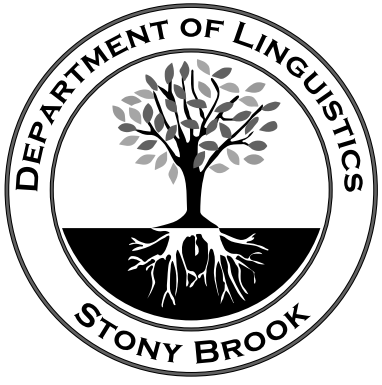
Subregular Tree Transductions, Movement, Copies, Traces, and the Ban on Improper Movement

(most succinct title ever)

Thomas Graf



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The talk in a nutshell

- Movement is **tier-based strictly local (TSL)**.
  1. as a syntactic dependency (Graf 2018)
  2. as a structure building operation (this talk)
- There's some interesting wrinkles.
  - **conceptual:** copies (often) easier than traces
  - **empirical:** natural languages obey additional conditions that are needed for traces/linearization

Formal core contribution

Input-strictly local tree-to-tree transductions with lexical TSL tests (ISL[lexTSL])

Linguistic core contribution

Output-oriented
Ban on Improper Movement (OOBoIM)

Outline

1. Movement is local over tiers
2. Subregular transductions for syntax
   - ISL transductions for Merge
   - Adding tiers for movement
3. The challenge of linearization
4. Extra stuff for the MG nerds

Overall framework

- **Subregular program**
  - identify subclasses of finite-state machinery over strings & trees for phenomena in phonology, morphology, syntax, semantics (Heinz 2018; Chandlee 2022; Graf 2022a,b)
  - TSL an important subregular class

Jeff Heinz

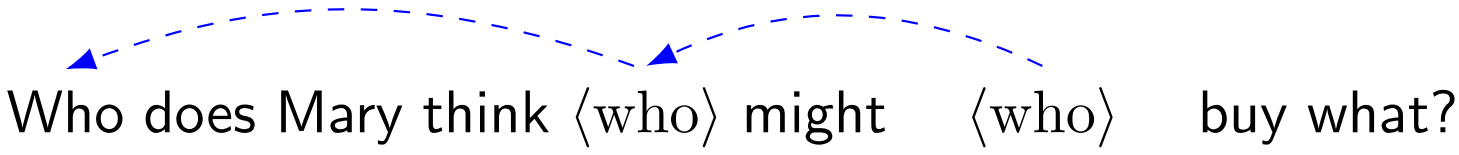
- **Minimalist grammars (MGs)**
  - formalization of Minimalist syntax (Stabler 1997, 2011)
  - allows us to stick closely to syntactic proposals
  - subregular syntax uses a modified version (sets of licensee features, not strings)

Ed Stabler

Minimalist grammars and movement

Who does Mary think might buy what?

Minimalist grammars and movement



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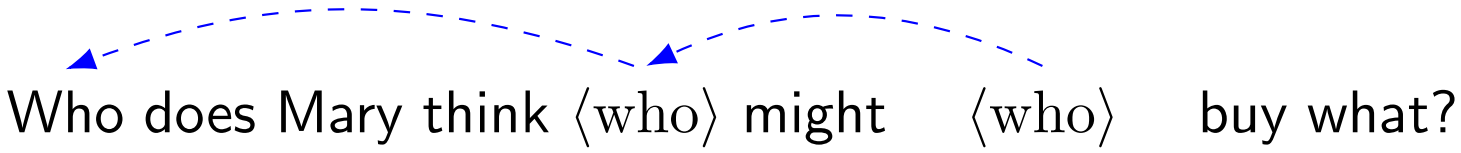

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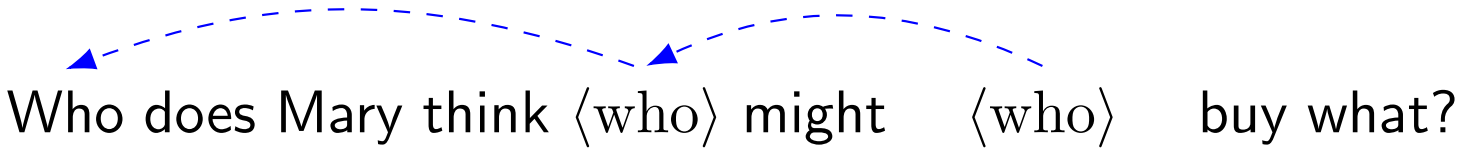

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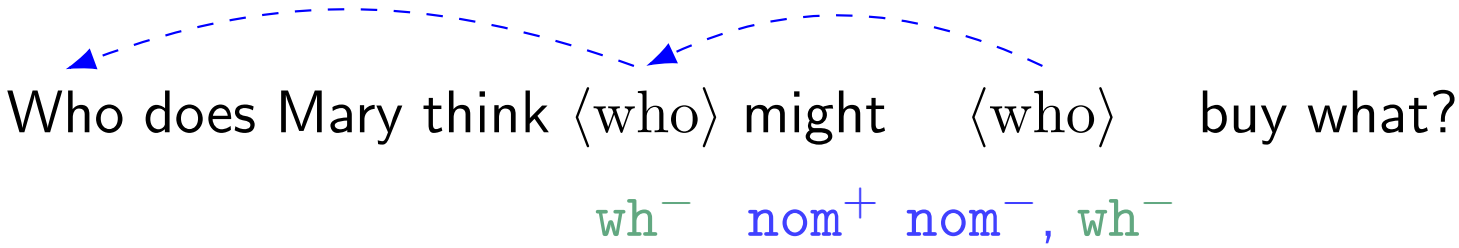

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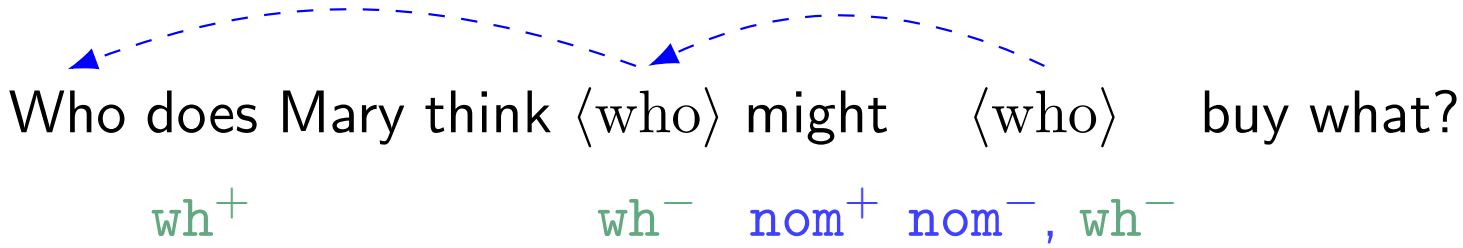

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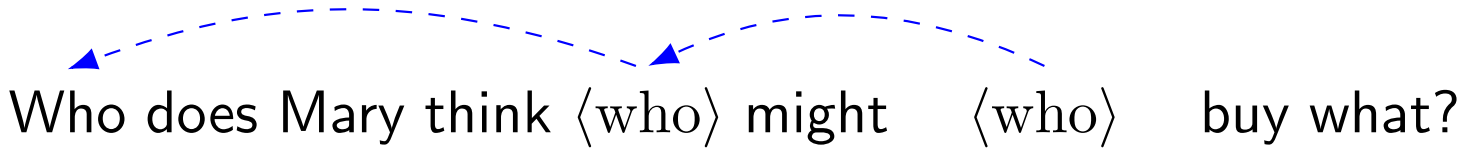
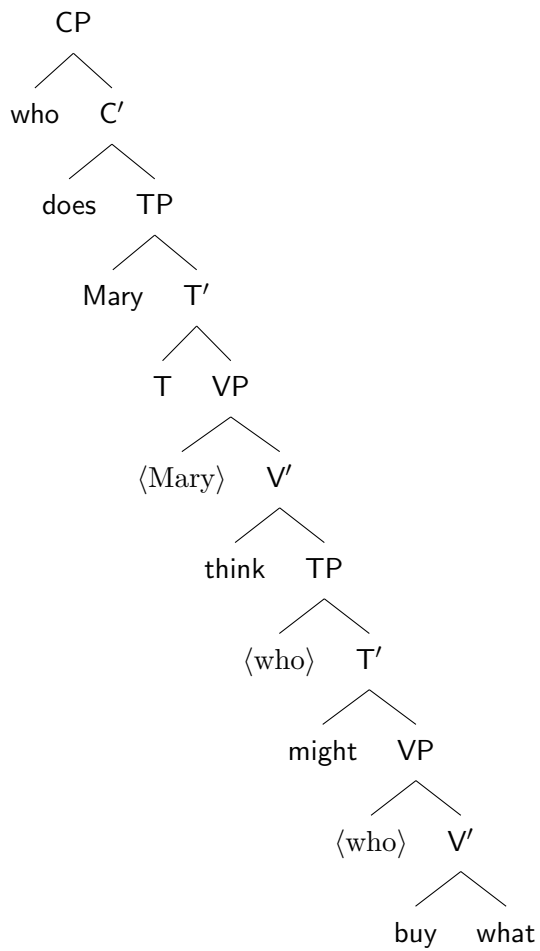


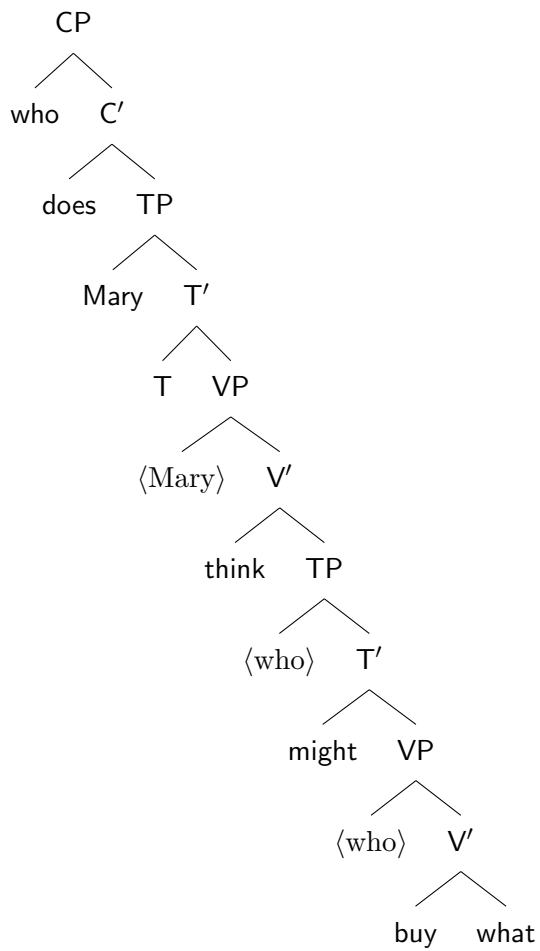
$\texttt{wh}^+$ $\texttt{wh}^-$ $\texttt{nom}^+$ $\texttt{nom}^-$, $\texttt{wh}^-$

