Gestures, Coupling Graphs, and Strings

WorMTRiP 2022

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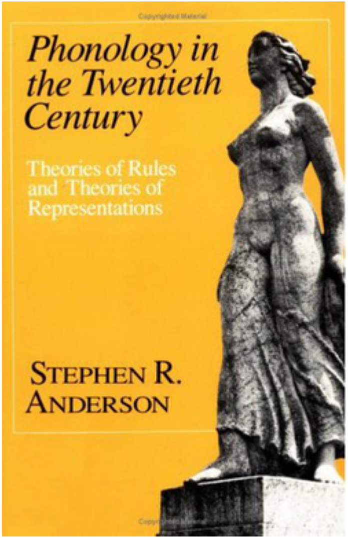
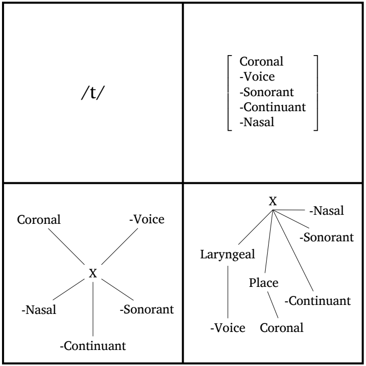
Phonological Representations

- Representations are central to modern phonological theory.
- Many different proposals across phonological domains.



Dresher (2009); Archangeli (1988); Clements (1985); Goldsmith (1976); Inkelas and Shih (2016); Browman and Goldstein (1986); *among many others*

Segmental Representations



- Many different proposals within the generative tradition
- Focus of this talk will be on segmental representations

Comparing Representations

- Previous research has used model theory to compare different proposed representations.
  - Syllable Representations
  - Tonal Geometry
  - Autosegmental/Q Theory
  - Feature Systems

Strother-Garcia (2019); Oakden (2020); Jardine et al. (2021); Nelson (2022)

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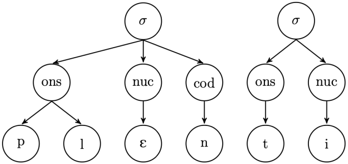

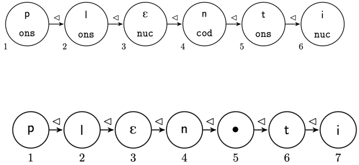

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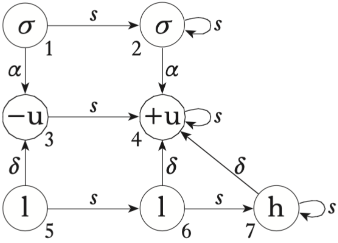

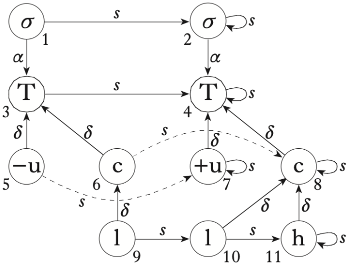

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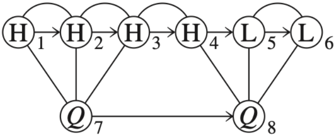

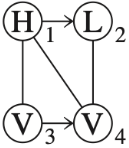

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CPL($\mathcal{M}^v$)	$\mathcal{M}^v_P$	$\mathcal{M}^v_F$	$\mathcal{M}^v_C$
voi	{N,D}	{N,D}	{D}
son	{N}	{N}	{N}
son ∧ voi	{N}	{N}	{}
Missing	–	{D}, {T}, {D,T}	{T}, {D,T}
Extra	–	–	–

CNPL($\mathcal{M}^v$)	$\mathcal{M}^v_P$	$\mathcal{M}^v_F$	$\mathcal{M}^v_C$
voi	{N,D}	{N,D}	{D}
¬voi	{T}	{T}	{N,T}
son	{N}	{N}	{N}
¬son	{D,T}	{D,T}	{D,T}
son ∧ ¬son	{}	{}	{}
son ∧ voi	{N}	{N}	{}
son ∧ ¬voi	{}	{}	{N}
¬son ∧ voi	{D}	{D}	{D}
¬son ∧ ¬voi	{T}	{T}	{T}
voi ∧ ¬voi	{}	{}	{}
Missing	–	–	–
Extra	{D}, {T}, {D,T}	–	{N,T}

