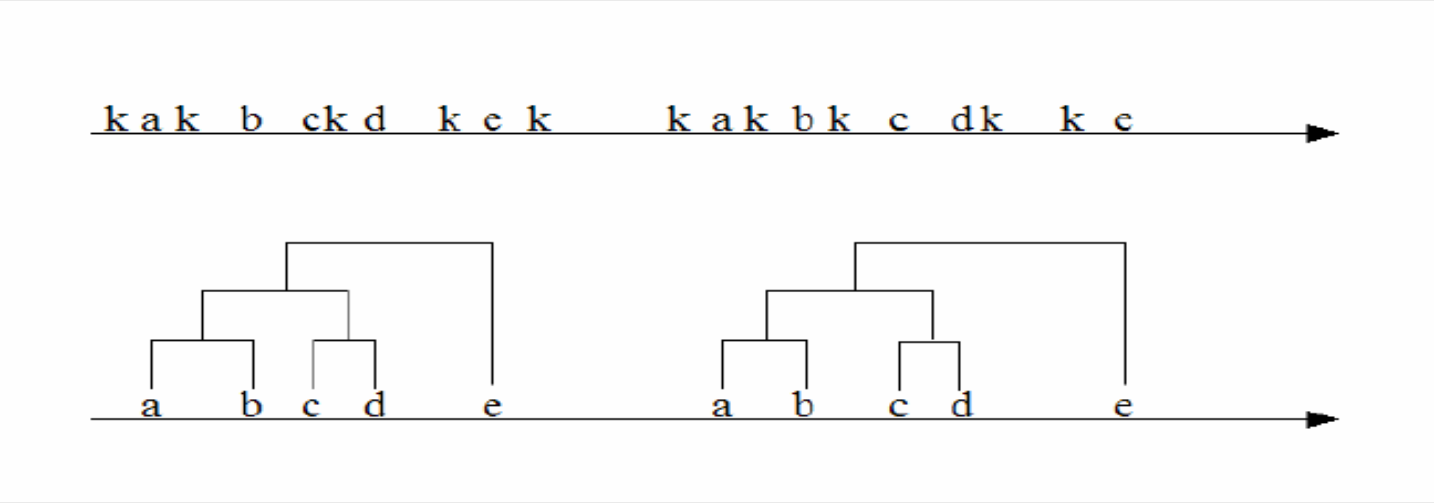
1 and 2 are identical


a k k k k akbk c d k
k k k c d k
akb k c d k k k b k
c k k akb k
kk akb kc d k k d
T


a k k k k a k b k c d k
k k k c d k
a k b k c d k k k b k
c k k a k b k
k k a k b k c d k k d
T