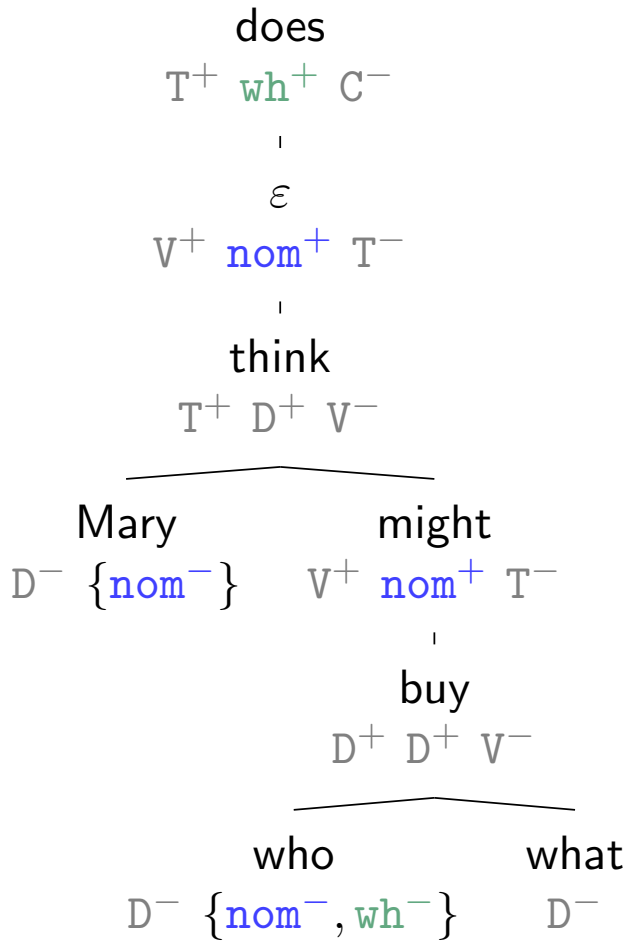


Minimalist grammars and movement

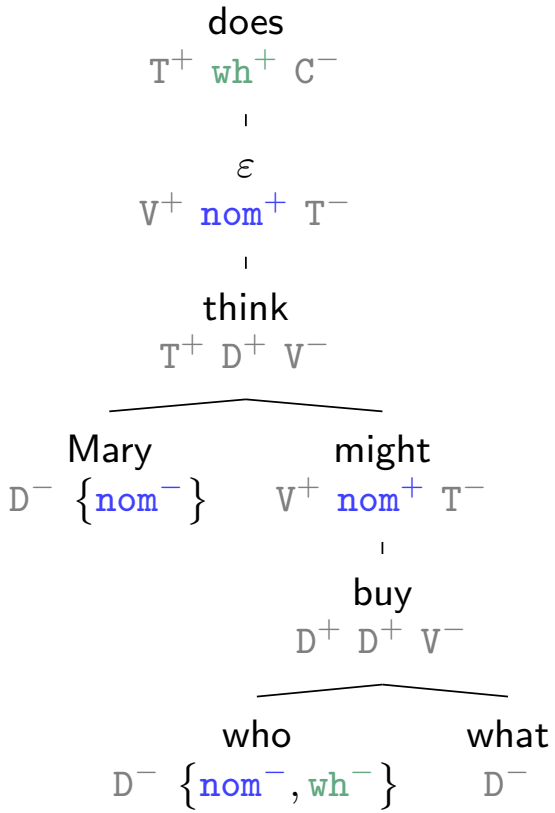
Who does Mary think ⟨who⟩ might ⟨who⟩ buy what?

$\texttt{wh}^+$ $\texttt{wh}^-$ $\texttt{nom}^+$ $\texttt{nom}^-$, $\texttt{wh}^-$



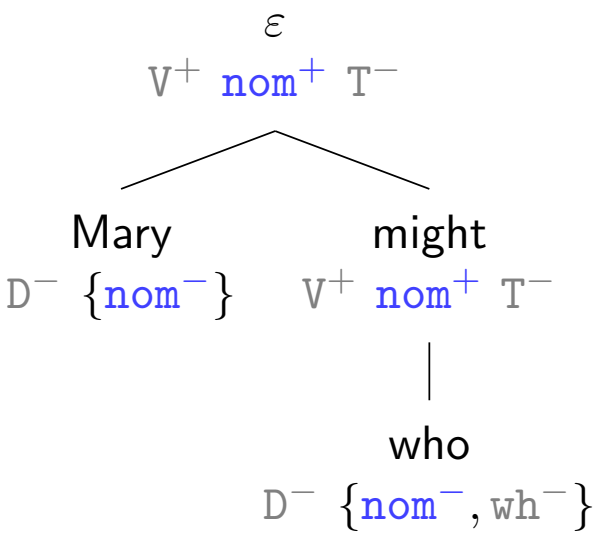


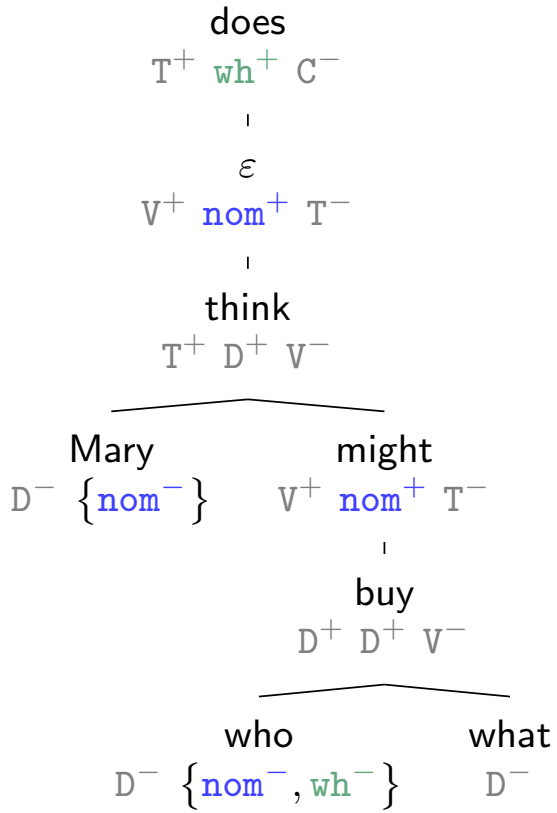
Movement in MGs is tier-based strictly local (TSL)



Movement in MGs is tier-based strictly local (TSL)

nom-tier





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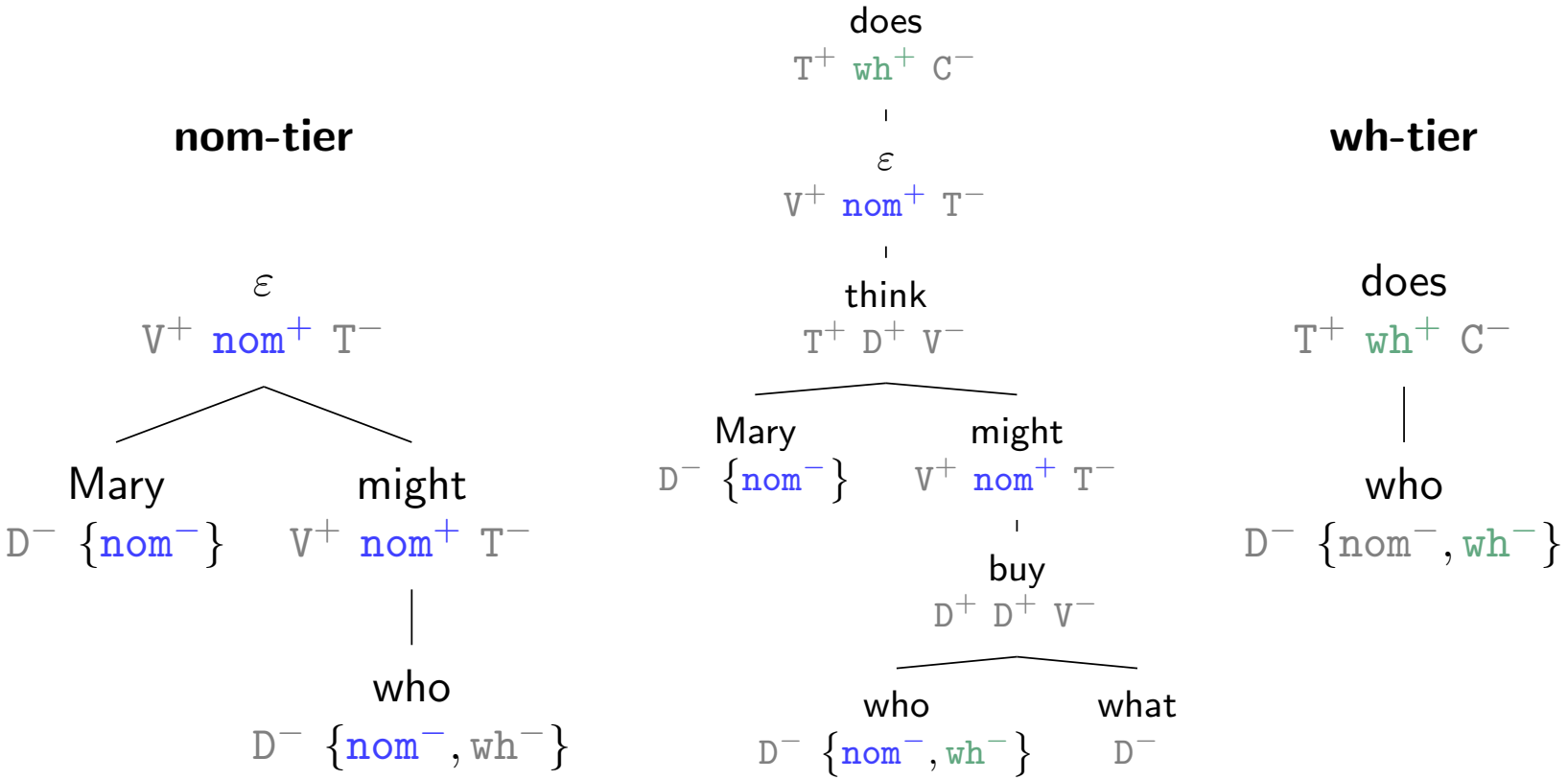