Strother-Garcia (2019); Oakden (2020); Jardine et al. (2021); Nelson (2022)

Cross-Theory Comparison

- All of the previous work has looked at representations within the larger tradition of generative phonology
  - roughly: input/output mappings described by symbolic changes

Browman and Goldstein (1986, 1992, 1995); Nam (2007); Goldstein (2011); Friedman and Visser (2014); Strother-Garcia (2019); Oakden (2020)

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- Articulatory Phonology is a theory of phonological representations based in nonlinear dynamics.
  - crucially: no input/output mappings

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Cross-Theory Comparison

- All of the previous work has looked at representations within the larger tradition of generative phonology
  - roughly: input/output mappings described by symbolic changes
- Articulatory Phonology is a theory of phonological representations based in nonlinear dynamics.
  - crucially: no input/output mappings
- In this talk I will show the *bi-interpretability* of strings and coupling graphs which are the lexical representations used in Articulatory Phonology.

Browman and Goldstein (1986, 1992, 1995); Nam (2007); Goldstein (2011); Friedman and Visser (2014); Strother-Garcia (2019); Oakden (2020)

Background

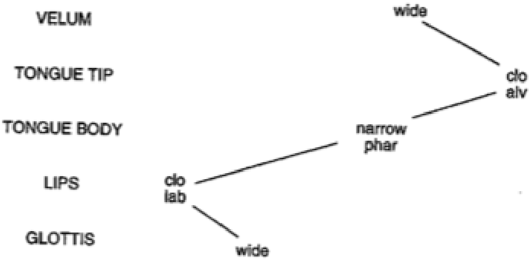
Gestural Representations

- A **gesture** is “a characteristic pattern of movement of an articulator (or of an articulatory subsystem) through space, over time” (p. 237)
- “We take, then, as a first hypothesis that gestures can be characterised in terms of a dynamical system and its associated motion variables and parameter values [e.g. constriction location/degree]...” (p. 240).
- $m\ddot{x} + k(x - x_0) = 0$

Gestural Representations

- "...a **constellation** of gestures is a set of gestures that are coordinated with one another by means of phasing..." (p. 185).
- "Each gesture is assumed to be active for a fixed proportion of its virtual cycle...The linguistic gestural model uses this proportion, along with the stiffness of each gesture and the phase relations among the gestures, to calculate a *gestural score* that specifies the temporal activation intervals for each each gesture in an utterance" (p. 187).
- "The parameter value specifications and activation intervals from the gestural score are input to the task-dynamical model..., which calculates the time-varying response of the tract variable and component articulators to the imposition of the dynamical regimes defined by the gestural score" (p. 188).

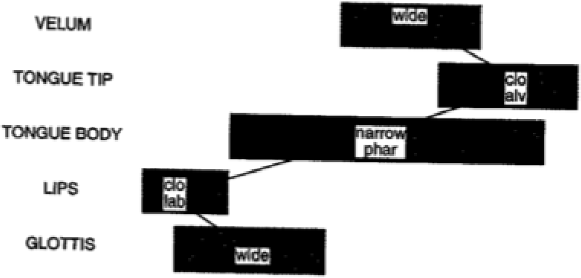
Gestural Representations



- Representations of [pɑn]
    - Constellation
    - Gestural Score
    - Trajectories

Browman and Goldstein (1986, 1995)

Gestural Representations



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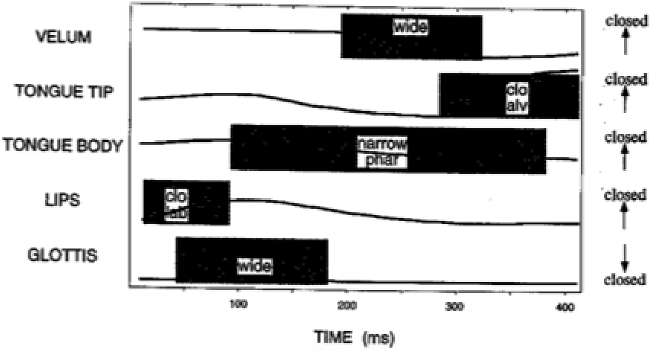
Browman and Goldstein (1986, 1995)

