Gestural Scores and Phonetic Transcription
Coordination of gestures in time

• The consonant and vowel gestures that form a word are each active for a fixed interval in time.

• The multiple gestures associated with a given consonant or vowel may not be synchronous with each other.

• Relative timing of gestures carries information.

• What is the appropriate timing?

• How do we find out?
Finding Gestures in Time

- To find when gesture is active in time, examine the movements of the constricting device that forms the constriction for that gesture.

- When it begins to move towards the gesture’s constriction target, this is the moment of gestural activation.

- When it begins to move away the gesture’s constriction target, this is the moment of gestural deactivation.
Gesture Activation Times

“two back”
Principles underlying Gesture Timing

• Gestures for word-initial C and the V begin at the same time!
  • Initial C and V are co-produced

• The V gesture continues about two and a half times as long as the C gesture

• The gesture for the final C begins roughly when the V gesture ends.
Gestural Scores

• Representation of the temporal organization of gestures

  • Time along horizontal dimension
  • Boxes represent intervals of time during which gestures are active in the vocal tract.
  • Gestures of oral constrictors, velum, glottis are displayed on different rows, e.g., “bad”:

    • Labels on the boxes indicate the constriction degree (and location) of the gesture.
    • Simplification: Glottal narrowing for voicing is left out.
Contrast among gestural scores

• Differences in gestural scores that can count as different words:
  • presence or absence of particular gestures
  • gestures' values of CD and CL
  • qualitative organization of gestures in time
Presence or absence of gestures: compositionality

**“bad”**
- VELUM
- TONGUE TIP
- TONGUE BODY
- LIPS
- GLOTTIS
- Bilabial stop
- Pharyngeal wide
- Alveolar stop

**“pad”**
- VELUM
- TONGUE TIP
- TONGUE BODY
- LIPS
- GLOTTIS
- Bilabial stop
- Pharyngeal wide
- Alveolar stop

**“ban”**
- VELUM
- TONGUE TIP
- TONGUE BODY
- LIPS
- GLOTTIS
- Bilabial stop
- Pharyngeal wide
- Alveolar stop

**“pan”**
- VELUM
- TONGUE TIP
- TONGUE BODY
- LIPS
- GLOTTIS
- Bilabial stop
- Pharyngeal wide
- Alveolar stop

**“Ann”**
- VELUM
- TONGUE TIP
- TONGUE BODY
- LIPS
- GLOTTIS
- Bilabial stop
- Pharyngeal wide
- Alveolar stop

**“tan”**
- VELUM
- TONGUE TIP
- TONGUE BODY
- LIPS
- GLOTTIS
- Bilabial stop
- Pharyngeal wide
- Alveolar stop

- Opening
Contrast: gestures' values of CD and CL

“sad”

- YELUM
- TONGUE TIP
- TONGUE BODY
- LIPS
- GLOTTIS

- alveolar fricative
- alveolar stop
- pharyngeal wide
- opening

“shad”

- pal-alveolar fricative
- alveolar stop
- pharyngeal wide
- opening
Contrast: organization in time

“bad”

“dab”
Cross-language timing differences: English vs. French

“two”
- atypical stop
- bilabial approximant
- velar narrow
- opening

“tous”
- atypical stop
- bilabial approximant
- velar narrow
- opening

“bun”
- opening
- alveolar stop
- uvular narrow
- bilabial stop

“bonne”
- opening
- alveolar stop
- uvular narrow
- bilabial stop
Gestural Scores & Phonetic Transcription

• Gestural scores
  • how how words differ from one another (contrast) in a given language
  • show how (similar) words in different languages are produced differently

• Phonetic transcription
  • intended to fulfill the same functions

• What is the relation?
Phonetic Transcription as Gestural Annotation

• Phonetic transcription can be viewed as a system (developed by phoneticians) for annotating the gestural score, using an string of alphabetic symbols.

• Humans can attend to (and become aware of) patterns of gesture in their own vocal tracts: which words are comprised of which gestures, in what rough organization.

