Prosody and Expressivity in Speech and in Musical Performance

Grégory Beller, PhD student IRCAM / Paris 6

Institut de Recherche et Coordination Acoustique/Musique

EMUS – AGORA conference (3/4)

Introduction

- I. Speech and Music
- II. Emotion and Expressivity
- III. Expressivity in Performance
- IV. Prosody
- V. Expressivity and Prosody

I. Speech and Music

- Are “communicative mean”
- Are both based on sound (same modality)
- Share cognitive processes [Ledoux2001]
- Are writeable: Text ⇔ score
- Are performed: Speaker ⇔ instrumentalist
- Share the same meanings ?

  => One at least: The expression of the emotions [Meyer1956] [Patel2008]…

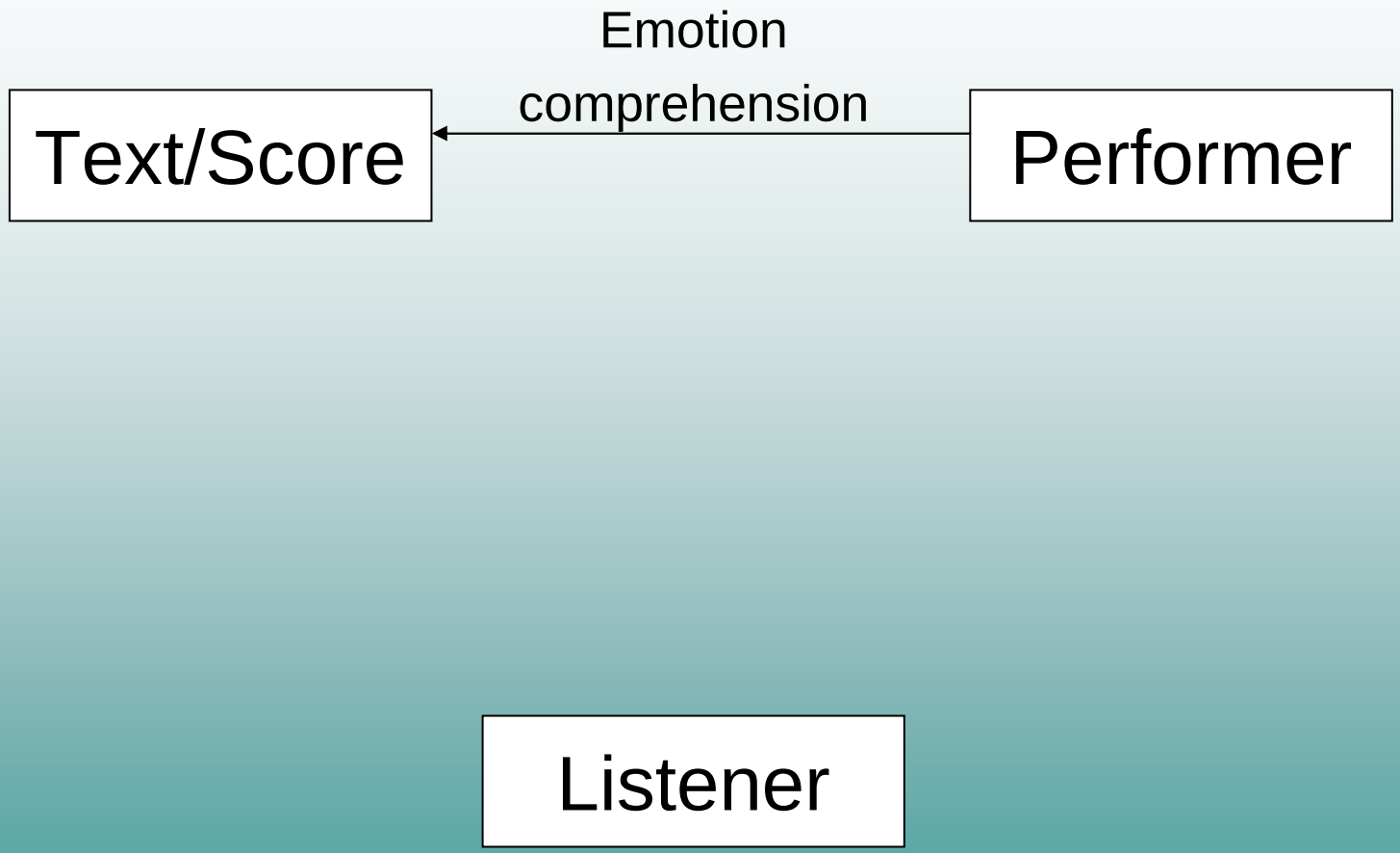
II. Emotion and Expressivity

Text/Score

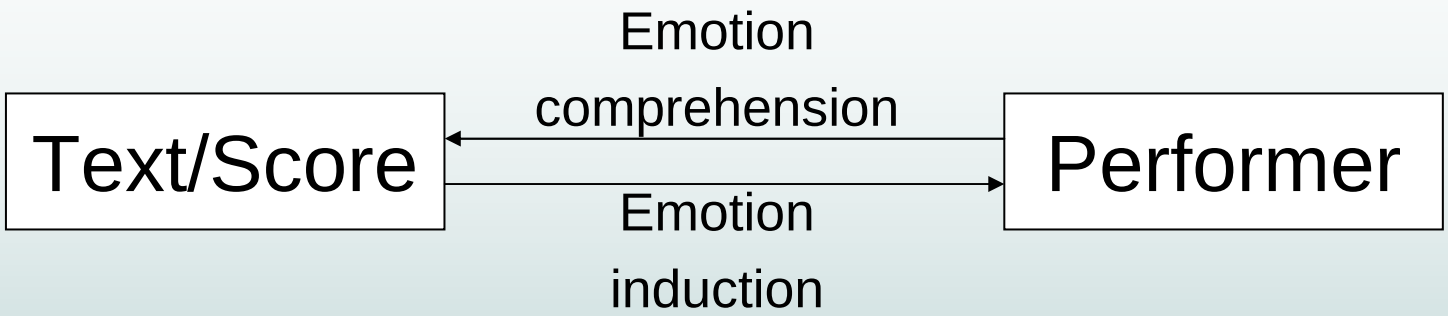
Performer

Listener

II. Emotion and Expressivity

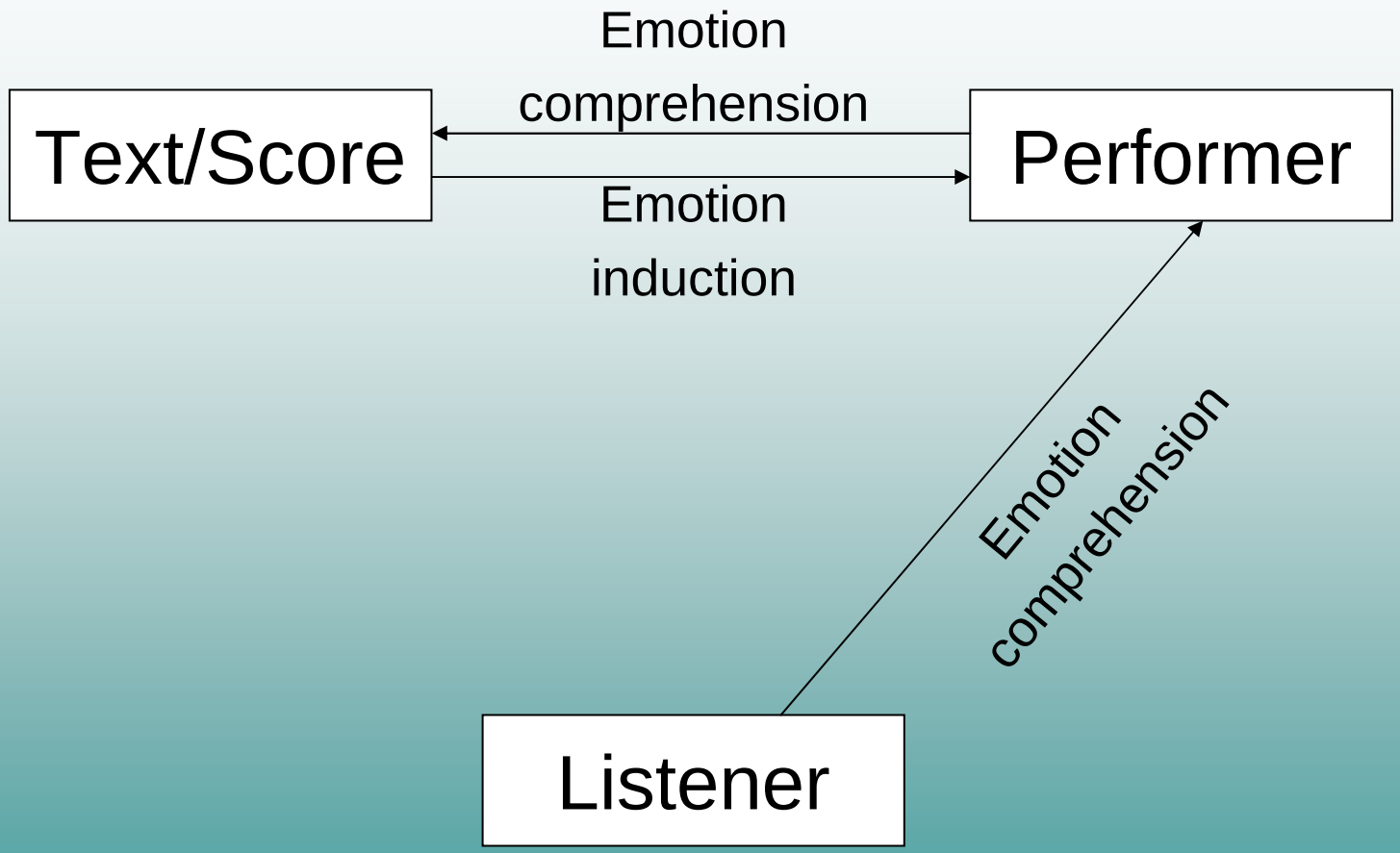


II. Emotion and Expressivity

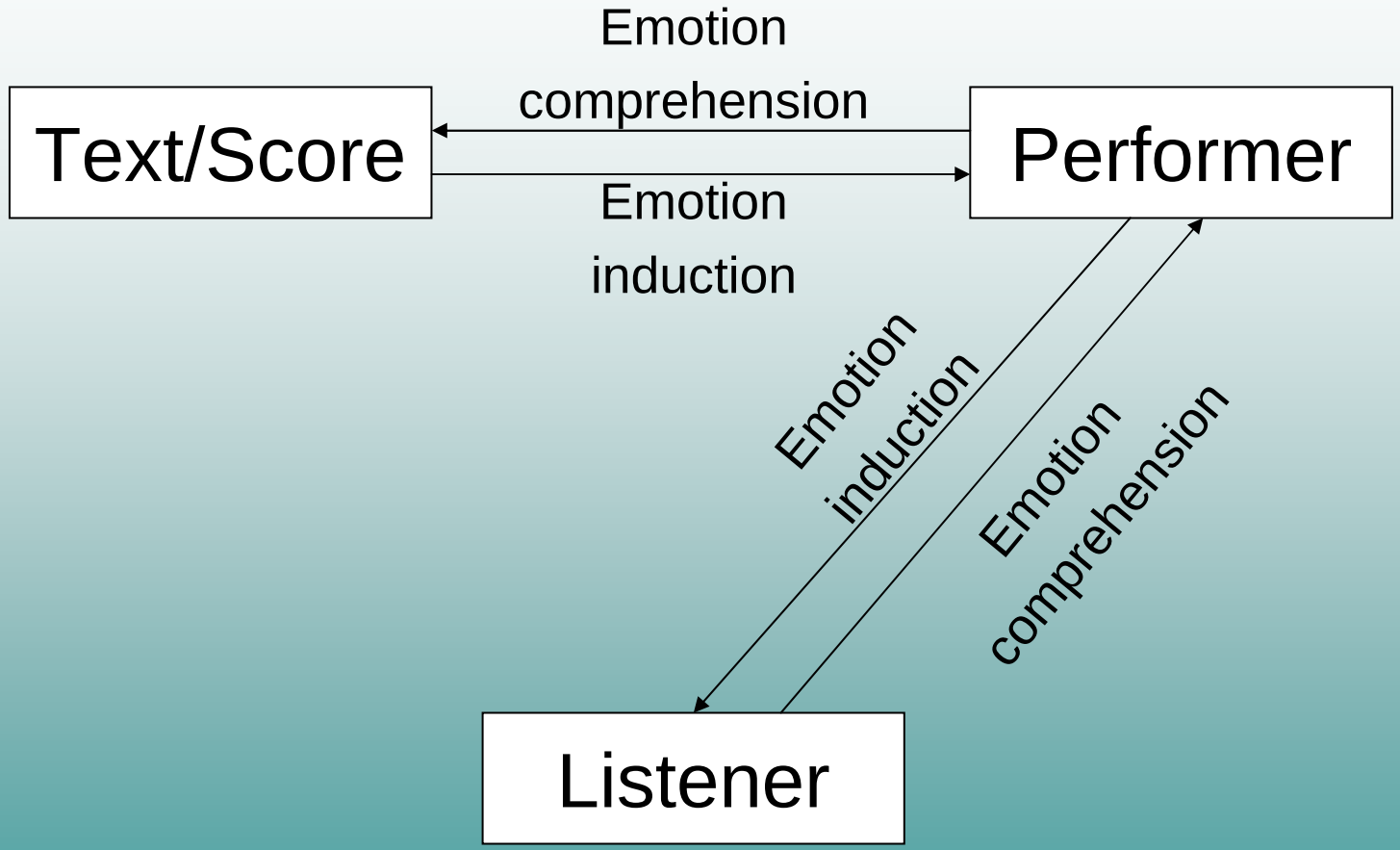


Listener

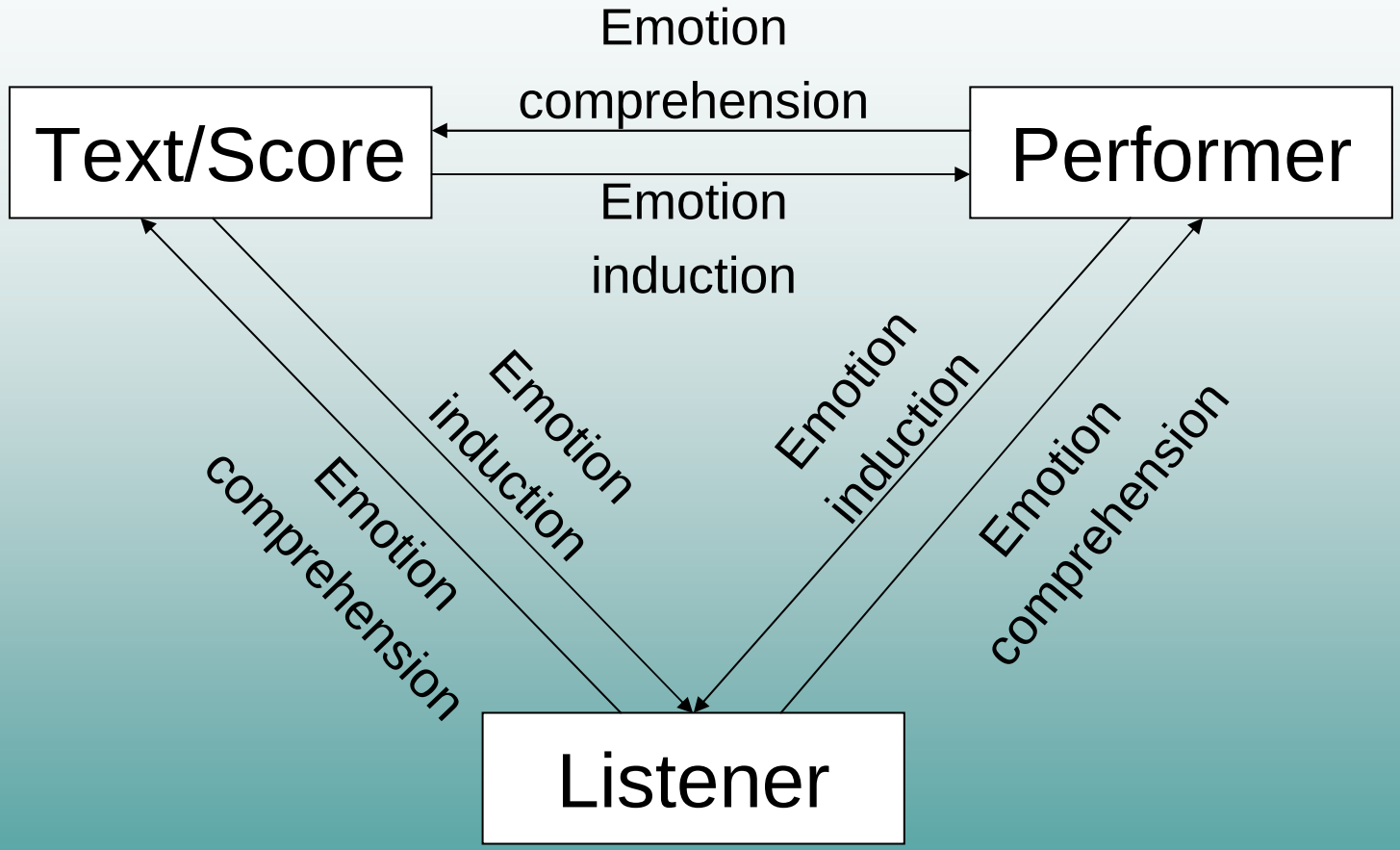
II. Emotion and Expressivity