Gestural Representations



- Representations of [pɑn]
  - Constellation
  - Gestural Score
  - Trajectories

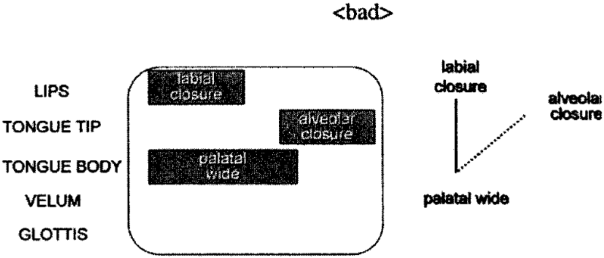
Browman and Goldstein (1986, 1995)

Coupling Graphs as Lexical Representations

"In previous work, the gestural scores were constructed using rules that specified the relative phase of pairs of gestures...In this model, planning oscillators associated with the set of gestures in a given utterance are coupled in a pairwise, bidirectional manner specified in a coupling graph (or structure) that is part of **the lexical specification of a word" (p. 38).**

Nam (2007)

Coupling Graphs as Lexical Representations



Nam (2007)

Articulatory Phonology vs. Gestural Representations in a Generative Phonology

- Many researchers have used gestural representations within generative phonology.
- Here, I am focused on Articulatory Phonology as a theory of phonology that does not have a generative element.
- This offers a more interesting comparison case and shows the strength of model theoretic representations as tools for theory comparison.

McMahon et al. (1994); Zsiga (1997); Gafos (2002); Hall (2003); Davidson (2004); Bateman (2007); *inter alia*

Model Theoretic Representations

Chadwick (2021) Model

$$< D, \lhd, \leftrightarrows, TB, TT, Glottis, Pharyngeal, Palatal, Uvular, Glide(G), Consonant(C), Vowel(V), Narrow, Closed, Wide, Str-\alpha, Wk-\alpha, \mu, \mu\mu, F > \quad (1)$$

Figure 2: Model Signature for Liquid Asymmetry

- Focus was specifically on liquid asymmetry.
- Only used in-phase and anti-phase binary relations
- Included extra information (alpha, mora)

Coupling Graph Models

Relation	Label
$\diamond$	In-phase
$\lhd_{180}$	Anti-phase
$\lhd_{60}$	Abutting
$\lhd_{30}$	Eccentric

- 4 binary relations based on common phase relations in Articulatory Phonology

Coupling Graph Models

Relation	Label	Relation	Label
LIPS	Labial Articulator	rel	Constriction Degree: release
TT	Tongue Tip Articulator	pro	Constriction Location: protruded
TB	Tongue Body Articulator	dent	Constriction Location: dental
VEL	Velum Articulator	alv	Constriction Location: alveolar
GLO	Glottis Articulator	palv	Constriction Location: postalveolar
clo	Constriction Degree: closed	pal	Constriction Location: palatal
crit	Constriction Degree: critical	vel	Constriction Location: velar
nar	Constriction Degree: narrow	uvul	Constriction Location: uvular
V	Constriction Degree: vowel	phar	Constriction Location: pharyngeal
wide	Constriction Degree: wide		

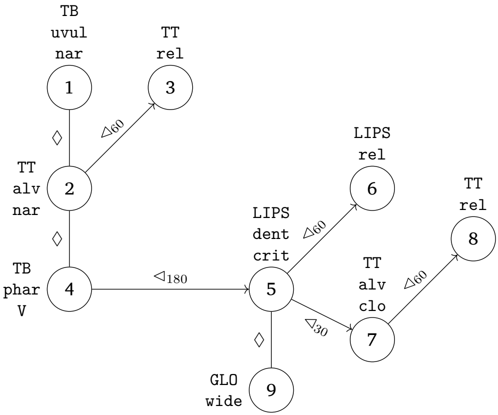
- Unary labeling relations.