Pattern identification

pattern analysis: **THEME software* (Magnusson, 2000)**

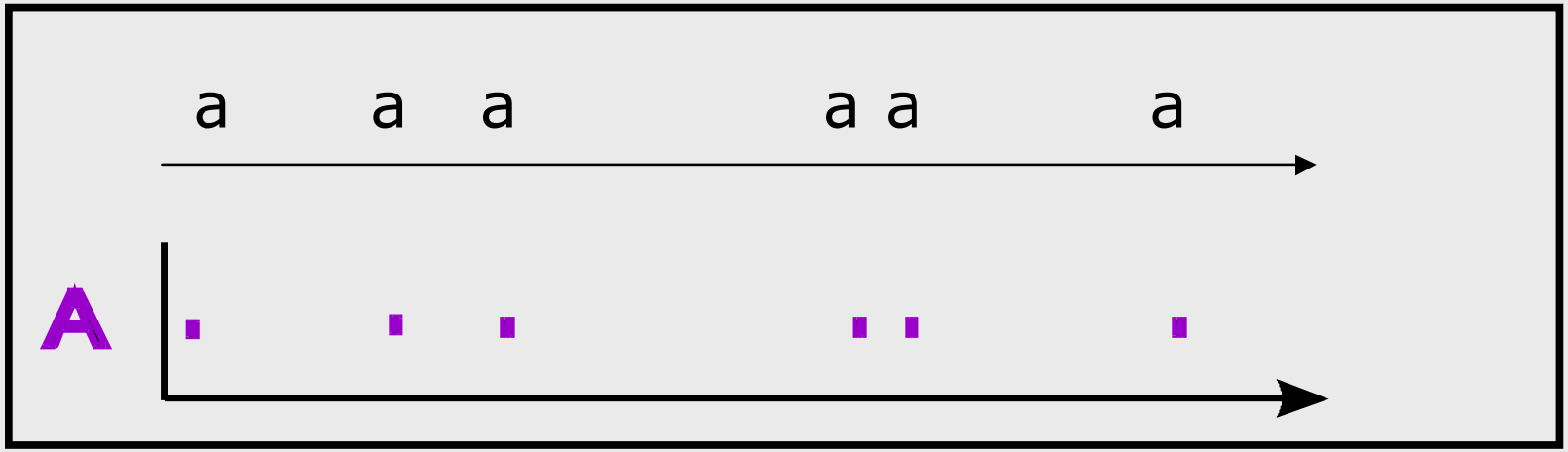


Magnusson, M. (2000). Discovering hidden time patterns in behavior:
T-patterns and their detection. *Behavior Research Methods, Instruments, & Computers*, 32 (I), 93-I IO

*www.noldus.com/site/content/files/product_leaflets/product_leaflet_theme.pdf

The Data: Series of Points on 1-Dim.

An **event-type** may be an **actor's** (agent's) **beginning or ending** of a particular **behavior**



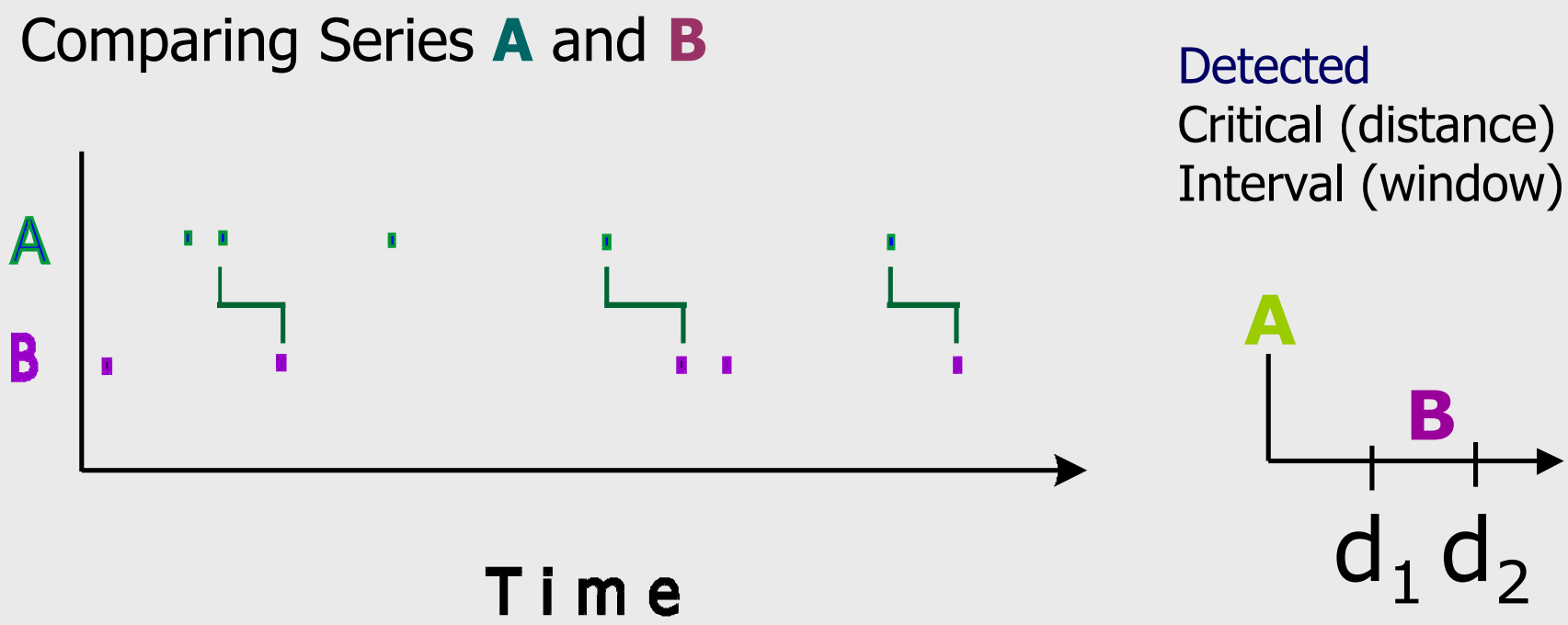
Sets of such series form multivariate point series to which all T-pattern definitions refer exclusively

Multivariate Point Series

The Basic Data Type

Towards a Detection Algorithm

Searching for Critical Intervals [d_1, d_2]



Repeatedly, an **A** is followed by a **B** within approximately the same distance