II. Emotion and Expressivity



II. Emotion and Expressivity



II. Emotion and Expressivity

- Difference between emotion perception and induction
- Differences between emotional state and emotional expression:
  - Emotional states are not controllable (~ [Changeux1983])
  - Emotional states are only deducible from the observation of the external emotional expression [Ekman1999]
  - Emotional expressions can be controlled [Scherer1984]
  - Emotional expressions can be reproduced and simulated (actor, performer…)

II. Emotion and Expressivity

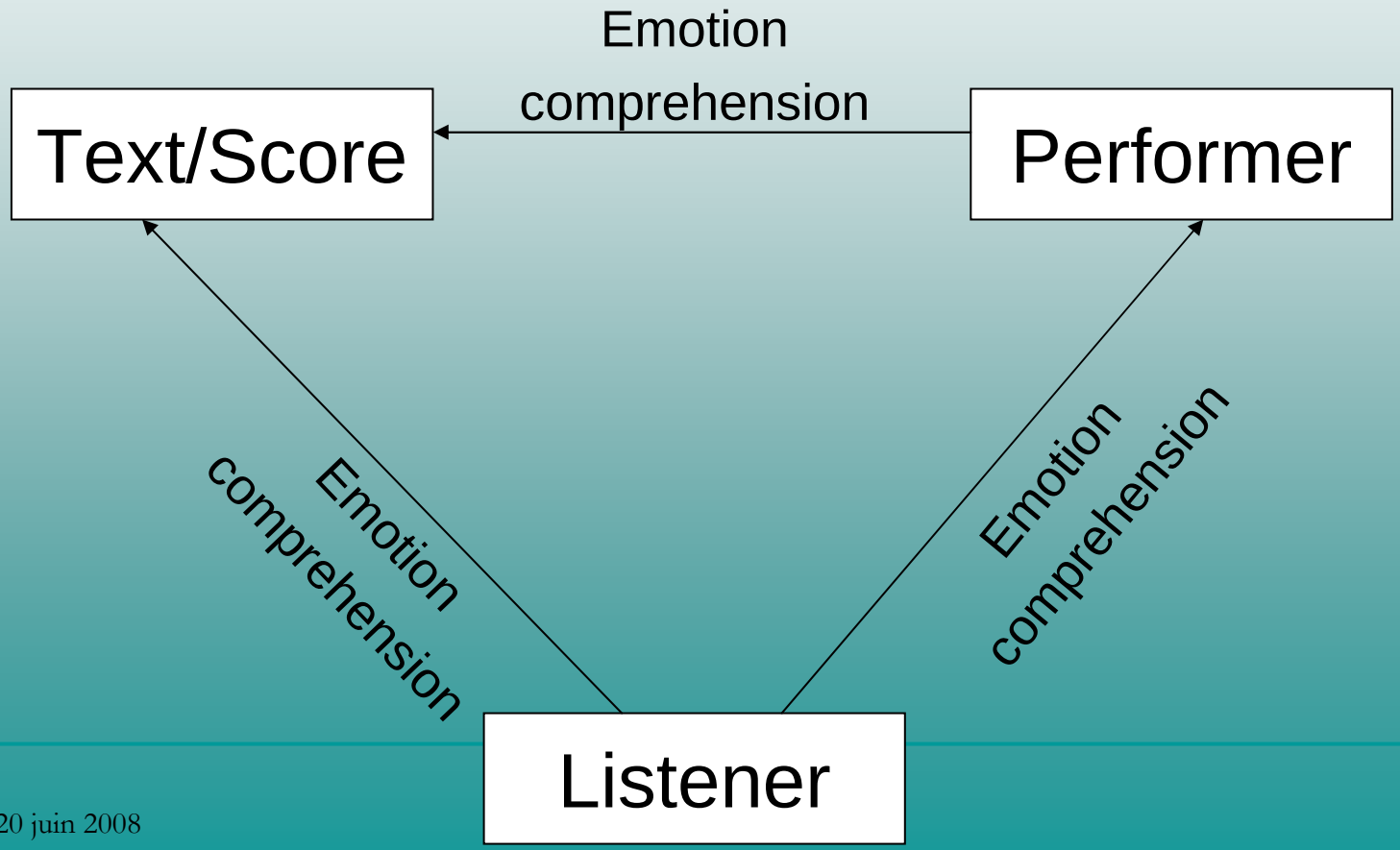
- A definition of expressivity
  - Expressivity is a level of information in communication.
  - This level groups together the external demonstrations, controlled or not, which are attributable to uncontrolled internal states. [Beller2008c]
  - Among these internal states are included the emotions, feelings, attitudes, moods, humors and psychological states.
  - Real emotional expressions are part of expressivity. Even if they are not controlled, they bring to the others the information of the people's internal state.