Coupling Graph Model: [læft]

$$\mathcal{D} := \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$$
$$\diamond := \{(1, 2), (2, 4), (5, 9)\}$$
$$\lhd_{180} := \{(4, 5)\}$$
$$\lhd_{60} := \{(2, 3), (5, 6), (7, 8)\}$$
$$\lhd_{30} := \{(5, 7)\}$$
$$\texttt{LIPS} := \{5, 6\}$$
$$\texttt{TT} := \{2, 3, 7, 8\}$$
$$\texttt{TB} := \{1, 4\}$$
$$\texttt{GLO} := \{9\}$$

$$\texttt{dent} := \{5\}$$
$$\texttt{alv} := \{2, 7\}$$
$$\texttt{uvul} := \{1\}$$
$$\texttt{phar} := \{4\}$$
$$\texttt{clo} := \{7\}$$
$$\texttt{crit} := \{5\}$$
$$\texttt{nar} := \{1, 2\}$$
$$\texttt{wide} := \{9\}$$
$$\texttt{rel} := \{3, 6, 8\}$$
$$\texttt{V} := \{4\}$$

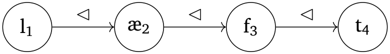
Coupling Graph Model: [læft]



String Model: [læft]

Relation	Label
$\lhd$	Successor
$\sigma(\forall\sigma \in \Sigma)$	Segment

$$\begin{aligned} \langle \mathcal{D} &:= \{1,2,3,4\} \\ \lhd &:= \{(1,2),(2,3),(3,4)\} \\ \text{æ} &:= \{2\} \\ \text{f} &:= \{3\} \\ \text{l} &:= \{1\} \\ \text{t} &:= \{4\} \\ \sigma &:= \{\}; \sigma \in \Sigma \setminus \{\text{æ,f,l,t}\}\rangle \end{aligned}$$



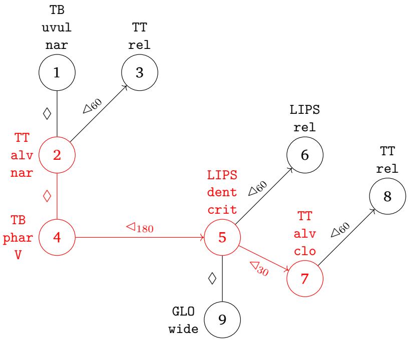
Translations

Translating between Structures

- We can translate between structures using monadic second order logic.
- Formulae such as $\varphi_P(x) = Q(x)$ are interpreted as "domain element x has property P in the output structure if it has property Q in the input structure".
- Here we'll define two translations:
  - Coupling graph to string: Γ^{sg}
  - String to coupling graph: Γ^{gs}

Courcelle (1994); Engelfriet and Hoogeboom (2001)

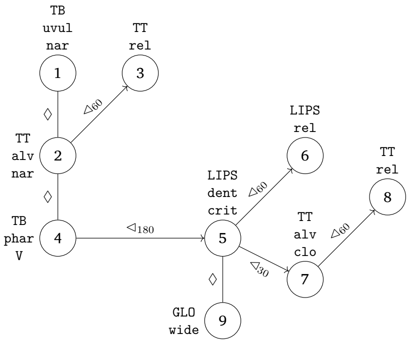
Identifying the “spine”



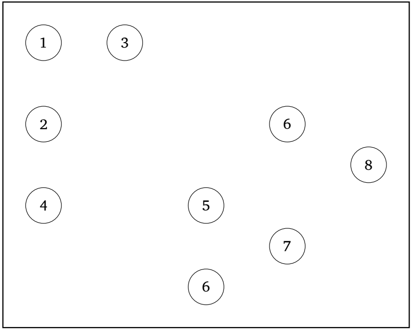
- We can identify the *spine* of a coupling graph by looking at the subgraph that does not include:
  - Secondary articulations
  - Release Gestures
  - Glottal Gestures
  - Velum Gestures