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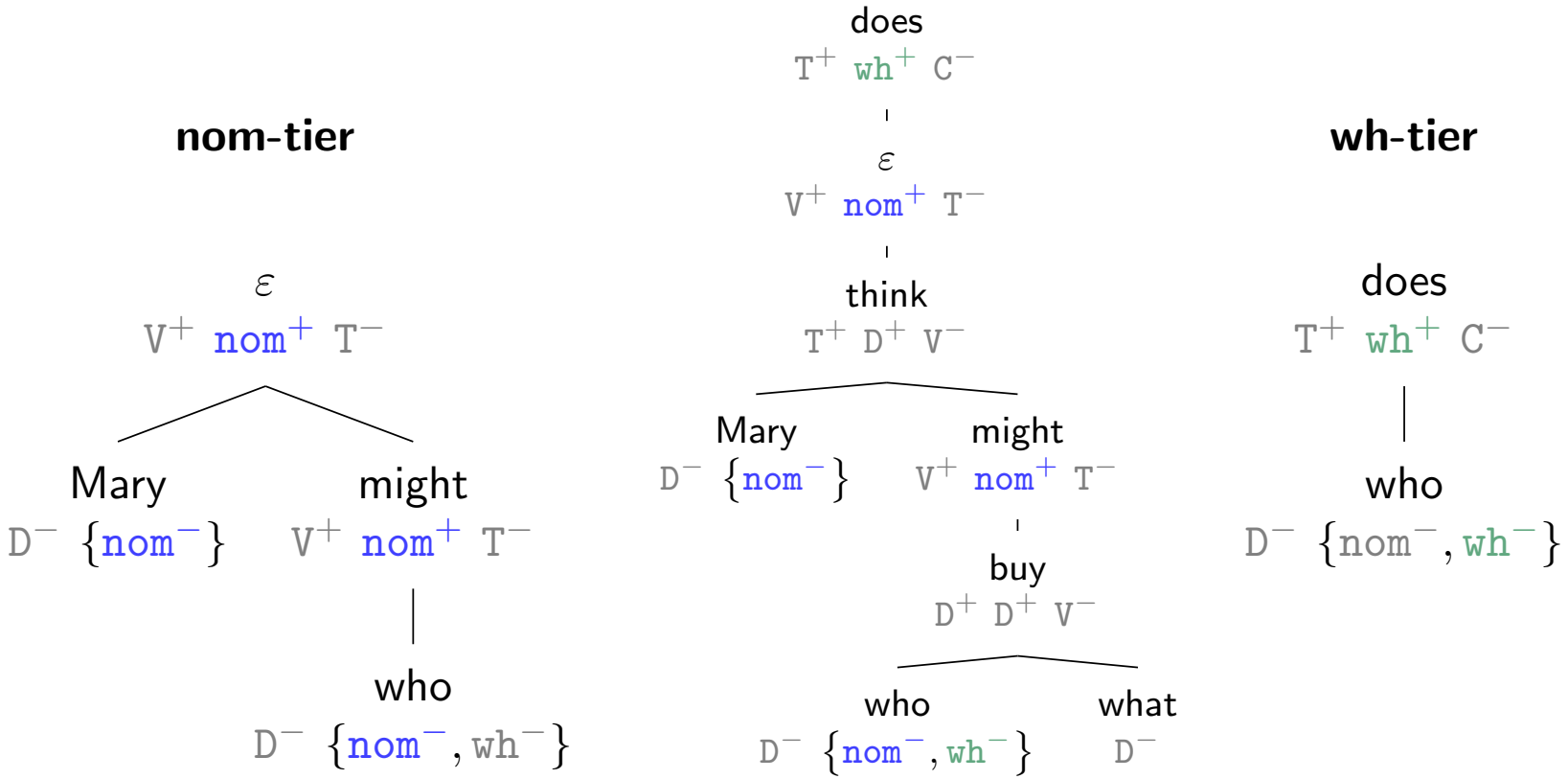


Feature checking as a constraint on each f-tier

1. Every f^+ has **exactly 1** f^- among its daughters.
2. Every f^- has f^+ **as its mother**.

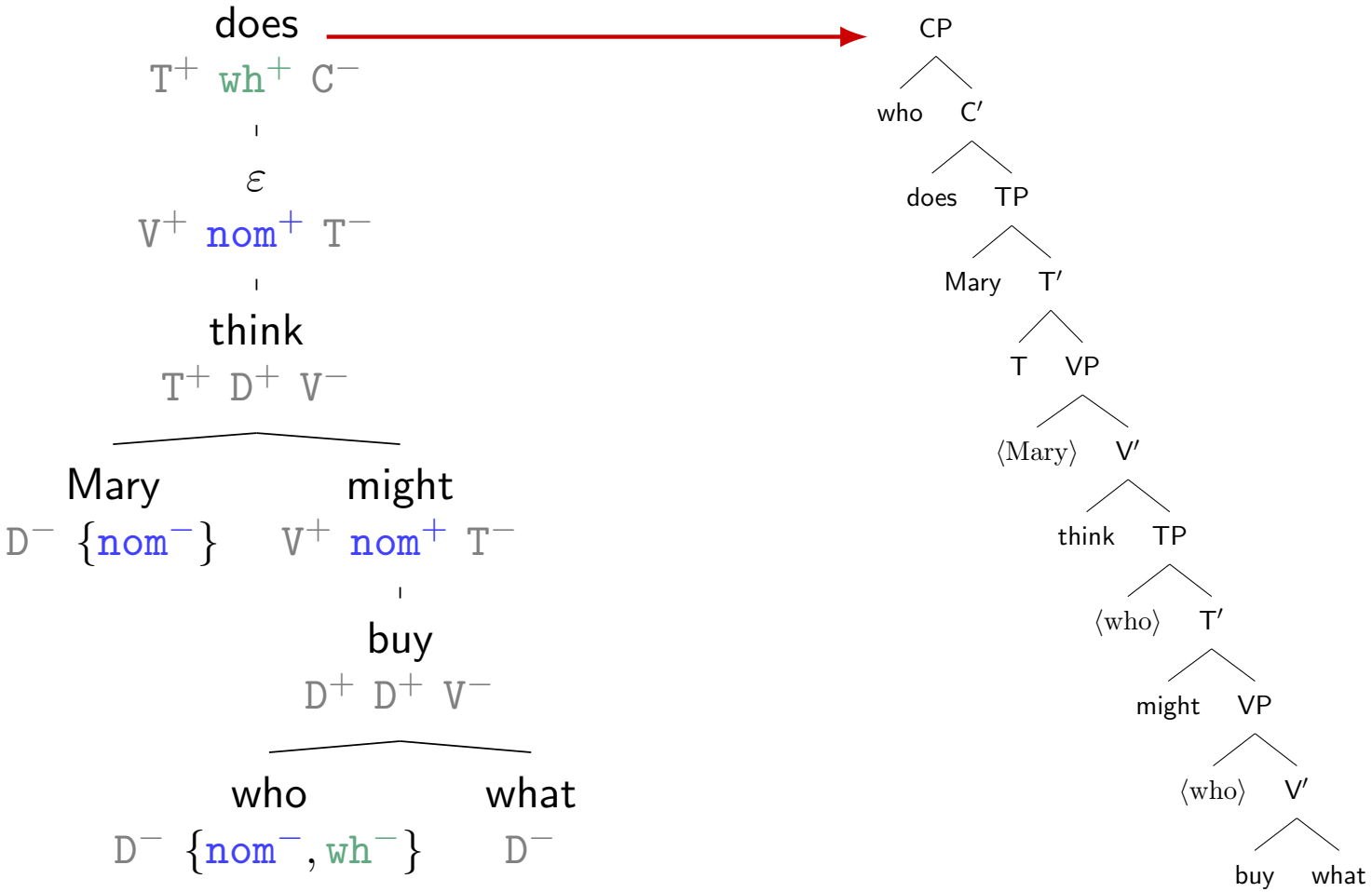
Who cares?

All of this is part of **a bigger program**.

1. **Learning**
   exploit subregular restrictions for new learning algorithms
   string extension learning, BUFIA
2. **Typology**
   explain crosslinguistic absence of certain types of patterns
   no "cowardly" island effects
3. **Universals**
   derive old/new universals from limits of machinery
   ISL-recoverability of category features, OOBoIM
4. **Theoretical unification**
   unify seemingly unrelated patterns
   vowel harmony & extraction morphology
5. **Cognitive parallelism**
   computational common core across language modules
   central role of SL and TSL

An incomplete picture

Movement isn't just a syntactic dependency, it **affects the output**.



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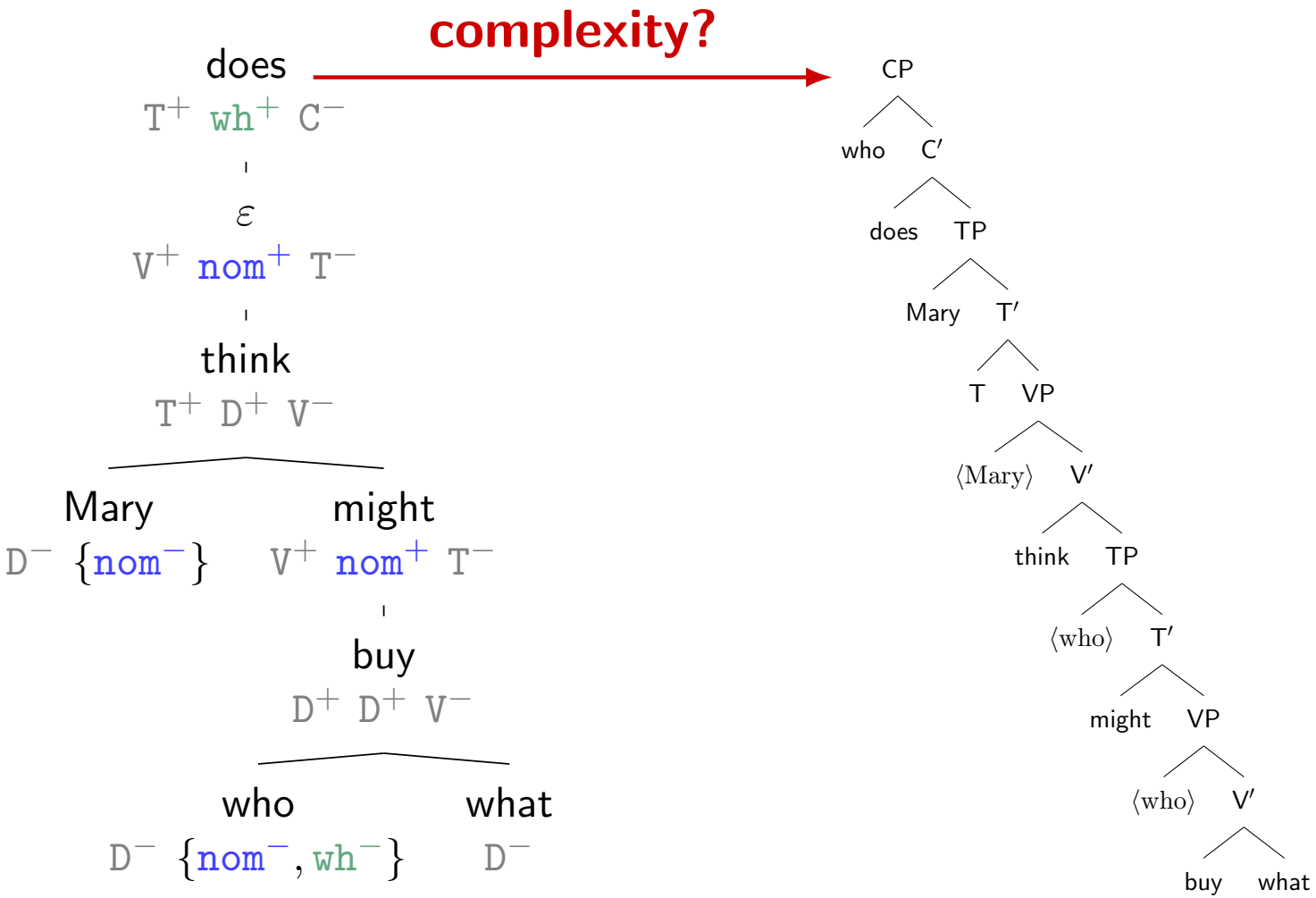