  • This awareness must have been the basis for the invention of alphabetic writing systems, which represent gestural structures using strings of symbols.

• Analogy with chemistry
Transcription Types

• **Broad Phonemic**
  
  • Each phoneme is a symbol for a contrastive gesture or a set (combination) of gestures.
  
  • The order of phonemes symbolizes contrastive aspects of gestural organization.
  
  • Two transcriptions that differ in at least one symbol or one ordering are potentially contrastive.

• **Narrow Phonetic**
  
  • Annotates non-contrastive details of gestural score.
  
  • Two transcriptions that differ in at least one symbol represent utterances that may or may not contrast.
Phonemic Transcription: Annotation Principles

1. Each distinctive oral constriction gesture is annotated by a distinct symbol.

   bæd vs dæd

2. The ordering of symbols represents the order in which the corresponding gestures (or sets of gestures) reach their targets.
3. When a distinctive Laryngeal or Velic gesture overlaps an oral constriction gesture, a single symbol is used for the gestural combination.
# Consonant Phonemes & Gestures

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<td>h</td>
<td>opening</td>
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</tr>
</tbody>
</table>
Vowels

• A single symbol is used for distinctive combinations of tongue and lip gestures for vowels.
  • e.g., /but/

• Diphthongs have two symbols: one for each tongue gesture
  • e.g. /baIt/
Narrow Transcription

• Annotation of details of the gestural score

• Alphabetic symbols between square brackets e.g., [bæn]

• Two transcriptions that differ in at least one symbol represent utterances that may or may not contrast

• English:
  • [tẽn] in "ten times"
  • [tẽŋ] in “ten things”
Language-specific details of gestural score

“two”

“tous”

“bun”

“bonne”
Types of Details

1. temporal overlap between gestures
   - aspiration of initial stops in English
   - nasalization of vowels in English before nasals.

2. constriction properties
   - **degree:**
     *flapping* in American English: Coronal stops and the laryngeal opening gestures "shrink" between stressed and unstressed vowels, and become approximants or "flaps". "latest" [leɪɪʃɪst]
   - **location:**
     *place assimilation* in American English: Final nasals may be assimilated to the place of a following stop. "miss you" [mɪʃju]
Aspiration of initial voiceless stops

VELIC

TB

TT

LIPS

bilabial stop

palatal wide

alveolar stop

LARYNGEAL

[b] [æ] [d]

[p] [h] [æ] [d]
Nasalization of vowels before nasals

[diagram showing phonetic processes]
Flapping

“Tim takes”

“latest”

[tʰIm]  [tʰeIks]  [leIʃt]
Place Assimilation

• Contextual variation in narrow transcription of the same word:
  • “miss it” [mɪs]
  • “miss you” [mɪʃ]

• Example
  • “I’m sure I’m gonna miss you”

  slow fast

• What is going on here?
  • We change alveolar fricative to palatoalveolar before [j]?
  • Gestures overlap in time?
Change in Gestural overlap: Synthesis

**SLOW**
- VELUM: WIDE
- LIPS: STOP
- TT: ALV FR
- TB: PALATAL NAR
- GLOTTIS: WIDE

**FAST**
- VELUM: WIDE
- LIPS: STOP
- TT: ALV FR
- TB: PALATAL NAR
- GLOTTIS: WIDE
Place Assimilation: nasal

- Final /n/ is sometimes assimilated to the place of a following labial or dorsal stop:

- "can be"
  - [kãenbi] slow vs. [kãembi] fast
Nasal Assimilation: Synthesis

“can be” SLOW

VELUM
LIPS
TT
TB
GLOTTIS

“can be” FAST

VELUM
LIPS
TT
TB
GLOTTIS
Nasal Assimilation to a following coronal

• “ten times” [tɛn] vs “ten things” [tẽŋ]

• overlap of alveolar nasal and dental fricative results in blending of the two TT gestures
The difficulty we have in perceiving this is probably due to the fact that we perceive the underlying contrastive gestural units, not their context-dependent consequences.
MRI evidence for blending

“shorten this”

“open every”