Objectives:

- **Use factorial typology to predict possible languages**
- **Consider implications of syllable-structure analysis in OT**

Background preparation:

- *Exercise - Constraint rankings & their predictions*

0. Today's plan

- OT check-in

- Factorial typology:
  The predictions of a constraint *set*

- Factorial typology of basic syllable structure

- Comparing models:
  Syllable structure with OT vs. rules

1. OT check-in

- How do we use an OT tableau to **figure out the constraint ranking** in a particular language (working from a data set)?

    - What do we know?

    - What do we need to figure out?

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    → the **winning output**; the **input** (proposed)

  - What do we need to figure out?

    → how the constraints are **ranked**

    How do we do this?

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  - What do we know?

    → the **winning output**; the **input** (proposed)

  - What do we need to figure out?

    → how the constraints are **ranked**

    How do we do this?

    - find informative losers
    - make valid ranking arguments (add W/L!)

1. OT check-in

- How do we use an OT tableau to **predict which output candidate wins** for a certain input in a certain language (whose grammar we know)?
  - What do we know?

  - What do we need to figure out?

1. OT check-in

- How do we use an OT tableau to **predict which output candidate wins** for a certain input in a certain language (whose grammar we know)?
  - What do we know?
    → the constraint **ranking**; the **input** of interest

  - What do we need to figure out?
    → which **output candidate** is optimal ("the best") according to the ranking
    How do we do this?
      - Try the **faithful** output (looks like the input)
      - What other candidates lead to **conflict**?

1. OT check-in

- How do we use a tableau to **predict** the output, given the ranking and the input?

- Do we add W/L marks as part of figuring this out?

- Which output wins, if A » B » C?

/input/	A	B	C
(a) *faithful output*	*		
(b) output2		*	*
(c) output3		*	

1. OT check-in

- How do we use a tableau to **predict** the output, given the ranking and the input? (No W/L this time!)

- Which output wins, if A » B » C?

/input/	A	B	C
(a) *faithful output*	*!		
(b) output2		*	*!
→ **(c) output3**		*	

- Optional: Use '!' when the ranking is **known**, to show what violation **makes** a candidate lose

2. Factorial typology

- In OT, because the **constraints are universal**...

  - whenever we propose a constraint in the analysis of one language,

  - we are automatically proposing that this constraint is found in all languages

- Consider the **typological implications** of a constraint we are using in an analysis:

  - If this constraint is found in all languages,

  - and could potentially be ranked high or low,

  - are we making inaccurate **predictions**?
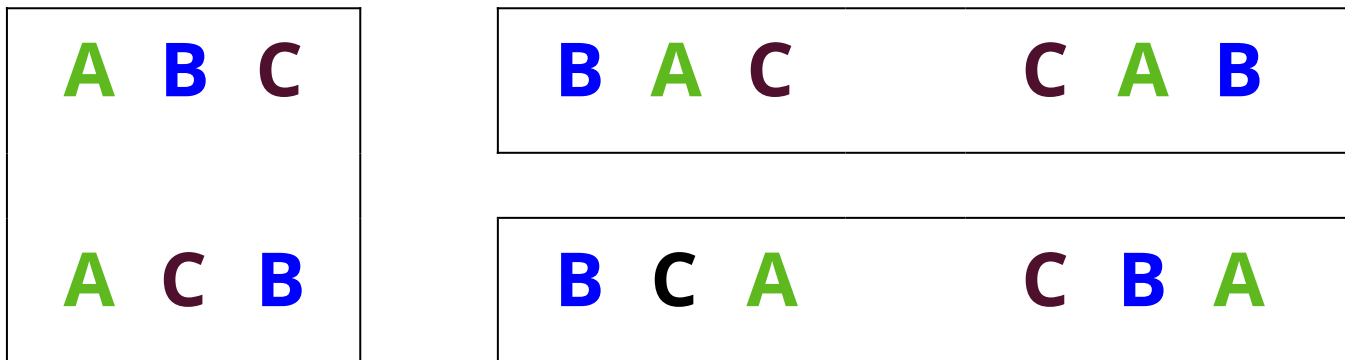
2. Factorial typology

- How do we **test** the typological implications (=predictions) of a proposed set of constraints?

  - Consider **all possible rankings**
  - Consider *what kind* of language each ranking would predict
  - Evaluate whether such languages are plausible

- This is obviously a very large undertaking

  - Typically, we consider the predictions of a small set of relevant constraints at a time
  - (There is also OT analysis software to help with this!)