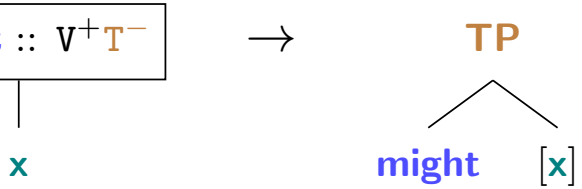
Phrase structure trees without movement

no movement $\Rightarrow$ easy translation to phrase structure trees

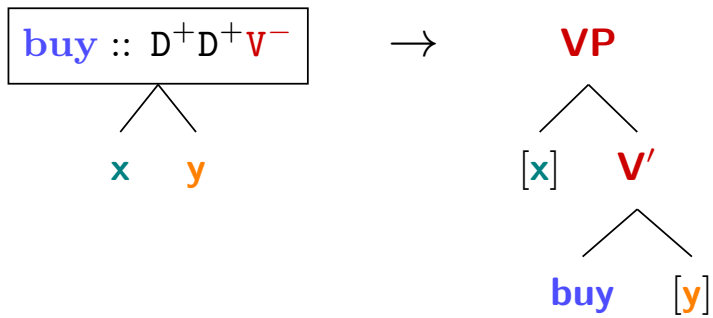
who :: $\mathtt{D}^-$ $\rightarrow$ who

what :: $\mathtt{D}^-$ $\rightarrow$ what

might :: $\mathtt{V}^+\mathtt{T}^-$ $\rightarrow$



buy :: $\mathtt{D}^+\mathtt{D}^+\mathtt{V}^-$ $\rightarrow$



Phrase structure trees without movement

no movement ⇒ easy translation to phrase structure trees

who :: D⁻ → who

what :: D⁻ → what

might :: V⁺T⁻ → TP

x

might [x]

buy :: D⁺D⁺V⁻ → VP

x y

[x] V′

buy [y]

might
V⁺ T⁻
|
buy
D⁺ D⁺ V⁻
who what
D⁻ D⁻

Phrase structure trees without movement

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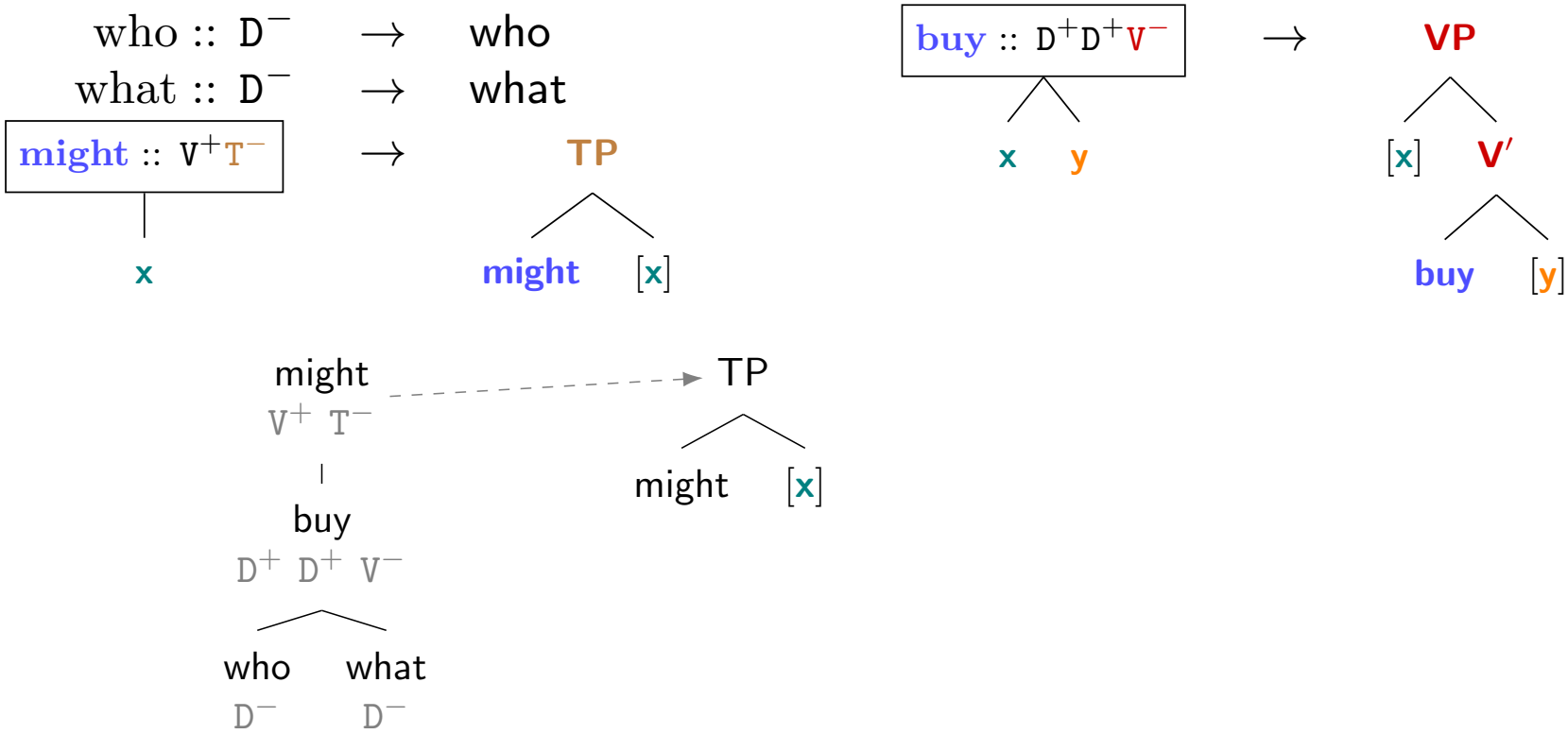


Phrase structure trees without movement

no movement ⇒ easy translation to phrase structure trees

who :: D^- → who

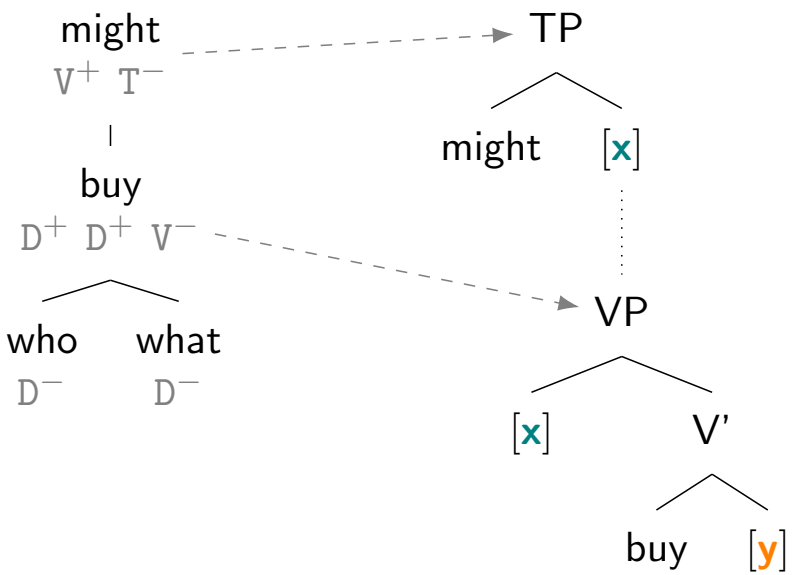
what :: D^- → what

might :: V^+T^- → TP

x — might [x]

buy :: $D^+D^+V^-$ → VP

x y — [x] V′ — buy [y]



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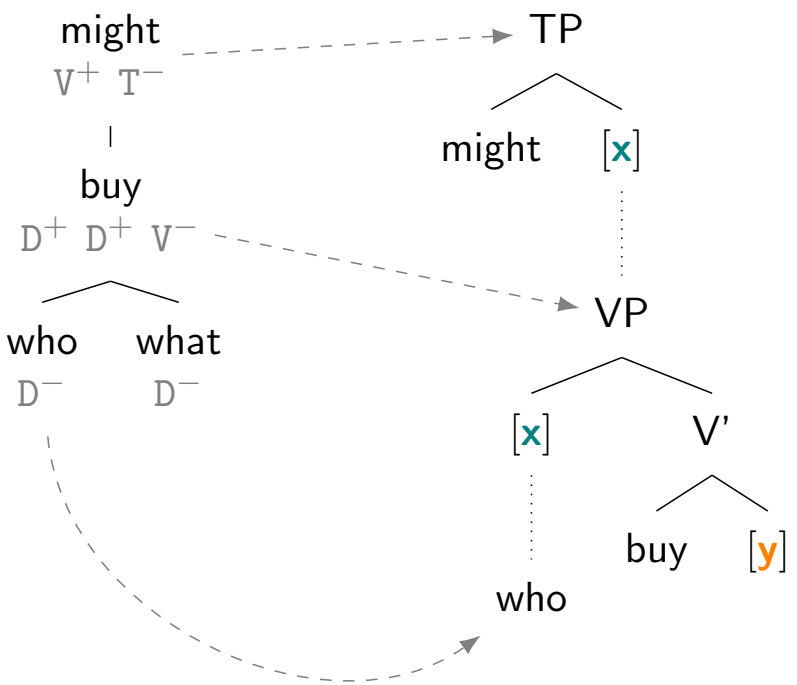
x y → [x] V′

buy [y]



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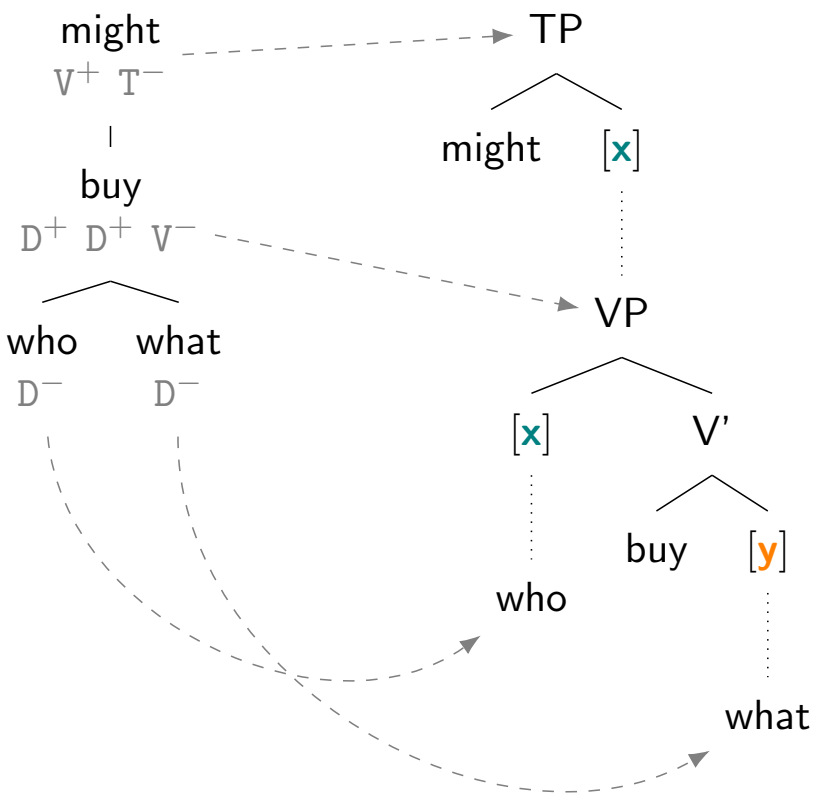