  - Expressivity can induce an emotional state, but it most of the time allows only to perceive an emotional state.

II. Emotion and Expressivity

- Can we express the same internal states with music and speech ?
  - Category specific representations:
    - Ekman's universal emotions : Anger, disgust, fear, **happy**, **sad**, surprise [Ekman1999a]
    - Hevner's musical expressions: Vigorous, exciting, **happy**, graceful, serene, dreamy, **sad**, dignified [Hevner1939]
  - Dimensional representations:
    - Cognitive appraisal scales : Valence (positive vs. negative), Degree (weak vs. strong), Activation (introvert vs. extravert), Pleasure (pleasure vs. displeasure), Arousal (activity vs. passivity), Stance (accepting vs. stern)… [Schroeder2003]
    - Meyer's expectancy [Meyer, 1956]

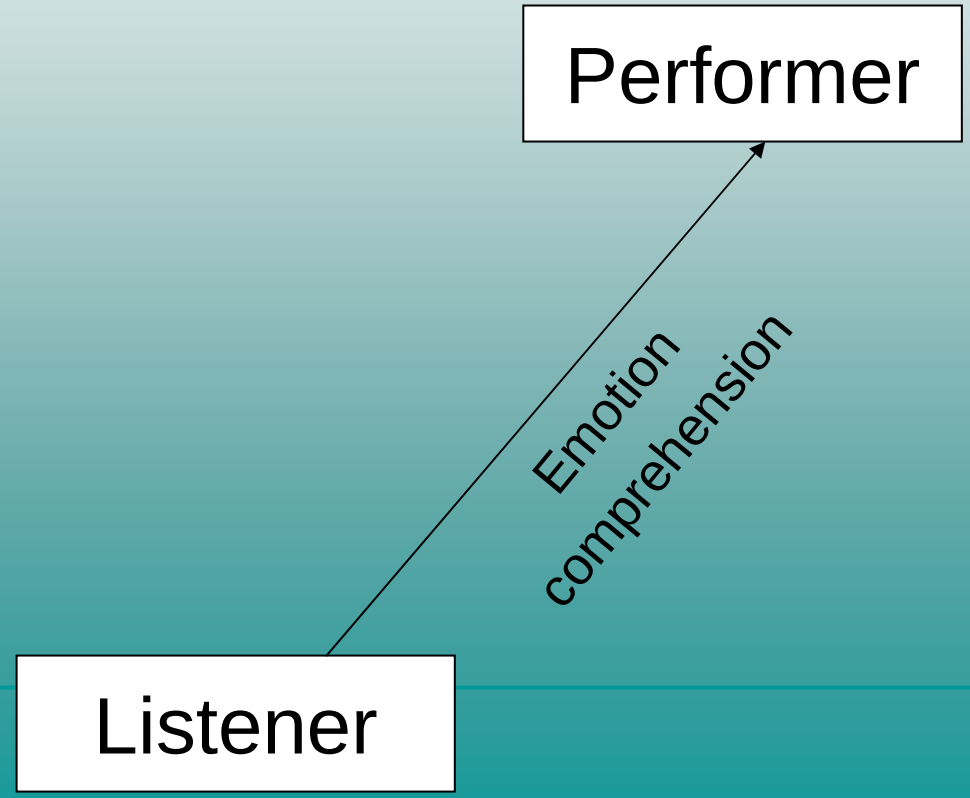
III. Expressivity in performance

- How are expressed emotions in speech and music ?
  - Three "*interactors*" in expressivity perception