Translating from coupling graph to string

Input



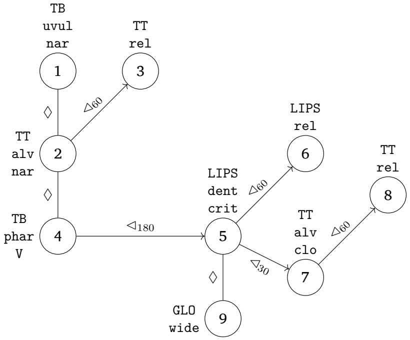
Workspace



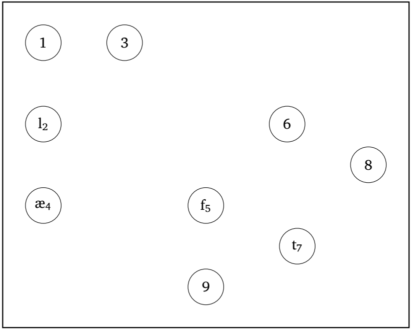
- $C := \{1\}$

Translating from coupling graph to string

Input



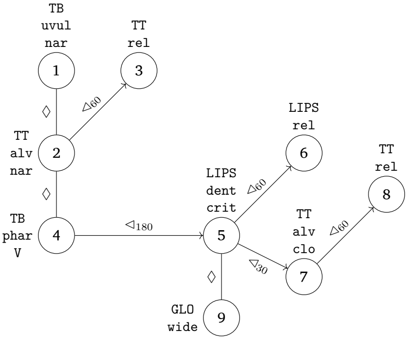
Workspace



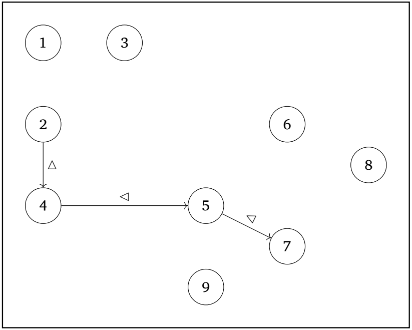
- $\varphi_{\text{l}}(x) := \texttt{TT}(x) \wedge \texttt{alv}(x) \wedge \texttt{nar}(x) \wedge \exists y[x \diamond y \wedge \texttt{voc}(y) \wedge \texttt{TB}(y) \wedge \texttt{uvul}(y)]$
- $\varphi_{\text{æ}}(x) := \texttt{TB}(x) \wedge \texttt{phar}(x) \wedge \texttt{V}(x)$
- $\varphi_{\text{f}}(x) := \texttt{LIPS}(x) \wedge \texttt{dent}(x) \wedge \texttt{crit}(x) \wedge \exists y[x \diamond y \wedge \texttt{GLO}(y) \wedge \texttt{wide}(y)]$
- $\varphi_{\text{t}}(x) := \texttt{TT}(x) \wedge \texttt{alv}(x) \wedge \texttt{clo}(x) \wedge ((\exists yz[y \lhd_{60} x \Rightarrow (y \diamond z \wedge \texttt{GLO}(z))]) \vee (\exists y[x \diamond y \wedge \texttt{GLO}(y) \wedge \texttt{wide}|(y)]))$

Translating from coupling graph to string

Input



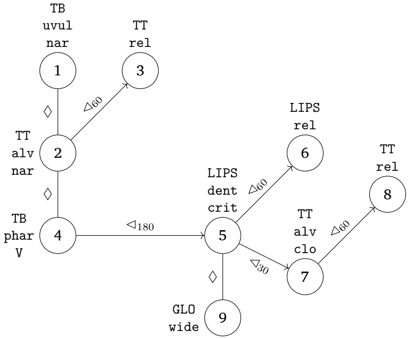
Workspace



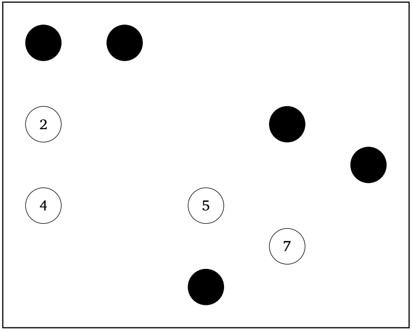
- Onset Cs are in phase with V and anti-phase with preceding C.
- First coda C is anti-phase with V; all other Cs eccentric with preceding C.
- $\varphi_{\lhd}(x,y) := (x \lhd_{180} y) \vee (x \lhd_{30} y) \vee (x \Diamond y \wedge \mathtt{V}(y) \wedge \neg \exists z [x \lhd_{180} z])$