- How many **possible rankings** are there for a set of 3 constraints?

- How many **possible rankings** are there for a set of 3 constraints?

A B C	B A C C A B
A C B	B C A C B A

  - 3 * 2 * 1 = 6 rankings ('3 factorial')
  - $n * (n–1) * (n–2) * … * 1 = n!$ ('n factorial')

- The **list of all possible rankings** of a set of constraints is called the **'factorial typology'** of that set of constraints

3. Factorial typology of basic syllable structure

- Prep qns: <u>Constraint rankings and their predictions</u>
  - What are **all the rankings** of the mini constraint set NoEpenthesis, Onset, NoCoda?

- Prep qns: <u>Constraint rankings and their predictions</u>

  - **All the rankings** of NoEpenthesis, Onset, NoCoda?

1	Onset	»	NoCoda	»	NoEpenthesis
2	NoCoda	»	Onset	»	NoEpenthesis
3	NoEpenthesis	»	Onset	»	NoCoda
4	NoEpenthesis	»	NoCoda	»	Onset
5	Onset	»	NoEpenthesis	»	NoCoda
6	NoCoda	»	NoEpenthesis	»	Onset

  Group discussion | For your ranking:
  - Which **output** wins for **/abik/**? **/kamo/**?
  - Which **σ types** (CV, CVC, V, CV) are **allowed**?

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Debriefing

Questions we will now consider:

- **Which output** wins for **/abik/** under each ranking? What about **/kamo/**?

  - What "kind of language" does each ranking produce? (generalizations about σ structure)

- Are all the **predicted language types** plausible?

  - What are the actual cross-linguistic facts about onsets and codas?

3. Factorial typology of basic syllable structure

- What violations are assigned to each of these candidates? (dashed lines = constraints not ranked)

  - Do we predict different outcomes in different languages?

/abik/	NoEpenth	Onset	NoCoda
(a) a.bik			
(b) a.bi.kə			
(c) ta.bik			
(d) ta.bi.kə			

3. Factorial typology of basic syllable structure

- What violations are assigned to each of these candidates? (dashed lines = constraints not ranked)

  - Do we predict different outcomes in different languages?

/abik/	NoEpenth	Onset	NoCoda
(a) a.bik		*	*
(b) a.bi.kə	*	*	
(c) ta.bik	*		*
(d) ta.bi.kə	**		

3. Factorial typology of basic syllable structure

- What violations are assigned to each of these candidates? (dashed lines = constraints not ranked)
  - Do we predict different outcomes in different languages?

/kamo/	NoEpenth	Onset	NoCoda
(a) ka.mo			
(b) kam.o			
(c) ə.ka.mo			
(d) ka.mot			

3. Factorial typology of basic syllable structure

- What violations are assigned to each of these candidates? (dashed lines = constraints not ranked)

  - Do we predict different outcomes in different languages?

/kamo/	NoEpenth	Onset	NoCoda
(a) ka.mo			
(b) kam.o		*	*
(c) ə.ka.mo	*	*	
(d) ka.mot	*		*

- Which output wins for /abik/ under this ranking?

1) O<small>NSET</small> » N<small>O</small>C<small>ODA</small> » N<small>O</small>E<small>PENTHESIS</small>

/abik/	ONSET	NOCODA	NOEPENTH
(a) a.bik	*	*	
(b) a.bi.kə	*		*
(c) ta.bik		*	*
(d) ta.bi.kə			**

- Which output wins for /abik/ under this ranking?

1) ONSET » NOCODA » NOEPENTHESIS   /abik/ → [ta.bi.kə]

/abik/		ONSET	NOCODA	NOEPENTH
(a)	a.bik	*!	*	
(b)	a.bi.kə	*!		*
(c)	ta.bik		*!	*
→ (d)	ta.bi.kə			**

3. Factorial typology of basic syllable structure

- Which output wins for /abik/ under this ranking?

2) NoCoda » Onset » NoEpenthesis

/abik/	NoCoda	Onset	NoEpenth
(a) a.bik	*	*	
(b) a.bi.kə		*	*
(c) ta.bik	*		*
(d) ta.bi.kə			**

3. Factorial typology of basic syllable structure

- Which output wins for /abik/ under this ranking?

2) NoCoda » Onset » NoEpenthesis   /abik/ → [ta.bi.kə]

/abik/		NoCoda	Onset	NoEpenth
(a)	a.bik	*!	*	
(b)	a.bi.kə		*!	*
(c)	ta.bik	*!		*
→ (d)	ta.bi.kə			**

3. Factorial typology of basic syllable structure

- Which output wins for /abik/ under this ranking?