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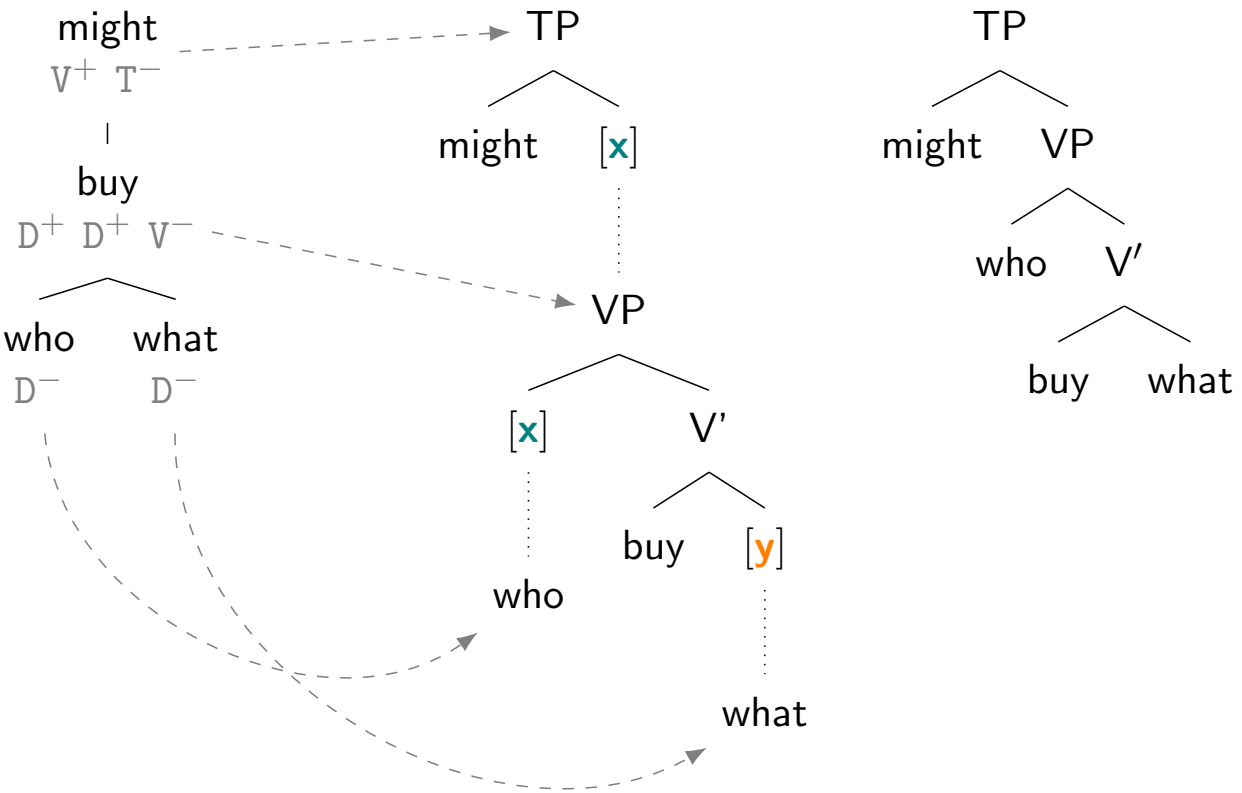

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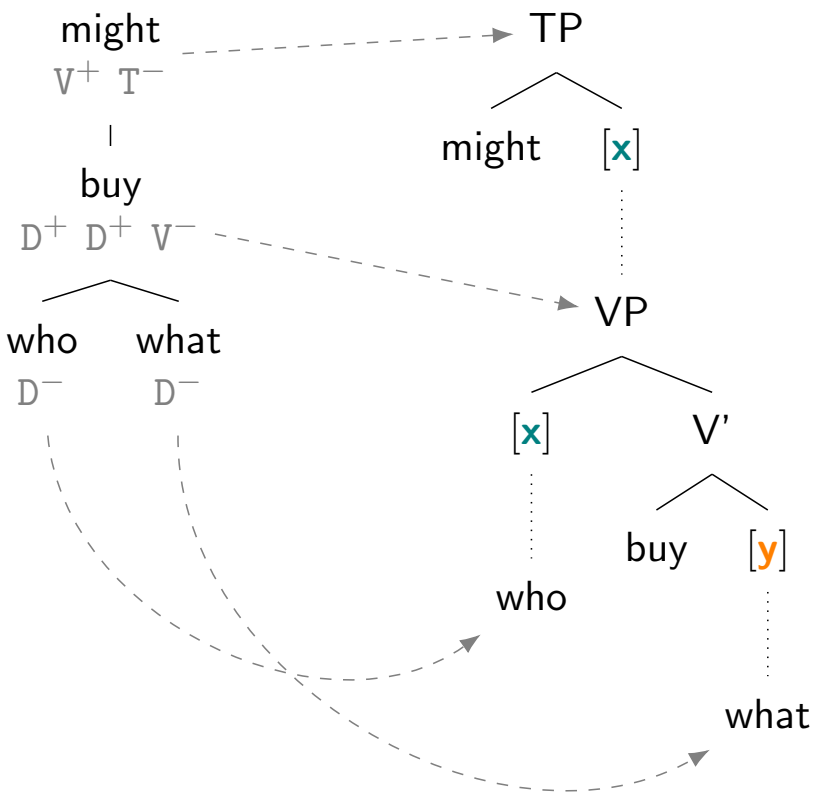
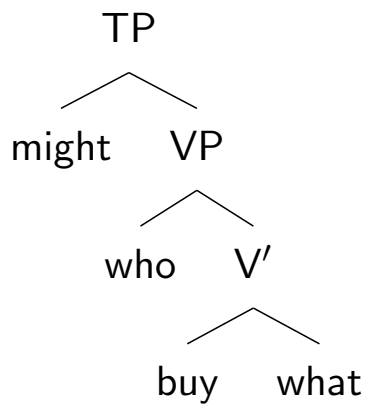




≈ **Tree Substitution Grammar**

ISL transductions

Movement-free translation is **input strictly local (ISL)**.

The intuition behind ISL

Each node **n** in input **i** is rewritten as some finite structure based only on **n** itself and its local context in **i**.

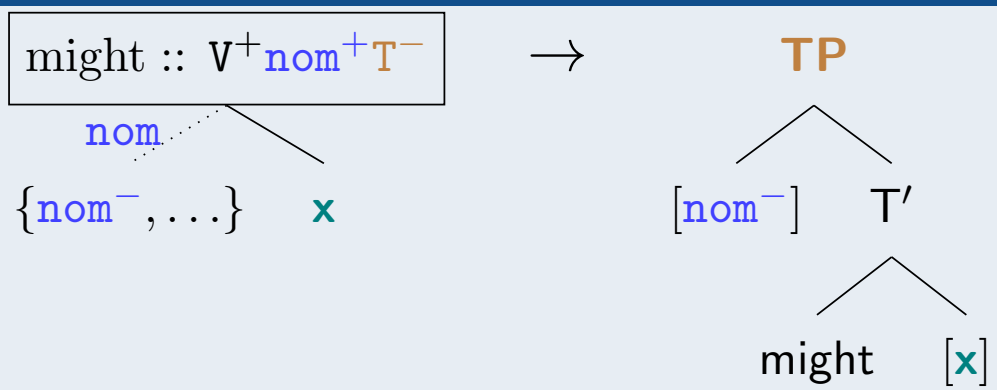
- ubiquitous in phonology, morphology (Chandlee 2014; Chandlee and Heinz 2018)
- tree-version for syntax originally proposed for very different purposes (Graf 2020; see also Ji and Heinz 2020 and Ikawa et al. 2020)

Jane Chandlee

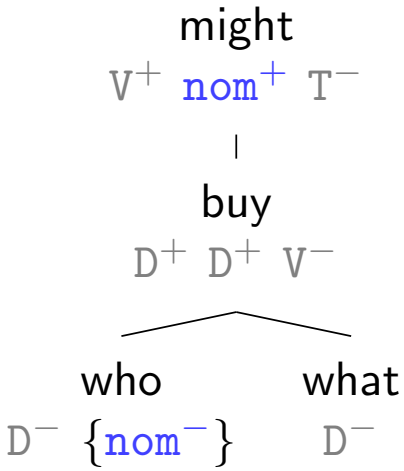
Adding tier relations

- ISL limited to local contexts $\Leftrightarrow$ unbounded movement
- **But:** movement is **local over tiers**
- suffices to enrich ISL rewrite rules with tier-daughter relation

ISL rewrite rule with nom-daughter relation



Example with subject movement



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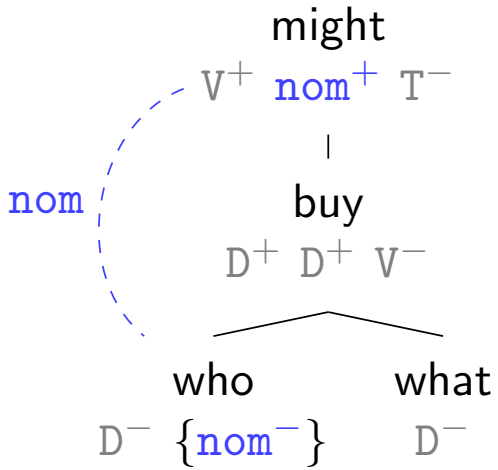

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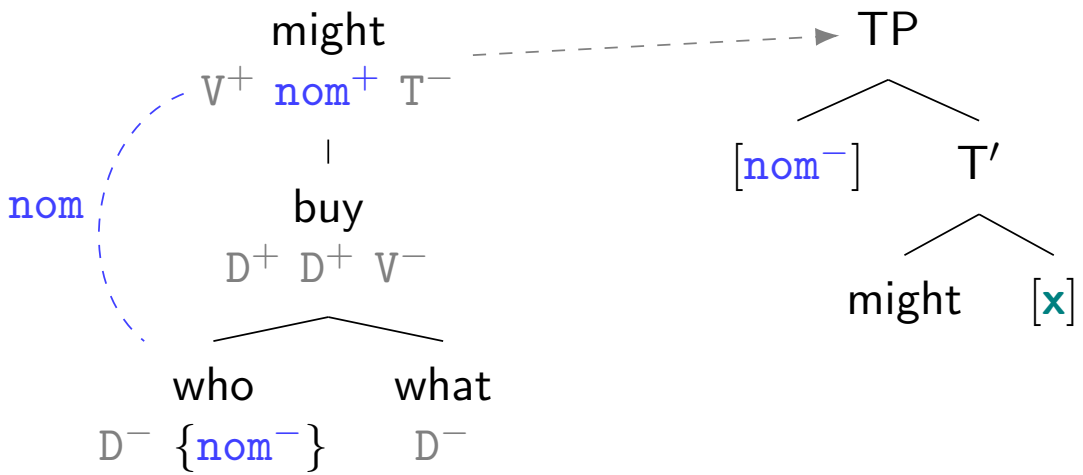