Translating from coupling graph to string

Input

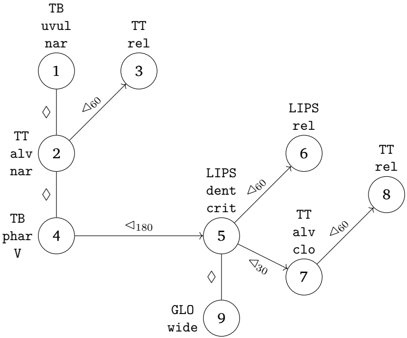


Workspace

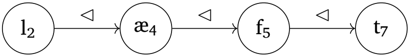


- "spine" identification.
- $\varphi_{license}(x) := \neg\mathtt{rel}(x) \wedge \neg\mathtt{GLO}(x) \wedge ((\mathtt{TB}(x) \wedge \neg\mathtt{V}(x)) \Rightarrow \neg\exists y[\mathtt{TT}(y) \wedge x \diamond y])$

Input



Output

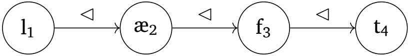


Expansion

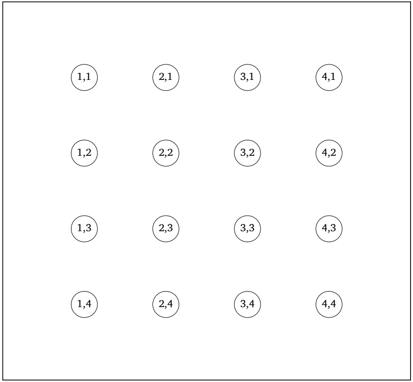
- Going from coupling graph to string removes information.
- What happens when we have to expand the representation and add more information by going from a string to a coupling graph?
- Spoiler: no real problems arise

Translating from string to coupling graph

Input



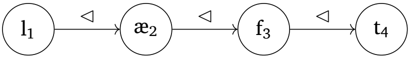
Workspace



- $C := \{1, 2, 3, 4\}$
- Unique copy sets for primary gesture, release gesture, secondary gestures, glottal/nasal gesture

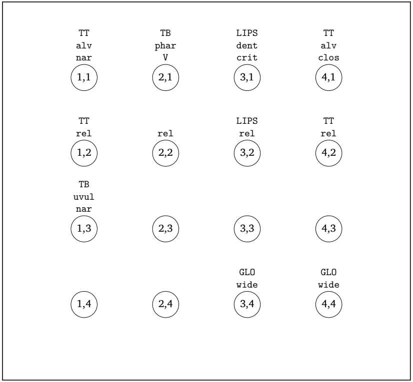
Translating from string to coupling graph

Input



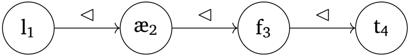
$$\varphi^1_{\texttt{LIPS}}(x) := \mathrm{f}(x)$$
$$\varphi^2_{\texttt{LIPS}}(x) := \varphi^1_{\texttt{LIPS}}(x)$$
$$\varphi^1_{\texttt{TT}}(x) := \mathrm{t}(x) \vee \mathrm{l}(x)$$
$$\varphi^2_{\texttt{TT}}(x) := \varphi^1_{\texttt{TT}}(x)$$
$$\varphi^1_{\texttt{TB}}(x) := \text{æ}(x)$$
$$\varphi^3_{\texttt{TB}}(x) := \mathrm{l}(x)$$
$$\varphi^4_{\texttt{GLO}}(x) := \mathrm{t}(x) \vee \mathrm{f}(x)$$
$$\varphi^1_{\texttt{dent}} := \mathrm{f}(x)$$
$$\varphi^1_{\texttt{alv}} := \mathrm{t}(x)$$
$$\varphi^1_{\texttt{phar}} := \text{æ}(x)$$
$$\varphi^3_{\texttt{uvul}} := \mathrm{l}(x)$$
$$\varphi^1_{\texttt{clo}} := \mathrm{t}(x)$$
$$\varphi^1_{\texttt{crit}} := \mathrm{f}(x)$$
$$\varphi^1_{\texttt{V}} := \text{æ}(x)$$
$$\varphi^1_{\texttt{nar}} := \mathrm{l}(x)$$
$$\varphi^3_{\texttt{nar}} := \mathrm{l}(x)$$
$$\varphi^4_{\texttt{wide}} := \mathrm{t}(x) \vee \mathrm{f}(x)$$