3) NoEpenthesis » Onset » NoCoda

/abik/	NoEpenth	Onset	NoCoda
(a) a.bik		*	*
(b) a.bi.kə	*	*	
(c) ta.bik	*		*
(d) ta.bi.kə	**		

3. Factorial typology of basic syllable structure

- Which output wins for /abik/ under this ranking?

3) NOEPENTHESIS » ONSET » NOCODA   /abik/ → [a.bik]

/abik/	NOEPENTH	ONSET	NOCODA
→ (a) a.bik		*	*
(b) a.bi.kə	*!	*	
(c) ta.bik	*!		*
(d) ta.bi.kə	*!*		

3. Factorial typology of basic syllable structure

- Which output wins for /abik/ under this ranking?

4) NoEpenthesis » NoCoda » Onset

/abik/	NoEpenth	NoCoda	Onset
(a) a.bik		*	*
(b) a.bi.kə	*		*
(c) ta.bik	*	*	
(d) ta.bi.kə	**		

3. Factorial typology of basic syllable structure

- Which output wins for /abik/ under this ranking?

4) NoEpenthesis » NoCoda » Onset   /abik/ → [a.bik]

/abik/		NoEpenth	NoCoda	Onset
→ (a)	a.bik		*	*
(b)	a.bi.kə	*!		*
(c)	ta.bik	*!	*	
(d)	ta.bi.kə	*!*		

- Which output wins for /abik/ under this ranking?

5) ONSET » NOEPENTHESIS » NOCODA

/abik/		ONSET	NOEPENTH	NOCODA
(a)	a.bik	*		*
(b)	a.bi.kə	*	*	
(c)	ta.bik		*	*
(d)	ta.bi.kə		**	

3. Factorial typology of basic syllable structure

- Which output wins for /abik/ under this ranking?

5) O<small>NSET</small> » N<small>O</small>E<small>PENTHESIS</small> » N<small>O</small>C<small>ODA</small>   /abik/ → [ta.bik]

/abik/		ONSET	NOEPENTH	NOCODA
(a)	a.bik	*!		*
(b)	a.bi.kə	*!	*	
→ (c)	ta.bik		*	*
(d)	ta.bi.kə		**!	

- Which output wins for /abik/ under this ranking?

6) NoCoda » NoEpenthesis » Onset

/abik/	NoCoda	NoEpenth	Onset
(a) a.bik	*		*
(b) a.bi.kə		*	*
(c) ta.bik	*	*	
(d) ta.bi.kə		**	

- Which output wins for /abik/ under this ranking?

6) NoCoda » NoEpenthesis » Onset   /abik/ → [a.bi.kə]

/abik/		NoCoda	NoEpenth	Onset
(a)	a.bik	*!		*
→ (b)	a.bi.kə		*	*
(c)	ta.bik	*!	*	
(d)	ta.bi.kə		**!	

- Which output wins for /abik/ under each ranking?

1 ONSET » NOCODA » NOEPENTH   /abik/ → [ta.bi.kə]
2 NOCODA » ONSET » NOEPENTH   /abik/ → [ta.bi.kə]

3 NOEPENTH » ONSET » NOCODA   /abik/ → [a.bik]
4 NOEPENTH » NOCODA » ONSET   /abik/ → [a.bik]

5 ONSET » NOEPENTH » NOCODA   /abik/ → [ta.bik]

6 NOCODA » NOEPENTH » ONSET   /abik/ → [a.bi.kə]

- Which output wins for /abik/ under these rankings?

  1 O$_\text{NSET}$ » N$_\text{O}$C$_\text{ODA}$ » N$_\text{O}$E$_\text{PENTH}$ /abik/ → [ta.bi.kə]

  2 N$_\text{O}$C$_\text{ODA}$ » O$_\text{NSET}$ » N$_\text{O}$E$_\text{PENTH}$ /abik/ → [ta.bi.kə]

- What generalizations can we make about syllable structure options for a language with this pattern?

3. Factorial typology of basic syllable structure

- Which output wins for /abik/ under these rankings?

  1   Onset » NoCoda » NoEpenth   /abik/ → [ta.bi.kə]

  2   NoCoda » Onset » NoEpenth   /abik/ → [ta.bi.kə]

- What generalizations can we make about syllable structure options for a language with this pattern?
  - Onsetless syllables are forbidden
  - Codas are forbidden

3. Factorial typology of basic syllable structure

- Which output wins for /abik/ under these rankings?