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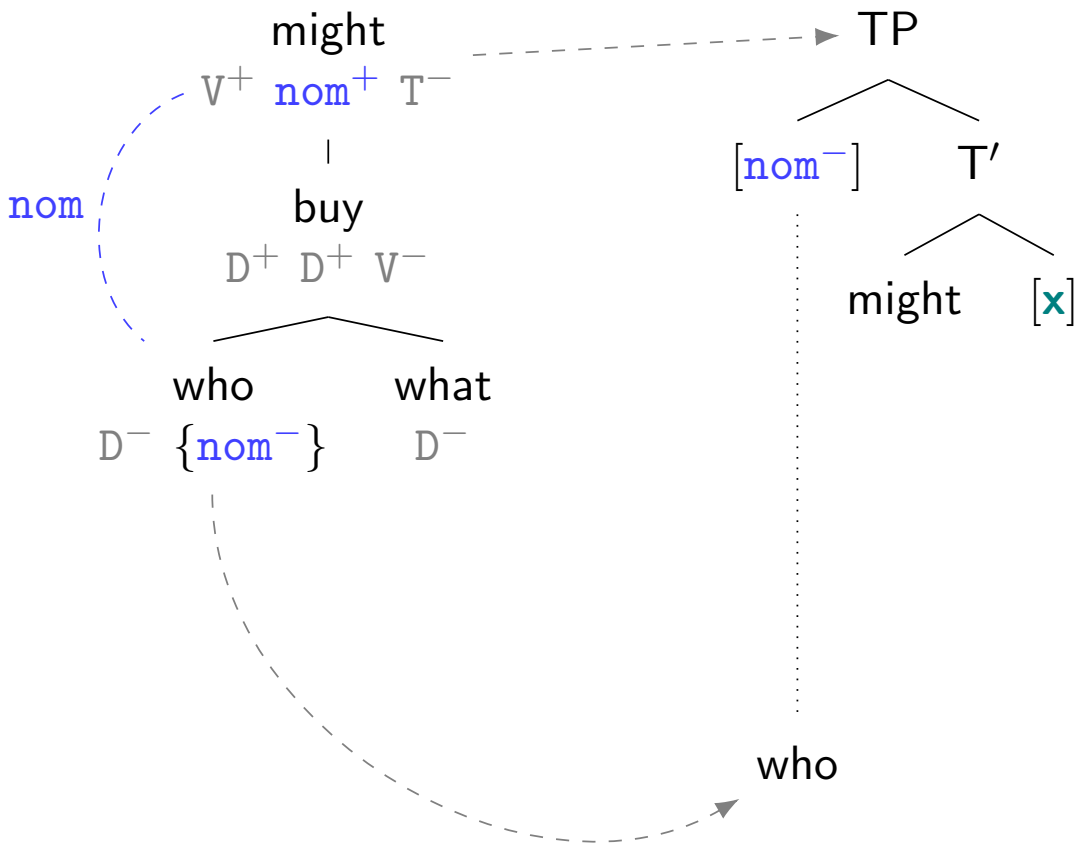

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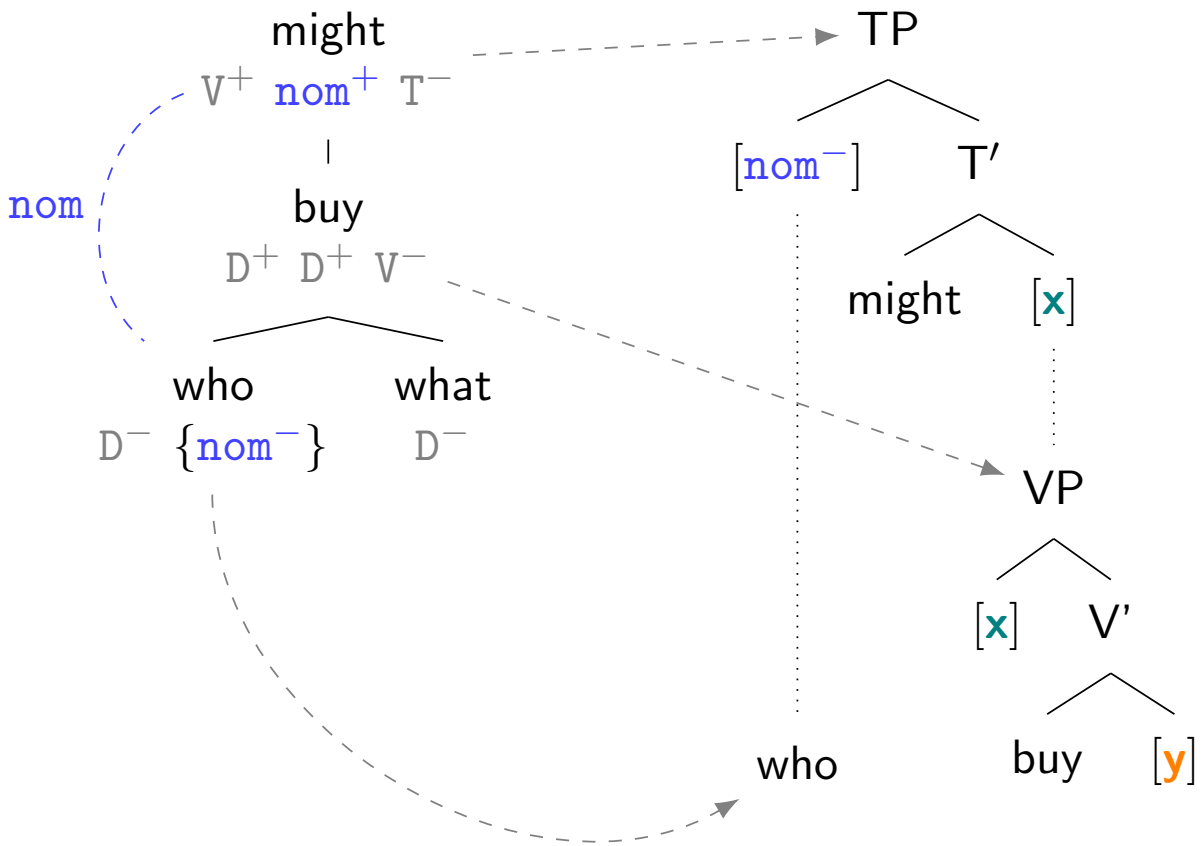

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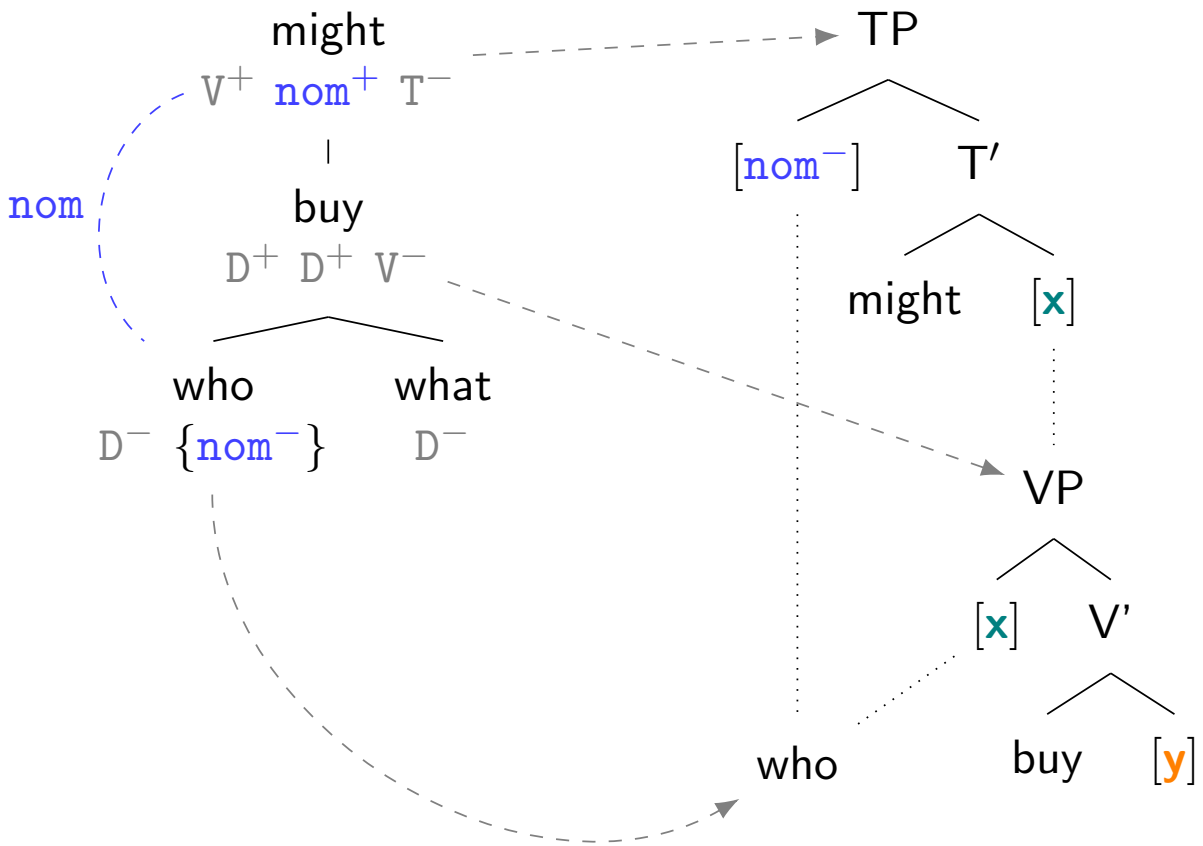

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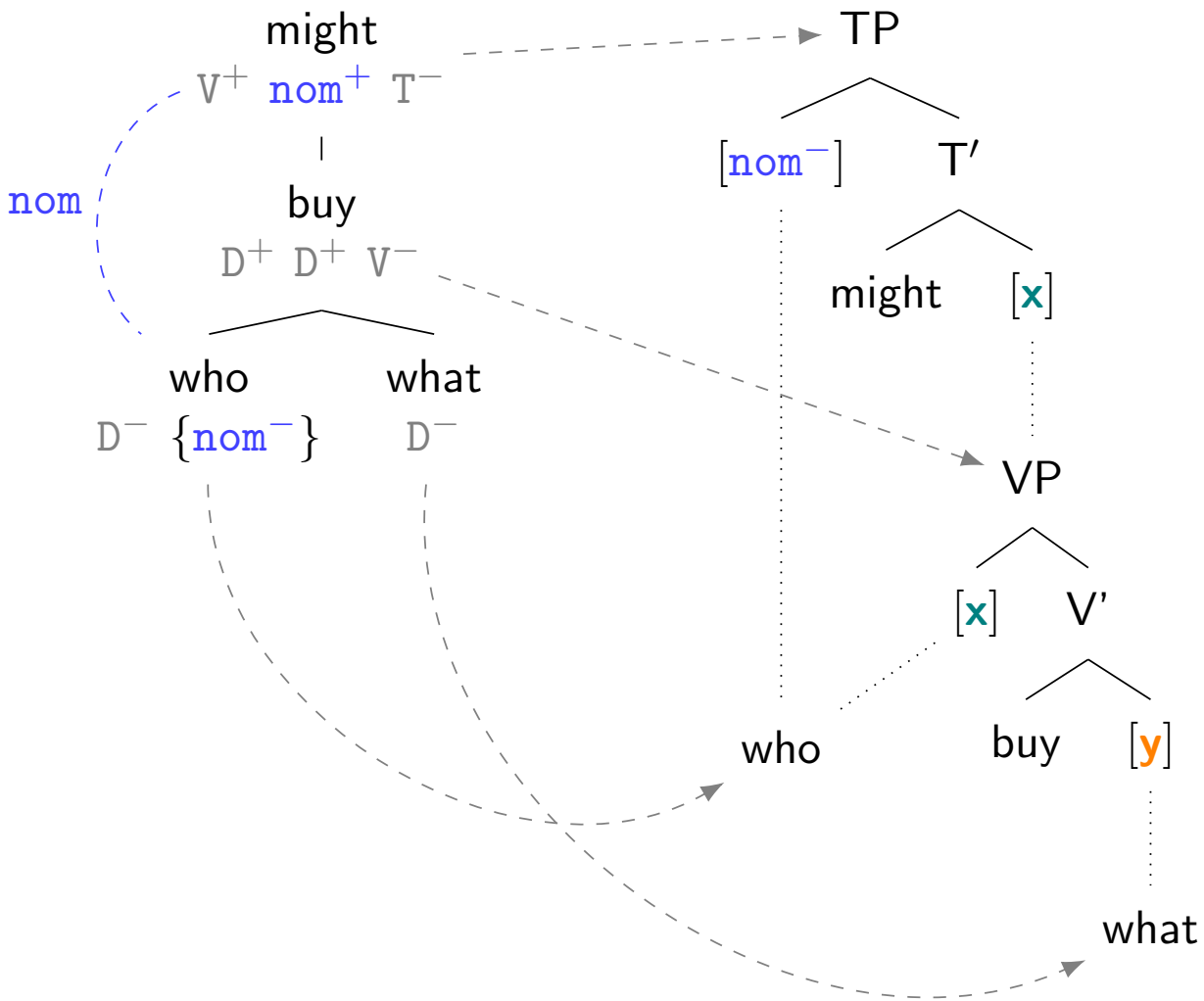