Workspace



Translating from string to coupling graph

Input



$$\varphi_{\diamond}^{1,1}(x,y) := x \lhd y \wedge \text{æ}(y) \wedge \neg\text{æ}(x)$$

$$\varphi_{\diamond}^{1,3}(x,y) := (x = y) \wedge \mathrm{l}(x)$$

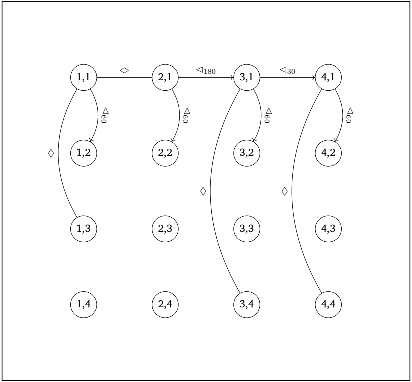
$$\varphi_{\diamond}^{1,4}(x,y) := (x = y) \wedge \mathrm{t}(x) \vee \mathrm{f}(x)$$

$$\varphi_{\lhd 180}^{1,1}(x,y) := x \lhd y \wedge \text{æ}(x) \wedge \neg\text{æ}(y)$$

$$\varphi_{\lhd 60}^{1,2}(x,y) := (x = y)$$

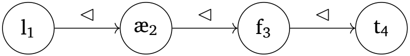
$$\varphi_{\lhd 30}^{1,1}(x,y) := \neg\text{æ}(x) \wedge \neg\text{æ}(y) \wedge \exists z[z \lhd x \wedge \text{æ}(z)]$$

Workspace



Translating from string to coupling graph

Input



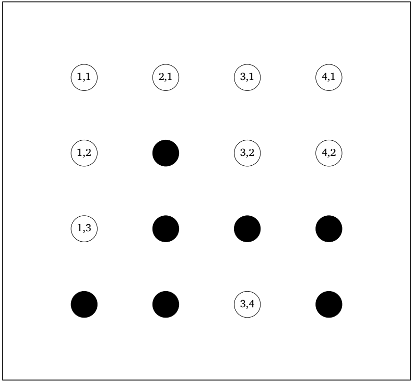
$$\varphi^1_{license}(x) := \texttt{True}$$

$$\varphi^2_{license}(x) := \mathrm{f}(x) \vee \mathrm{t}(x) \vee \mathrm{l}(x)$$

$$\varphi^3_{license}(x) := \mathrm{l}(x)$$

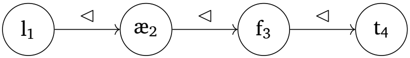
$$\varphi^4_{license}(x) := \mathrm{t}(x) \vee \mathrm{f}(x) \wedge \neg\exists y[y \triangleleft x \wedge \mathrm{f}(y) \vee \mathrm{t}(y)]$$

Workspace

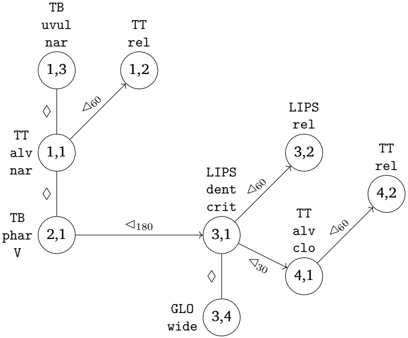


Translating from string to coupling graph

Input



Output



Bi-Interpretability

Definition:

We note that an interpretation $K : U \to V$ gives us a construction of an internal model $\widetilde{K}(\mathcal{M})$ of U from a model M of V. We find that U and V are bi-interpretable iff, there are interpretations $K : U \to V$ and $M : V \to U$ and formulas F and G such that, for all models $\mathcal{M}$ of V, the formula F defines an isomorphism between $\mathcal{M}$ and $\widetilde{M}\widetilde{K}(\mathcal{M})$, and, for all models $\mathcal{N}$ of U, the formula G defines an isomorphism between $\mathcal{N}$ and $\widetilde{K}\widetilde{M}(\mathcal{N})$.