    3   N<small>O</small>E<small>PENTH</small> » O<small>NSET</small> » N<small>O</small>C<small>ODA</small>   /abik/ → [a.bik]

    4   N<small>O</small>E<small>PENTH</small> » N<small>O</small>C<small>ODA</small> » O<small>NSET</small>   /abik/ → [a.bik]

- What generalizations can we make about syllable structure options for a language with this pattern?

3. Factorial typology of basic syllable structure

- Which output wins for /abik/ under these rankings?

  3 NoEpenth » Onset » NoCoda   /abik/ → [a.bik]

  4 NoEpenth » NoCoda » Onset   /abik/ → [a.bik]

- What generalizations can we make about syllable structure options for a language with this pattern?

  - Onsetless syllables are allowed
  - Codas are allowed

3. Factorial typology of basic syllable structure

- Which output wins for /abik/ under this ranking?

  5   Onset » NoEpenth » NoCoda   /abik/ → [ta.bik]

- What generalizations can we make about syllable structure options for a language with this pattern?

3. Factorial typology of basic syllable structure

- Which output wins for /abik/ under this ranking?

  5   Onset » NoEpenth » NoCoda   /abik/ → [ta.bik]

- What generalizations can we make about syllable structure options for a language with this pattern?
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3. Factorial typology of basic syllable structure

- Which output wins for /abik/ under each ranking?

  6   NoCoda » NoEpenth » Onset   /abik/ → [a.bi.kə]

- What generalizations can we make about syllable structure options?

3. Factorial typology of basic syllable structure

- Which output wins for /abik/ under each ranking?

  6   NoCoda » NoEpenth » Onset   /abik/ → [a.bi.kə]

- What generalizations can we make about syllable structure options?

  - Onsetless syllables are allowed
  - Codas are forbidden

3. Factorial typology of basic syllable structure

- Are the predictions of our constraint set plausible?

Ranking	Onsets?	Codas?
1 ONSET » NOCODA » NOEP 2 NOCODA » ONSET » NOEP	required	forbidden
3 NOEP » ONSET » NOCODA 4 NOEP » NOCODA » ONSET	not required	not forbidden
5 ONSET » NOEP » NOCODA	required	not forbidden
6 NOCODA » NOEP » ONSET	not required	forbidden

3. Factorial typology of basic syllable structure

- Are the predictions of our constraint set plausible?

Ranking	Onsets?	Codas?
1 Onset » NoCoda » NoEp 2 NoCoda » Onset » NoEp	required	forbidden
3 NoEp » Onset » NoCoda 4 NoEp » NoCoda » Onset	not required	not forbidden
5 Onset » NoEp » NoCoda	required	not forbidden
6 NoCoda » NoEp » Onset	not required	forbidden

- Yes! Onsets can be required; codas can be banned; no language *bans* onsets, *requires* codas

3. Factorial typology of basic syllable structure

- Are the predictions of our constraint set plausible?

  - Yes! Onsets can be required; codas can be banned; no language *bans* onsets, *requires* codas

- Of course, we have to take into account NoDELETION as well — some languages that enforce onsets or ban codas do so via deletion instead of epenthesis

  - Checking that by hand would require that we look at 4! = 24 grammars, not just 6

- Ways to do an **approximate** check on the factorial-typology predictions of a **larger** constraint set

  - Consider what would happen *if each constraint were the highest ranked*

    - Example: If we propose a "HAVECODA" constraint, it will make bad predictions

  - Consider what would happen we switch the rankings of *just the faithfulness constraints* or *just the markedness constraints*

    - Example: Our 6 grammars, but with NODELETION *ranked below* NOEPENTHESIS

- One more complication
  - Sometimes there is a ranking predicted by factorial typology that no **known** language **actually uses**

  - This can often be explained by factors related to **phonetics**, **child language acquisition**, and **historical change**
    - A ranking that children would never see evidence to learn (for phonetic reasons) would never arise in any language

- A key point of this discussion

  - **Every OT analysis** is also inherently **making typological predictions**
  - This makes the theory more interesting, and **places more restrictions on it**, compared to rule-based phonology

5. Comparing models—σ with OT vs. rules

- When we analyzed syllable structure before, there were two steps in our procedure:

  Step 1. Determine **what syllable structure is like** in the language we are analyzing.

  - How did we do this before?

  - Does this need to change when we use OT?

- When we analyzed syllable structure before, there were two steps in our procedure:

  Step 1. Determine **what syllable structure is like** in the language we are analyzing.