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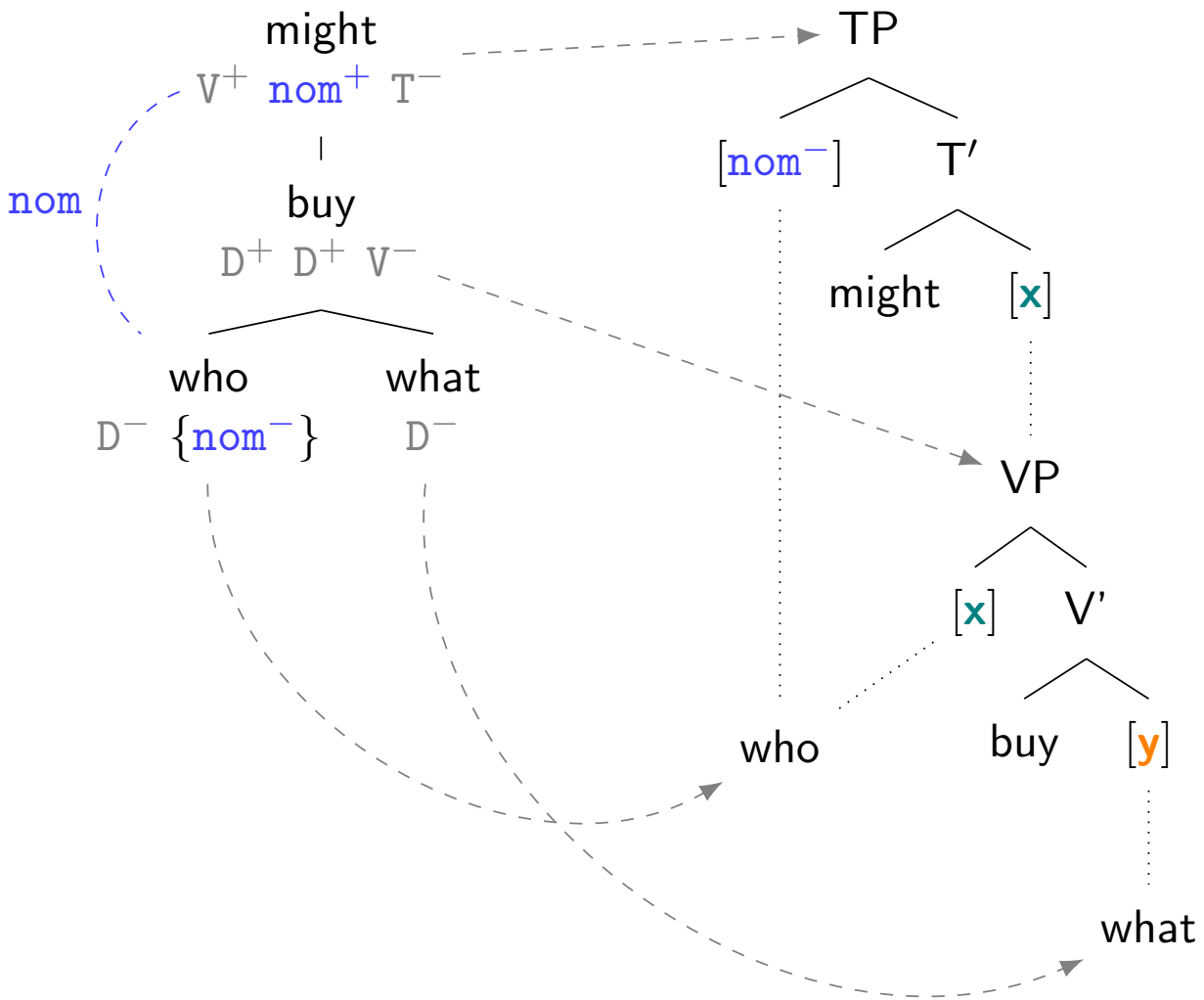

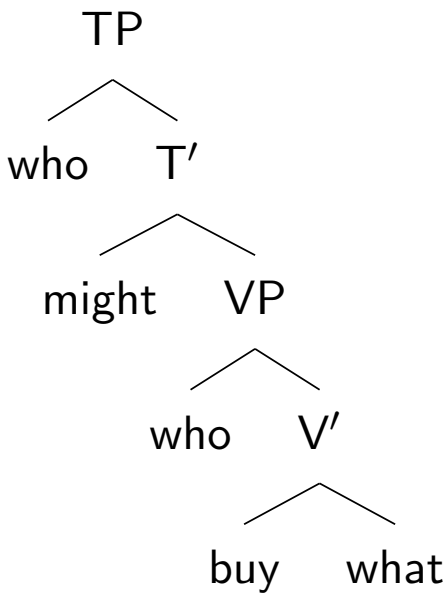

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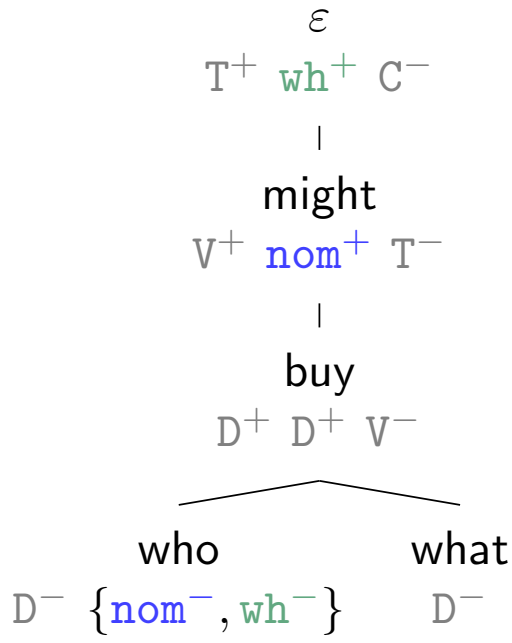

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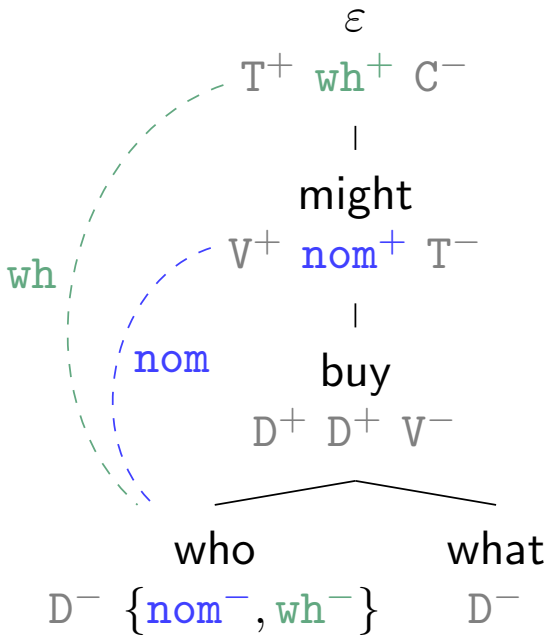

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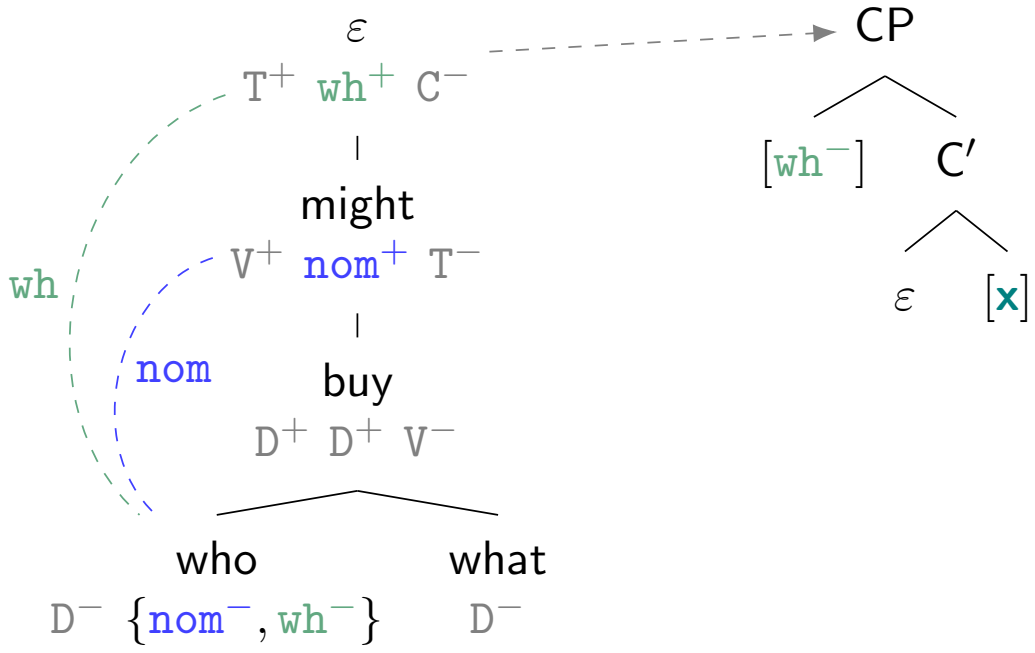