III. Expressivity in performance

- How are expressed emotions in speech and music ?
  - Three "*interactors*" in expressivity perception
  - Consensus on the expressive meaning of a piece



III. Expressivity in performance

Verbal [Beller2008c] Instrumental [Juslin2003b]

Text/score
Syntax
Structure

Performer
Actor
Instrumentalist
Identity
style
Technical skills

Motion

Expressivity

III. Expressivity in performance

Verbal [Beller2008c] Instrumental [Juslin2003b]

Text/score
Syntax
Structure

modality	dialog management
prominence	stress
	pragmatic
	emphasis

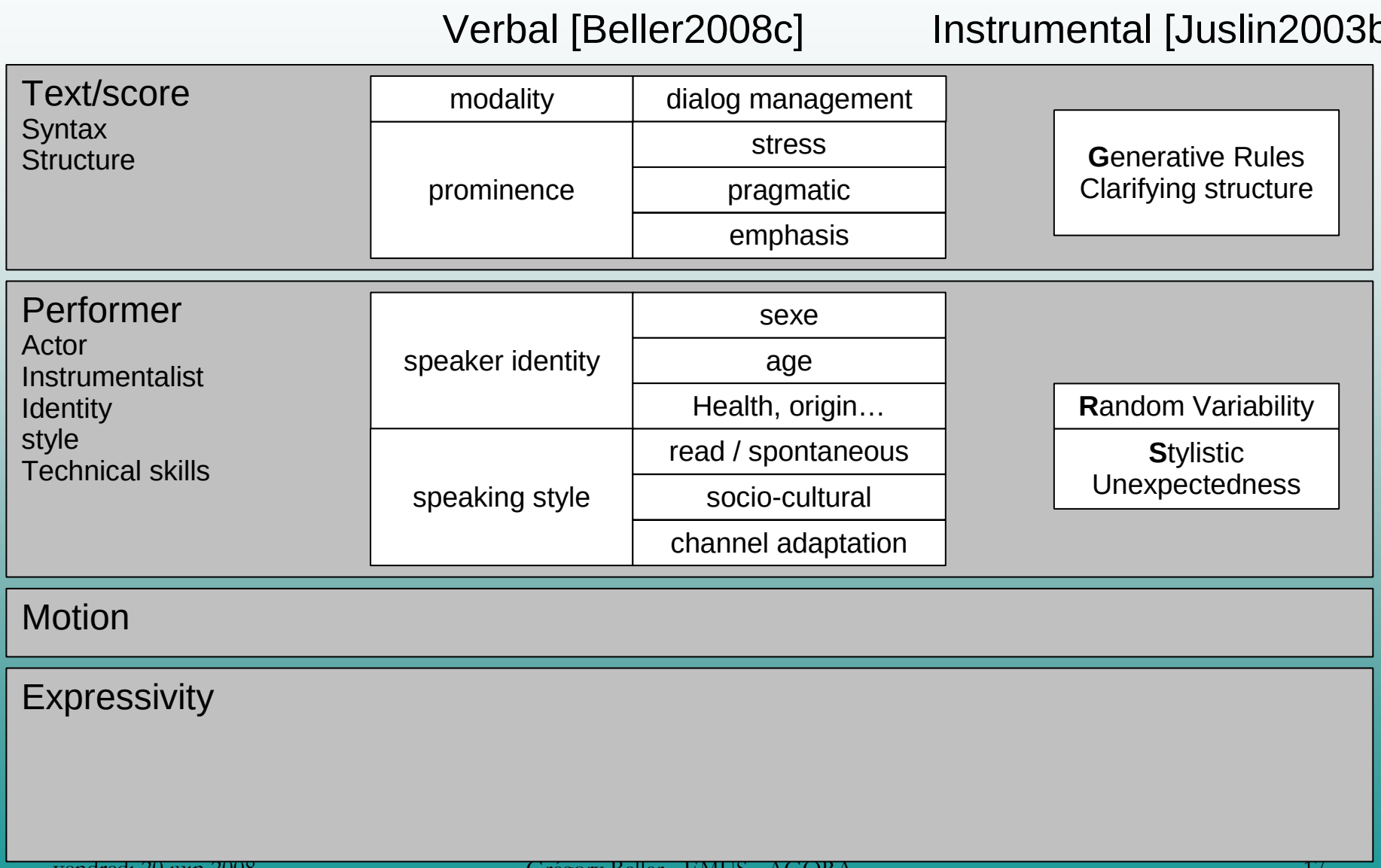
Generative Rules
Clarifying structure

Performer
Actor
Instrumentalist
Identity
style
Technical skills

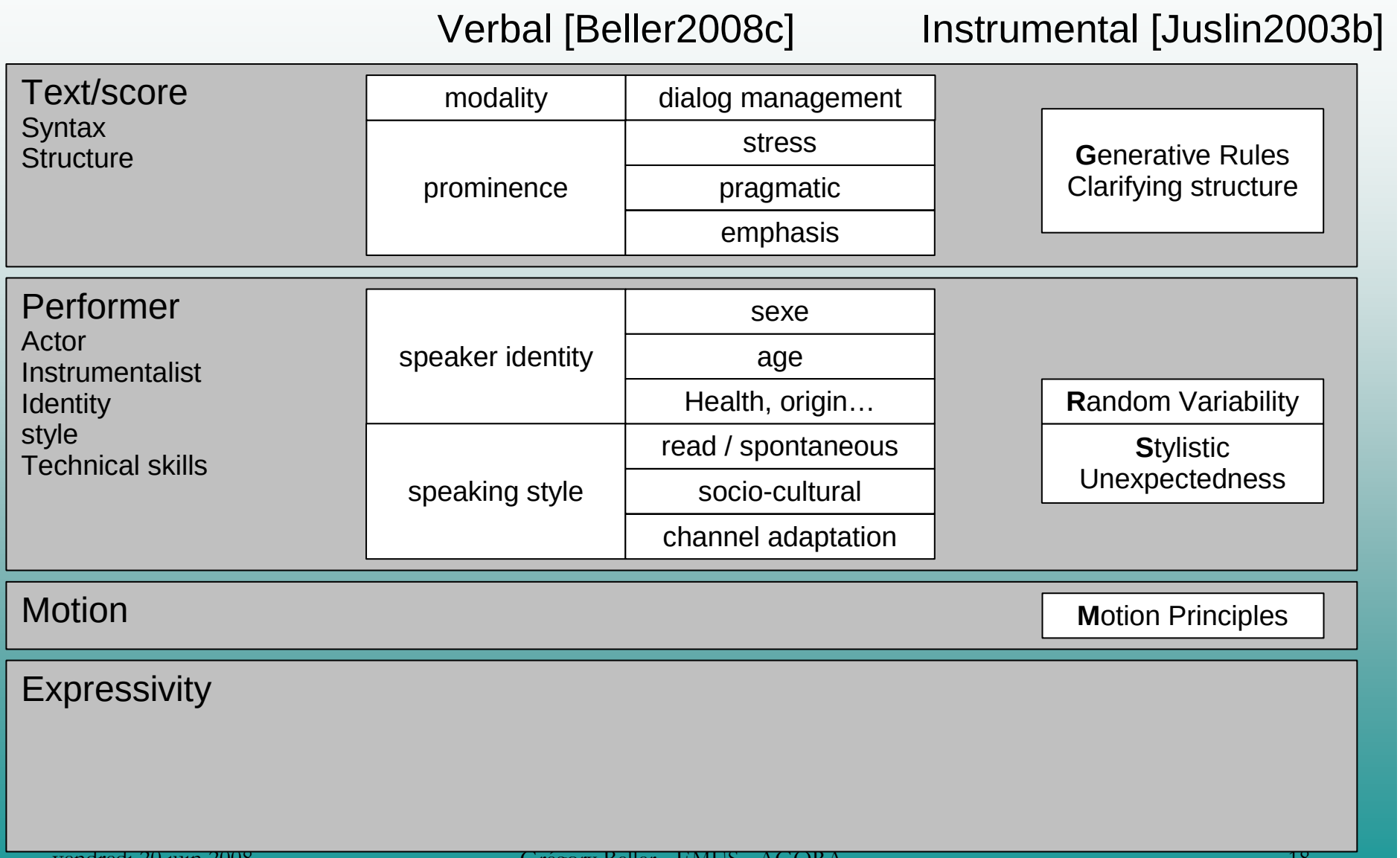
Motion

Expressivity

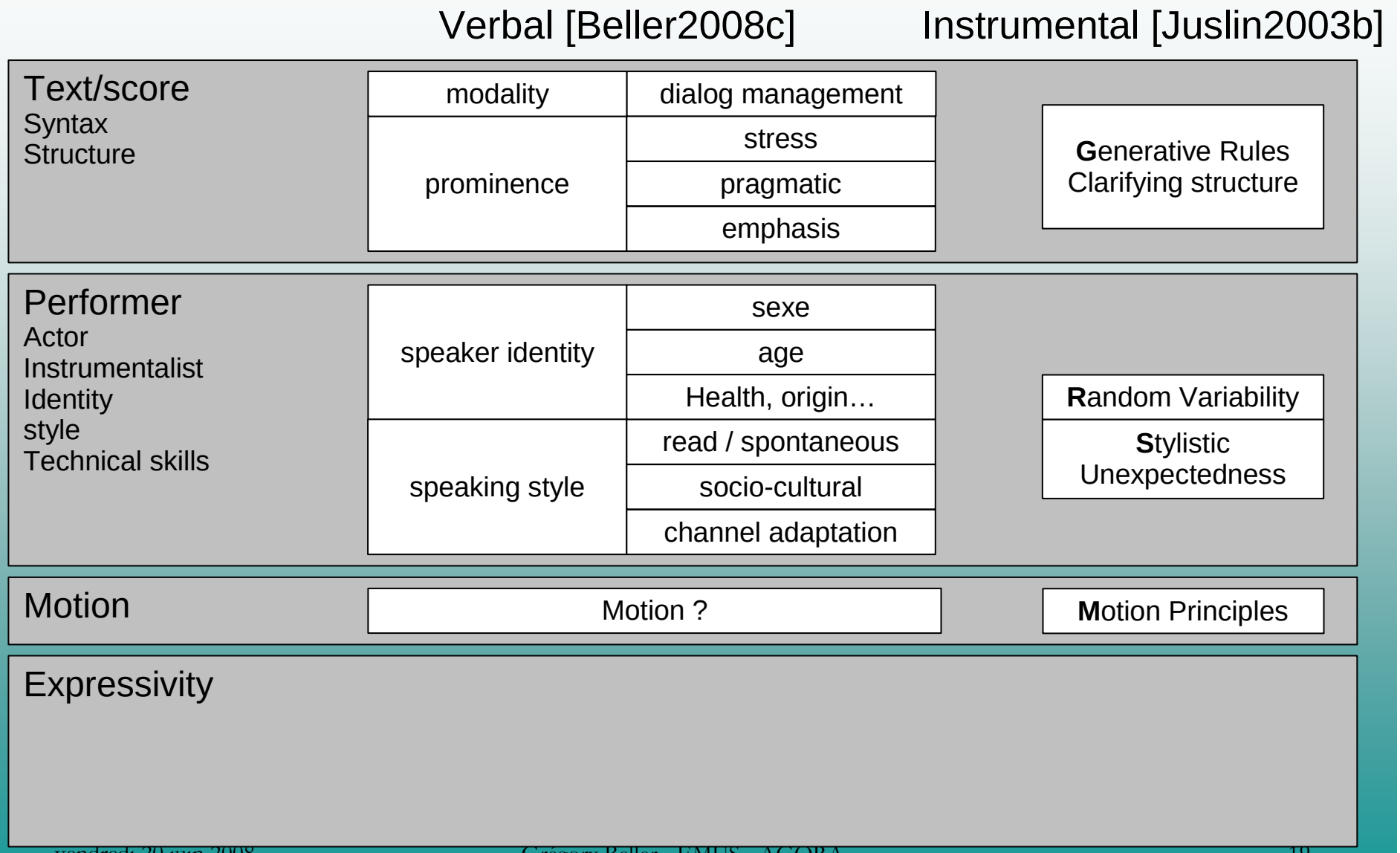
III. Expressivity in performance