  - We used **phonological evidence** from the data set to determine the "syllable-structure options"
    - What is a legal nucleus? Are onsets required? Are codas allowed? Are there onset or coda clusters?

  - Does this need to change when we use OT?

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  Step 1. Determine **what syllable structure is like** in the language we are analyzing.

  - We used **phonological evidence** from the data set to determine the "syllable-structure options"

    - What is a legal nucleus? Are onsets required? Are codas allowed? Are there onset or coda clusters?

  > **Step 1 does not change in OT.** We still need to use phonological evidence to make proposals about syllable structure in each language.

- When we analyzed syllable structure before, there were two steps in our procedure:

   Step 2. Make our **model of the mental grammar** produce the appropriate syllable structure for the language we are analyzing.
   - How did we do this before?
   - Does this need to change when we use OT?

5. Comparing models—σ with OT vs. rules

- When we analyzed syllable structure before, there were two steps in our procedure:

  Step 2. Make our **model of the mental grammar** produce the appropriate syllable structure for the language we are analyzing.

  - Originally, we took care of Step 2 by means of three **syllable-building rules**: the Nucleus Rule, the Onset Rule, and the Coda Rule

  - Does this need to change when we use OT?

5. Comparing models—σ with OT vs. rules

- When we analyzed syllable structure before, there were two steps in our procedure:

  Step 2. Make our **model of the mental grammar** produce the appropriate syllable structure for the language we are analyzing.

  - Originally, we took care of Step 2 by means of three **syllable-building rules**: the Nucleus Rule, the Onset Rule, and the Coda Rule

  > **OT does not use rules**→we don't use these now! We **rank constraints** such as O<small>NSET</small>, N<small>O</small>C<small>ODA</small>, etc., to **choose the right output** candidate

5. Comparing models—σ with OT vs. rules

- What is the status of the "syllable-structure options" in the two models?
    - "Syllable-structure options" = What is a legal nucleus? Are onsets required? Are codas allowed? Are there onset or coda clusters?

5. Comparing models—σ with OT vs. rules

- What is the status of the "syllable-structure options" in the two models?

  - "Syllable-structure options" = What is a legal nucleus? Are onsets required? Are codas allowed? Are there onset or coda clusters?

- Rule-based model: These "options" needed to be in the model, to stop syllable-building rules from applying (but how did that actually work?!)

- OT model: **Now these "options" are not themselves in the model!** (Whew.) They just help us summarize the facts about the world

5. Comparing models—σ with OT vs. rules

- Languages always syllabify [V.CV] and never [VC.V]
    - How did we make our rule-based model do this?
    - How do we make this happen in OT?

- Languages always syllabify [V.CV] and never [VC.V]
  - How did we make our rule-based model do this?
  - > We said that the Onset Rule had to apply *earlier than* the Coda Rule **in all languages**
    - This is unusual — rule ordering is usually language-specific

  - How do we make this happen in OT?
  - > The answer is a little surprising!

- Languages always syllabify [V.CV] and never [VC.V]
  - How do we make this happen in OT?

/kamo/	Oɴsᴇᴛ	NᴏCᴏᴅᴀ
(a) [ka.mo]		
(b) [kam.o]	*	*

  - Does Oɴsᴇᴛ have to be **ranked above** NᴏCᴏᴅᴀ for [ka.mo] to win?

5. Syllable-structure analysis—OT vs. rules

- Languages always syllabify [V.CV] and never [VC.V]
    - How do we make this happen in OT?

/kamo/	ONSET	NOCODA
→ **(a)** **[ka.mo]**		
(b) [kam.o]	*	*

- Does ONSET have to be **ranked above** NOCODA for [ka.mo] to win? No! If we have a constraint set that *has* ONSET and NOCODA — and not the reverse constraints — then [V.CV] *always* beats [VC.V]

5. Syllable-structure analysis—OT vs. rules

Summary: Model comparisons

- The role of the syllable-structure "options"

  - Rule-based model: needed to formalize them in order to have universal syllable-building rules, but unclear how!
  - OT model: doesn't need to formalize them; different rankings of universal constraints get the right patterns

- Universal choice of [V.CV] over *[VC.V]

  - Rule-based model: Arbitrary stipulation that Onset Rule precedes Coda Rule
  - OT model: No arbitrary ranking between O~NSET~, N~O~C~ODA~
    - Deeper qn: Why have O~NSET~, N~O~C~ODA~ as constraints?

6. General questions or concerns about OT?

- Any thoughts, questions, or concerns about this new view of the phonological mental grammar?