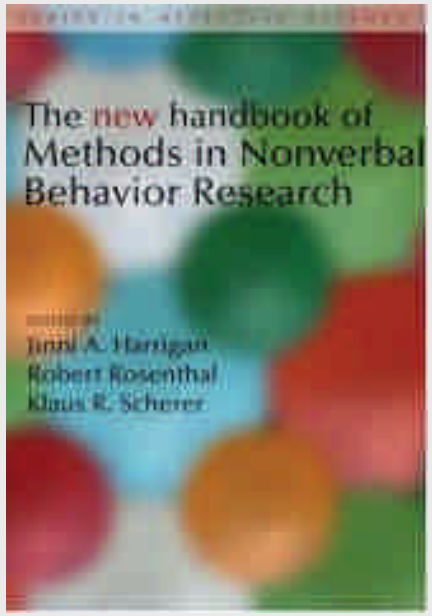
Standard Statistical Methods Inadequate for T-pattern Detection

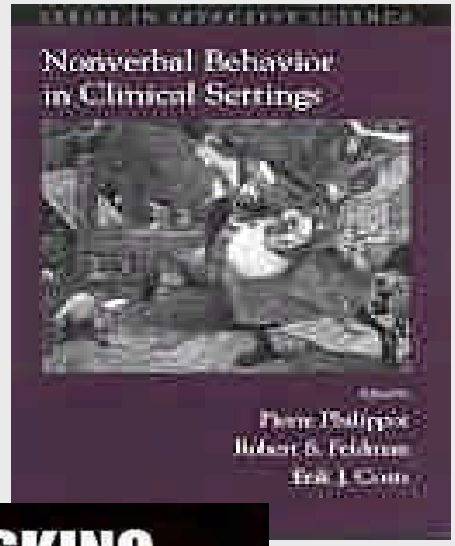
- **Multivariate statistical methods:** look for **clouds of points in n-dimensional space** rather than for syntactic structures on one dimension

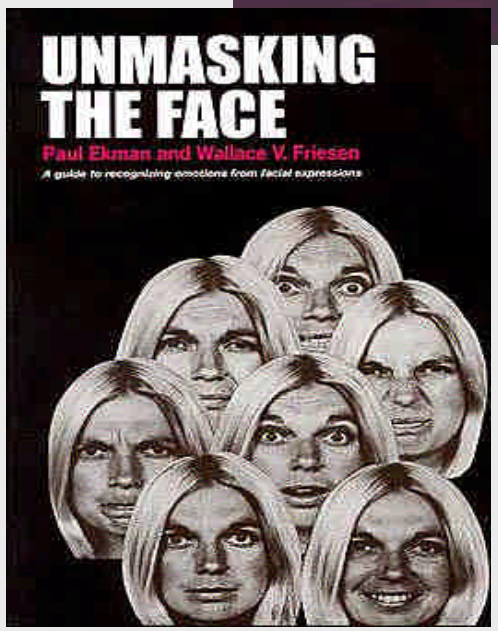
- **Time series analysis** looks for **trends or waves** rather than hierarchical **discontinuities** occurring **irregularly**

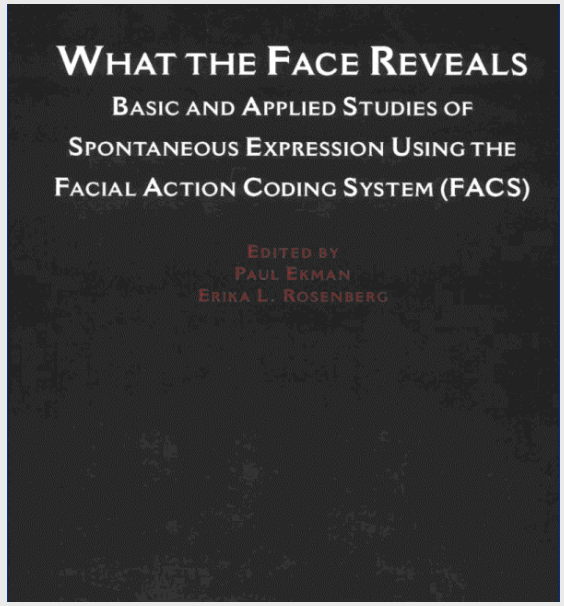
- **Sequential analysis** may look for **a priori unlikely time sequences** but involves **no concept of complex repeated 1-D shapes or patterns**. It may therefore detect a multitude of sequential relations **without ever detecting such underlying patterns**

To go further…..









Thank you for your attention!