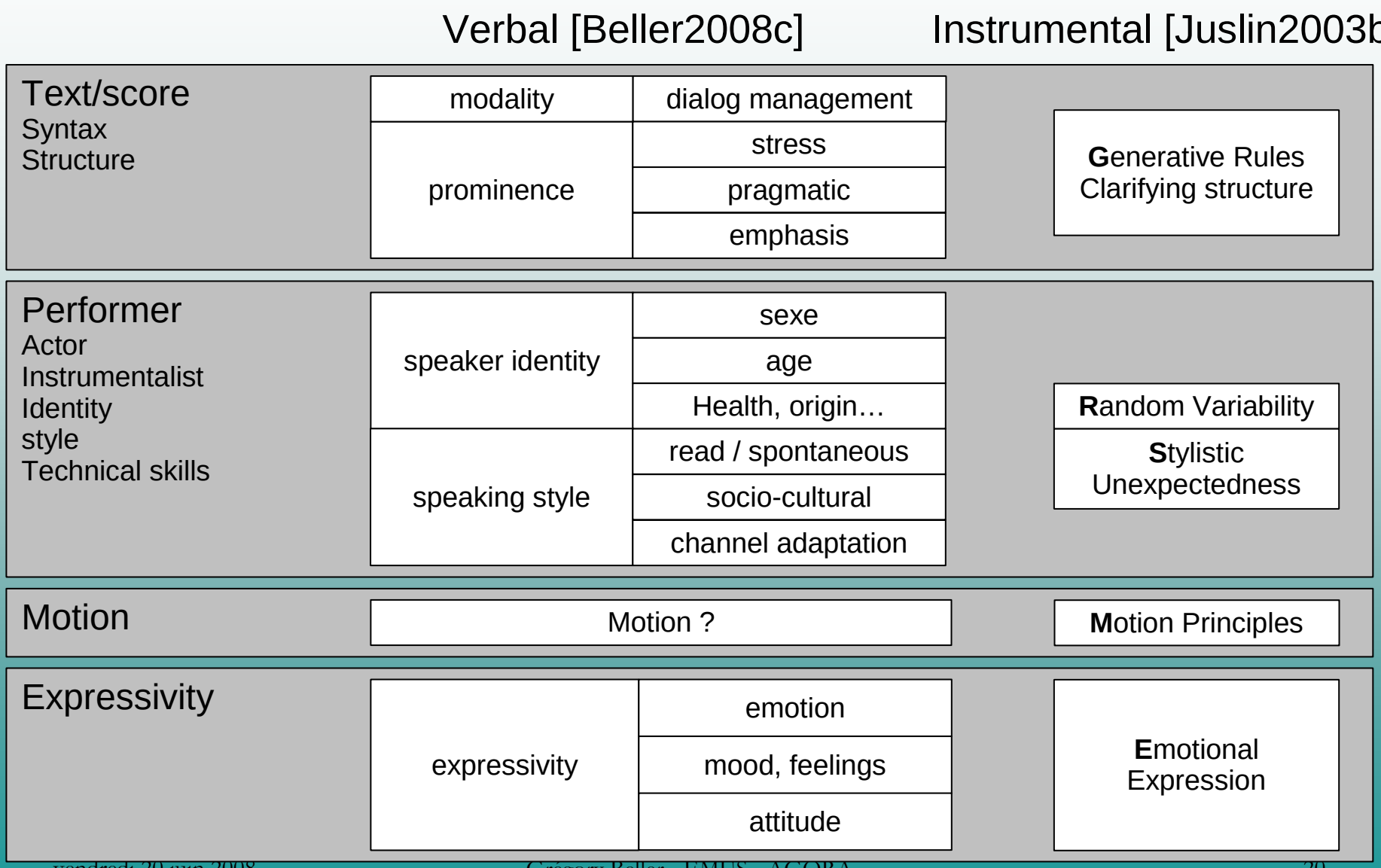
III. Expressivity in performance



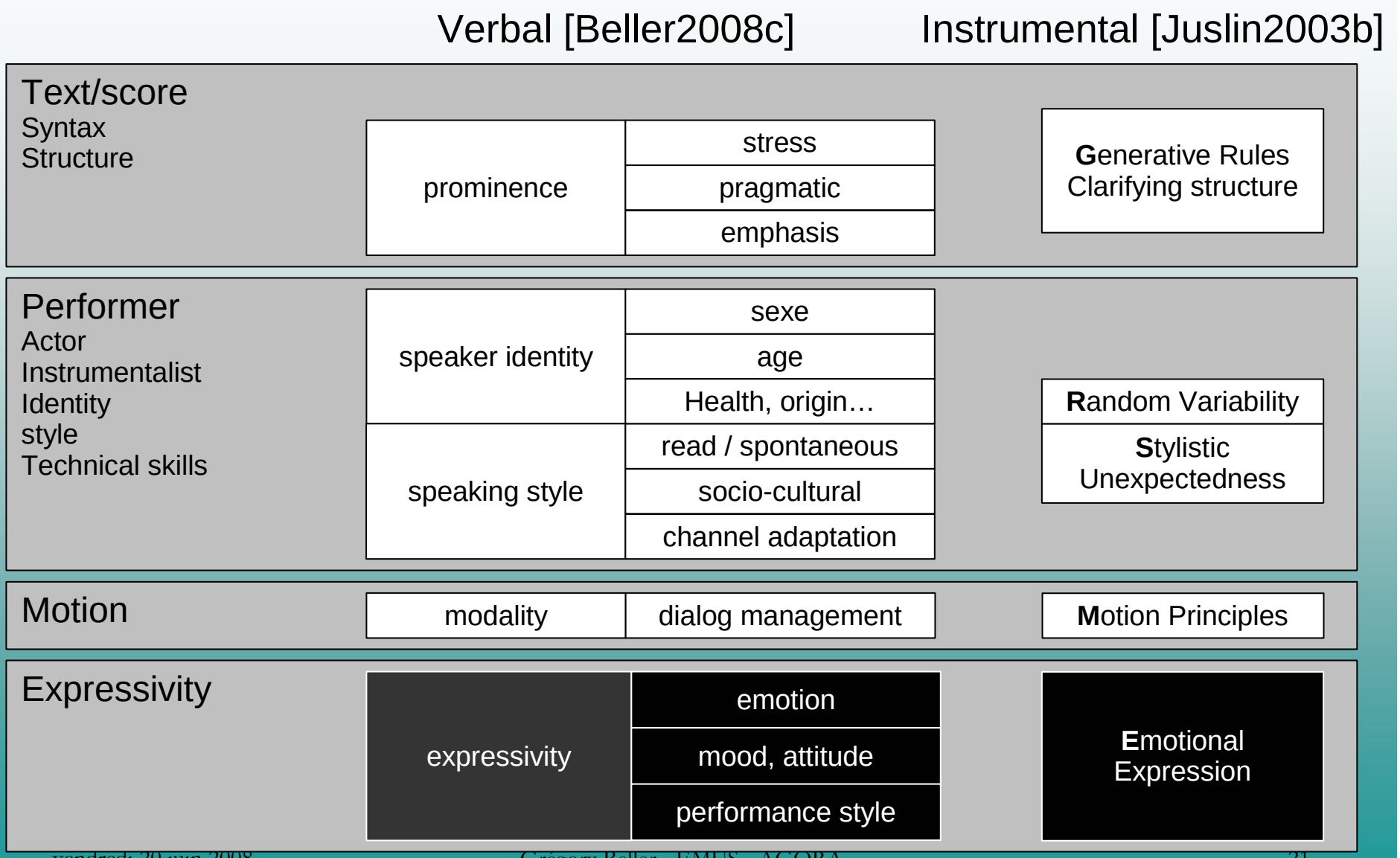
III. Expressivity in performance



III. Expressivity in performance



III. Expressivity in performance

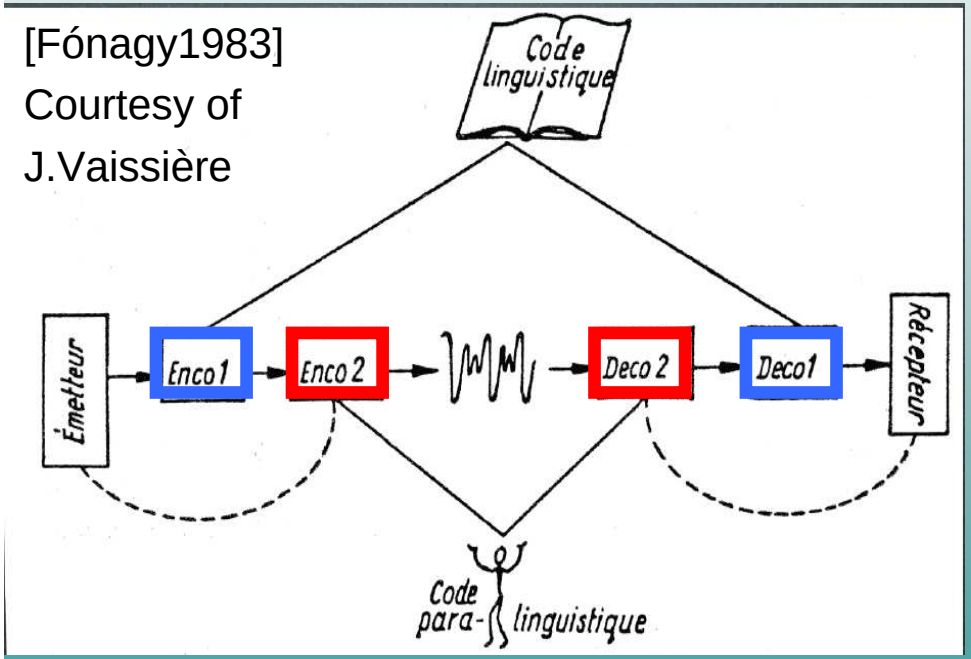


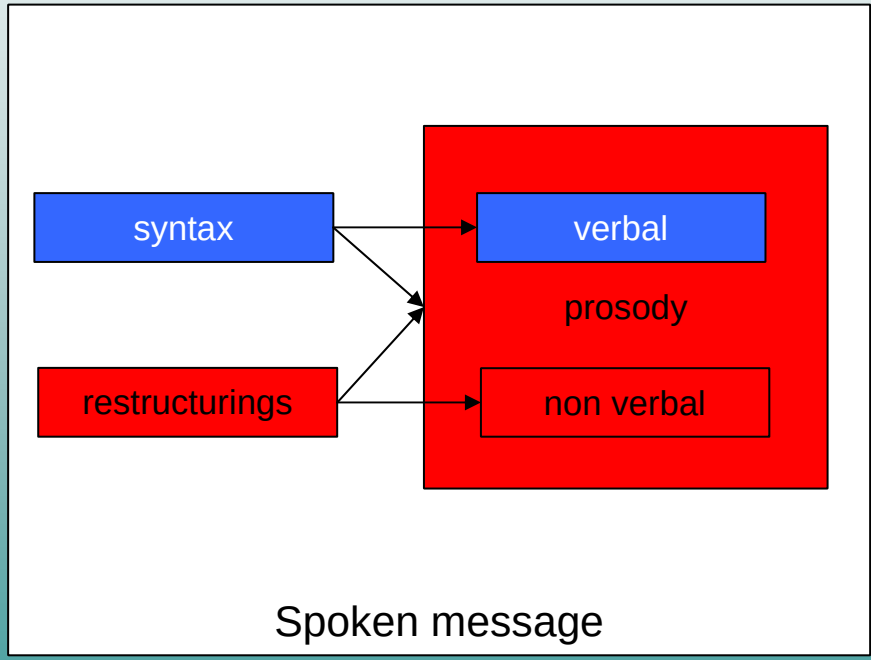
IV. Prosody

IV. Prosody

- **Double coding in speech** [Fónagy1983]
- Nonverbal and restructurings [Beller2008c]