Friedman and Visser (2014); Oakden (2020)

Bi-Interpretability

$\mathcal{M}^s$	string model of *laughed*
$\mathcal{M}^g$	coupling graph model of *laughed*
Γ^{sg}	string to coupling graph transduction
Γ^{gs}	coupling graph to string transduction

- $\mathcal{M}^s \equiv \Gamma^{gs}(\Gamma^{sg}(\mathcal{M}^s))$
- $\mathcal{M}^g \equiv \Gamma^{sg}(\Gamma^{gs}(\mathcal{M}^g))$
- This indicates the string and coupling graph models are **bi-interpretable**

Friedman and Visser (2014); Oakden (2020)

Conclusion

It’s symbols all the way down

Thus we are referring to the same set of dynamically specified gestures, but this time using symbols which serve as indices to entire dynamical systems. **These symbolic descriptions highlight those aspects of the gestural structures that are relevant for contrast among lexical items”** *(p. 241)*.

Browman and Goldstein (1986)

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- But the coupling graph to string translation is novel (as far as I'm aware).

Saltzman (2001)

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- Can we change the representations slightly to write a QF transduction?

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  - AP coupling graphs already contain all the necessary phonetic information.
  - Strings must be further transformed somehow (but we've seen that's not too difficult to do 😎).

Thank You!

Bibliography I

Archangeli, D. (1988). Aspects of underspecification theory. Phonology, 5(2):183–207.

Bateman, N. (2007). A crosslinguistic investigation of palatalization. University of California, San Diego.

Browman, C. P. and Goldstein, L. (1992). Articulatory phonology: An overview. Phonetica, 49(3-4):155–180.

Browman, C. P. and Goldstein, L. (1995). Dynamics and articulatory phonology. Mind as motion, 175:193.

Browman, C. P. and Goldstein, L. M. (1986). Towards an articulatory phonology. Phonology, 3:219–252.

Chadwick, S. (2021). A Computational Analysis for Articulatory Phonology: A Duel Example with the Phonotactic Properties of Rhotic Consonants in English. PhD thesis, Stony Brook University.

Clements, G. N. (1985). The geometry of phonological features. Phonology, 2(1):225–252.

Courcelle, B. (1994). Monadic second-order definable graph transductions: a survey. Theoretical Computer Science, 126(1):53–75.

Davidson, L. (2004). The atoms of phonological representation: Gestures, coordination and perceptual features in consonant cluster phonotactics. The Johns Hopkins University.

Dresher, B. E. (2009). The contrastive hierarchy in phonology. Number 121. Cambridge University Press.

Engelfriet, J. and Hoogeboom, H. J. (2001). MSO definable string transductions and two-way finite-state transducers. ACM Transactions on Computational Logic (TOCL), 2(2):216–254.

Friedman, H. M. and Visser, A. (2014). When bi-interpretability implies synonymy. Logic Group Preprint Series, 320:1–19.

Gafos, A. I. (2002). A grammar of gestural coordination. Natural language & linguistic theory, 20(2):269–337.

Goldsmith, J. A. (1976). Autosegmental phonology. PhD thesis, Massachusetts Institute of Technology.

Goldstein, L. (2011). Back to the past tense in english. In Representing language: Essays in honor of Judith Aissen, pages 69–88.

Hall, N. E. (2003). Gestures and segments: Vowel intrusion as overlap. University of Massachusetts Amherst.

Inkelas, S. and Shih, S. S. (2016). Re-representing phonology: consequences of q theory. In Proceedings of NELS, volume 46, pages 161–174.

Jardine, A., Danis, N., and Iacoponi, L. (2021). A formal investigation of q-theory in comparison to autosegmental representations. Linguistic Inquiry, 52(2):333–358.

McMahon, A., Foulkes, P., and Tollfree, L. (1994). Gestural representation and lexical phonology. Phonology, 11(2):277–316.

Nam, H. (2007). A gestural coupling model of syllable structure. PhD thesis, Yale University.

Nelson, S. (2022). A model theoretic perspective on phonological feature systems. Proceedings of the Society for Computation in Linguistics, 5(1).

Oakden, C. (2020). Notational equivalence in tonal geometry. Phonology, 37(2):257–296.

Saltzman, E. (2001). Tada (task dynamics application) manual.

Strother-Garcia, K. (2019). Using model theory in phonology: a novel characterization of syllable structure and syllabification. PhD thesis, University of Delaware.

Zsiga, E. C. (1997). Features, gestures, and igbo vowels: An approach to the phonology-phonetics interface. Language, pages 227–274.