[Fónagy1983]
Courtesy of
J.Vaissière





linguistic

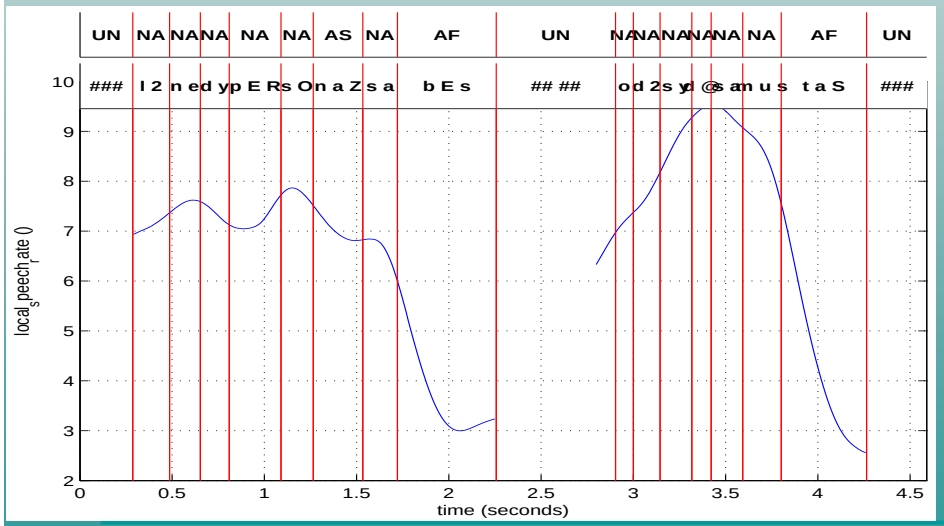
paralinguistic

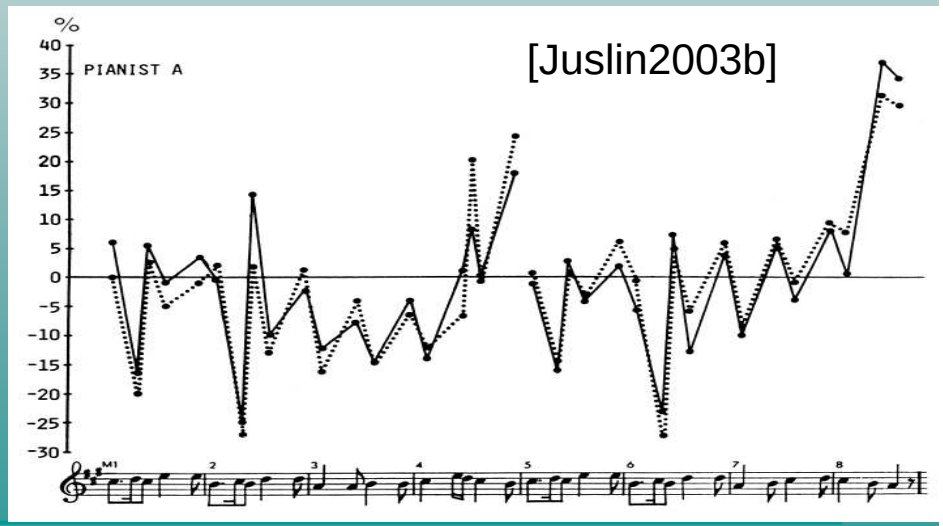
IV. Prosody

- Five dimensions [Pfitzinger, 2006]
  - Intonation, pitch, melody, contour
  - Intensity, energy, volume, loudness
  - Delivery rate, Speech rate, rhythm deviation
  - Articulation [Beller, 2008]
  - Source quality

IV. Prosody

- **Delivery rate**, Speech rate, rhythm deviation
  - Global speech rate / tempo (isochronous French syllables)
  - Local speech rate / Rhythm deviations [bresin2000]
    - Prominence/Accent ..\..\sounds\analyse\speech\rythm_speech\
    - Phrasing ..\..\sounds\analyse\speech\rythm_speech\
    - Breaths / Pauses [Beller2006]





IV. Prosody

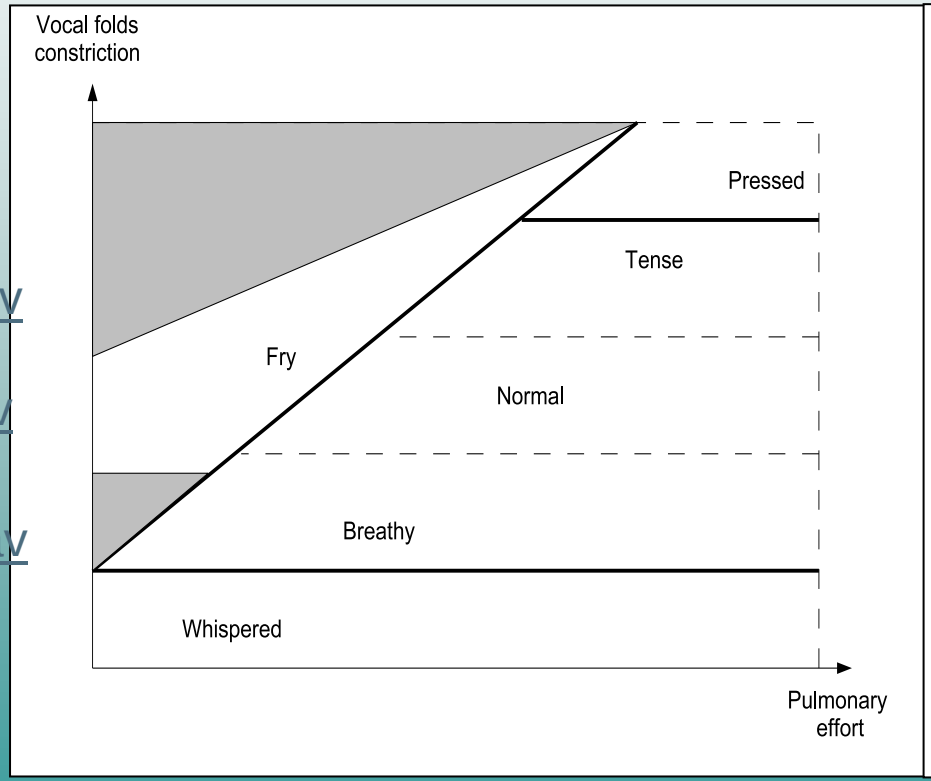
- **Articulation,** pronunciation
  - Global articulation degree
    - Parole liée, détachée (Hypo/Hyper articulation [Lindblom1983])
    - Staccato, legato
  - Coarticulation phenomenon
    - Elision, connection
    - Coarticulation of gestures [Rasamimanana2007]
      - acknowledgments to Arshia Cont
      - acknowledgments to Arshia Cont
  - Correlated with the delivery rate
      - acknowledgments to Nicolas Rasamimanana
      - acknowledgments to VOXLER Project

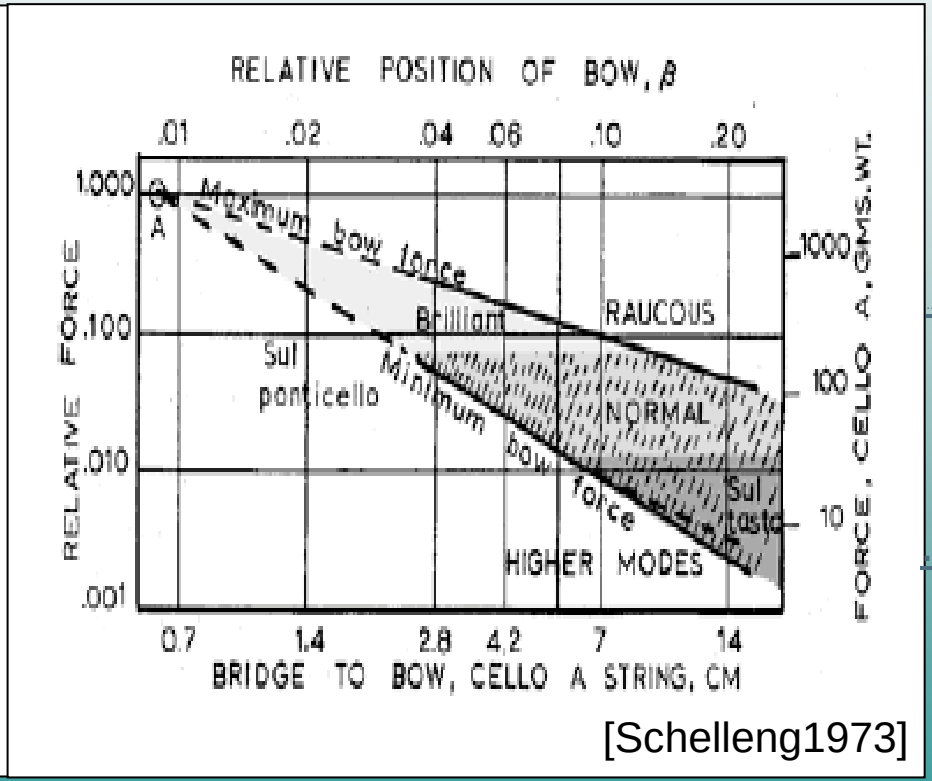
IV. Prosody

- **Source quality**, voice quality, phonation
  - Vibratory modes
    - Fry, normal, falsetto, whistle
    - “Fry” , sul tasto, ordinario, sul ponticello, harmonics …
  - Voicing
    - Temporal, dynamics of phonation
    - Spectral, voicing frequency
  - Voice quality
    - Tense, pressed
    - Normal
    - Breathy, whispery

IV. Prosody

- **Voice quality vs. Violin playing styles:**





[Schelleng1973]

V. Expressivity and prosody

- Different instruments => different prosodies ?
  - Cello is said very similar to voice, but production modes are quite far.
  - For other instruments, like percussive ones, sound comes from different gestures with different biomechanical constraints.
  - But same perception => same prosodic target ?

    A pianist plays phrases, but his fingers do not need to breath!

V. Expressivity and prosody

- Speech and musical performance share some acoustic cues to expressivity
  - Anger
    - ..\..\..\..\..\..\Corpus\Combe2006\Combe2006_AUDIO\Combe.459.e08.p05.i05.wav
    - acknowledgment to Bertrand Brayard and David Chaillou
  - Fear
    - ..\..\..\..\..\..\Corpus\Combe2006\Combe2006_AUDIO\Combe.160.e03.p05.i05.wav
    - acknowledgment to Bertrand Brayard and David Chaillou
  - Happiness
    - ..\..\..\..\..\..\Corpus\Combe2006\Combe2006_AUDIO\Combe.93.e02.p05.i01.wav
    - acknowledgment to Bertrand Brayard and David Chaillou
  - Sadness
    - ..\..\..\..\..\..\Corpus\Combe2006\Combe2006_AUDIO\Combe.279.e05.p05.i05.wav
    - acknowledgment to Bertrand Brayard and David Chaillou

[Gabrielson1996] [Balkwill1999] [Sloboda2001] [Bresin2001] [Juslin2003] [Scherer2004] [Beller2008]

V. Expressivity and prosody

- Anger
  - ..\..\..\..\..\..\Corpus\Combe2006\Combe2006_AUDIO\Combe
  - acknowledgment to Bertrand Brayard and David Chaillou
- Fear
  - ..\..\..\..\..\..\Corpus\Combe2006\Combe2006_AUDIO\Combe
  - acknowledgment to Bertrand Brayard and David Chaillou
- Happy
  - ..\..\..\..\..\..\Corpus\Combe2006\Combe2006_AUDIO\Combe
  - acknowledgment to Bertrand Brayard and David Chaillou
- Sad
  - ..\..\..\..\..\..\Corpus\Combe2006\Combe2006_AUDIO\Combe
  - acknowledgment to Bertrand Brayard and David Chaillou

Conclusion

- The separation between an emotional state and its expression allows the objective observation of this last one (so called expressivity).
- To study the expressivity in the performance, one needs to take apart other information levels (performer identity…) => use of neutral reference.
- The prosody seems to be an ideal footbridge for the study of both verbal and instrumental expressivities.
- The study of the nonverbal sounds is also a privileged way.
- Maybe expressive gestures or movements the acoustic shape of which remains to identify…
- Looking for other “expressive” instrumentalists.

Acknowledgements

- CHINKEL and actors of the VIVOS project
- Bertrand Brayard, Cellist of the national orchestra of Île-de-France
- Bruno Verbrugghe, VOXLER
- Nicolas Rasamimanana, IRCAM
- Arshia Cont, IRCAM (Boulez samples)
- Snorre Farner and all the IRCAM Analysis-synthesis team

- Thanks for your attention

Bibliography

- (LeDoux2005) LeDoux, J. & Jacob, O. Lavoisier (ed.) Le Cerveau des émotions 2005
- (Patel2008), Patel, A., Press, O. U. (ed.), Music, Language, and the Brain, 2008
- (Meyer1956), Meyer, L. B., Press, C. U. (ed.) Emotion and Meaning in Music, 1956
- (Changeux1983) Changeux, J. P. Fayard (ed.) L'Homme neuronal 1983
- (Scherer1984) Scherer, K. R. Shaver, P. (ed.) Emotion as a multicomponent process: A model and some cross-cultural data Review of Personality and Social Psychology, 1984, 5, 37-63
- (Ekman1999) Ekman, P. Dalgleish, T. & Power, T. (ed.) The Handbook of Cognition and Emotion Facial Expressions John Wiley & Sons, Ltd., 1999, 301-320
- (Beller08c) Beller, G. Lang, P. (ed.) Transformation of Expressivity in Speech. The Role of Prosody in the Expression of Emotions in English and in French, Peter Lang, 2008
- (Hevner1936) Hevner, K. Experimental studies of the elements of expression in music American Journal of Psychology, 1936, 48, 246-268
- (Juslin2003b) juslin, P. Five facets of musical expression: a psychologist's perspective on music performance Psychology of Music, 2003, 31(3), 273-302
- (Fonagy1983) Fónagy, I. La vive voix: essais de psycho-phonétique 1983
- (Beller2008a) Beller, G.; Veaux, C. & Rodet, X. IrcamCorpusExpressivity: Nonverbal Words and Restructurings LREC workshop on emotions, 2008
- (Beller2006c) Beller, G.; Schwarz, D.; Hueber, T. & Rodet, X. Speech Rates in French Expressive Speech Speech Prosody, ISCA, 2006
- (Obin2008b) Obin, N.; Rodet, X. & Lacheret-Dujour, A. Un modèle de durée des syllabes fondé sur les propriétés syllabiques intrinsèques et les variations locales de débit Journées d'étude de la parole, 2008
- (Ramus1999) Ramus, F.; Nespor, M. & Mehler, J. Correlates of linguistic rhythm in the speech signal 1999
- (Bresin2000) Bresin, R. Virtual Virtuosity. Studies in Automatic Music Performance TRITA-TMH 2000, 2000
- (lindblom1983) lindblom, B. McNeilage, P. F. (ed.) Economy of Speech Gestures Spinger-Verlag, New-York, 1983, The Production of Speech
- (Wouters2001) Wouters, J. & Macon, M. Control of spectral dynamics in concatenative speech synthesis IEEE Transactions on Speech and Audio Processing, 2001, 9, 30-38
- (Rasamimanana2007) Rasamimanana, N. H.; Kaiser, F. & Bevilacqua, F. Transients control of violin players: relationships between bow acceleration and string irregular vibrations (in preparation), 2007
- (Juslin2003a) Juslin, P. & Laukka, P. Communication of emotions in vocal expression and music performance: Different channels, same code? Psychological Bulletin , 2003, 129(5), 770-814
- (Scherer2004) Scherer, K. Which Emotions Can be Induced by Music? What are the Underlying: Mechanisms? And How Can We Measure Them? JNMR, 2004, 33
- (Gabrielson1996) Gabrielson, A. & Juslin, P. Emotional expression in music performance: Between the performers intention and the listeners experience Psychology of music, 1996, 24, 68-91
- (Schelleng1973) J. Schelleng. The bowed string and the player. The Journal of the Acoustical Society of America, 53(1), 1973.