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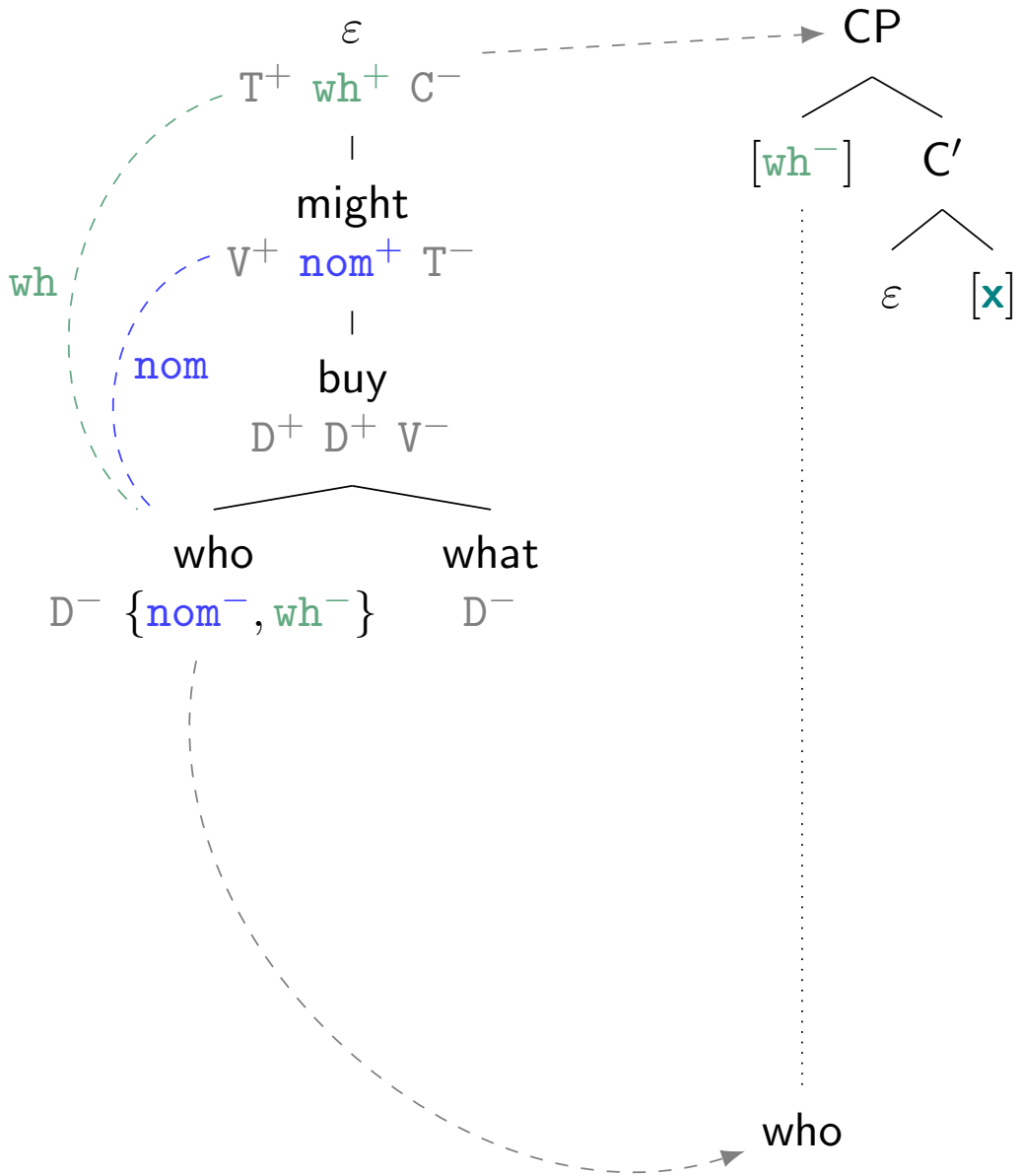

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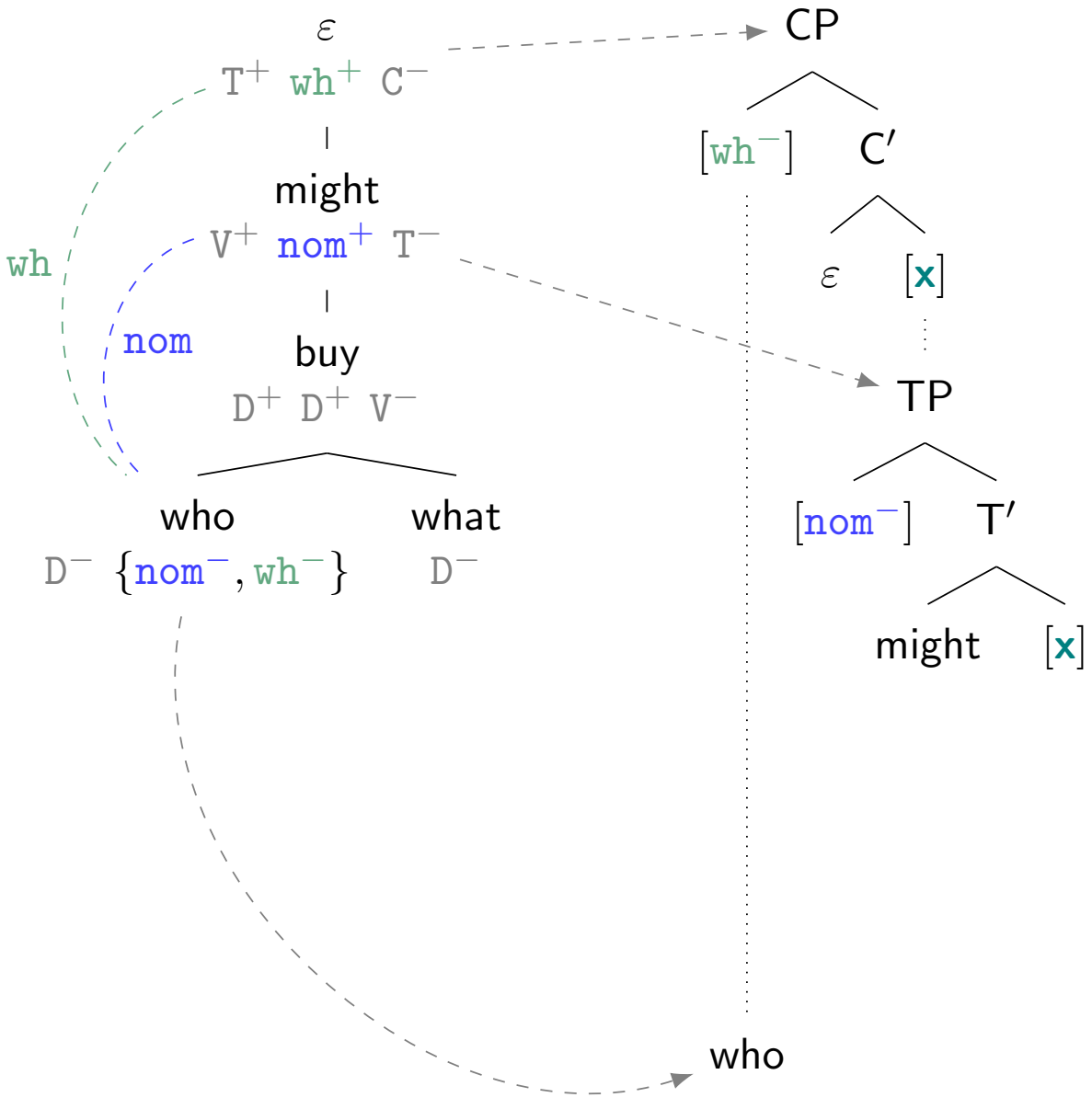

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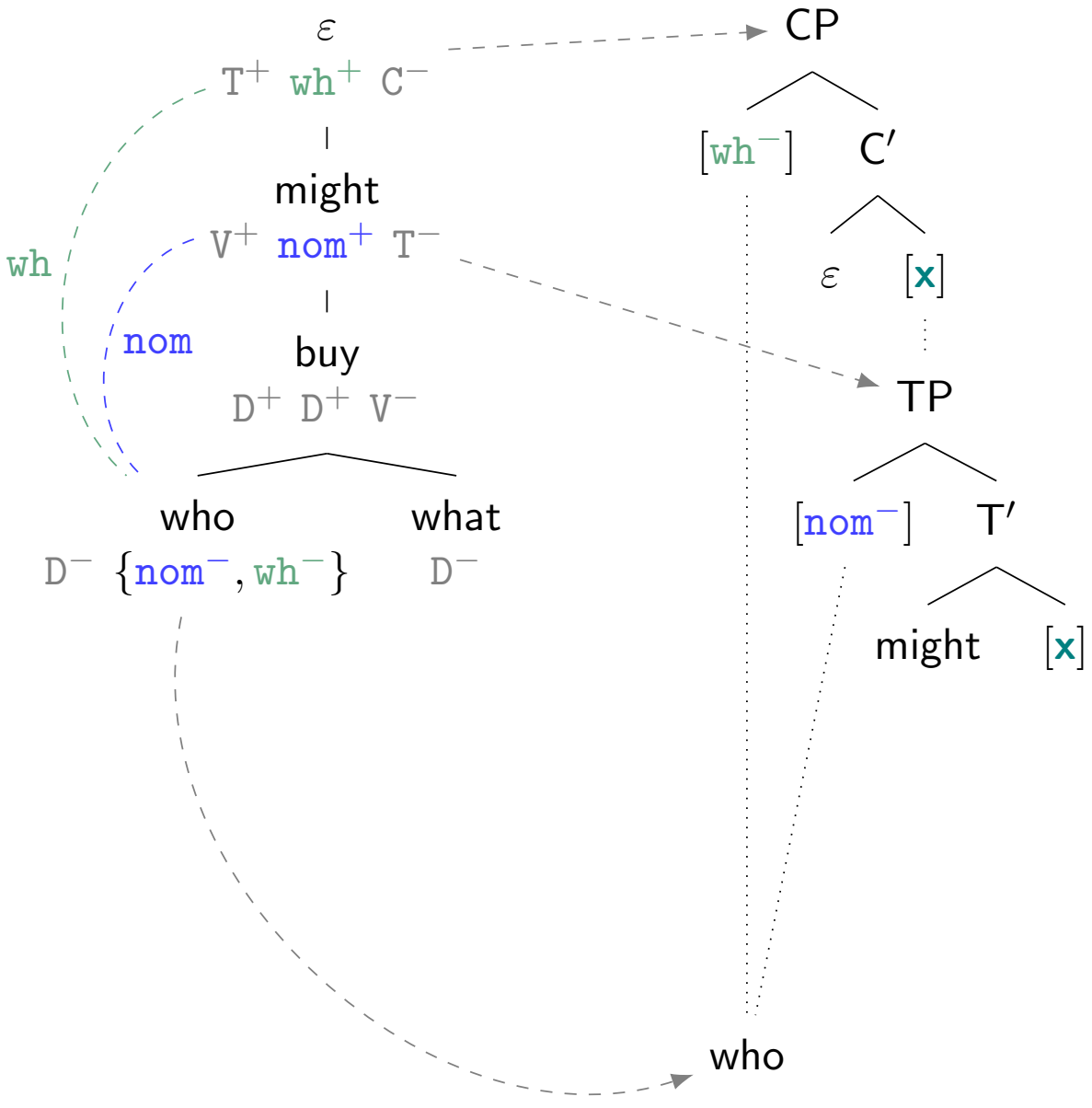

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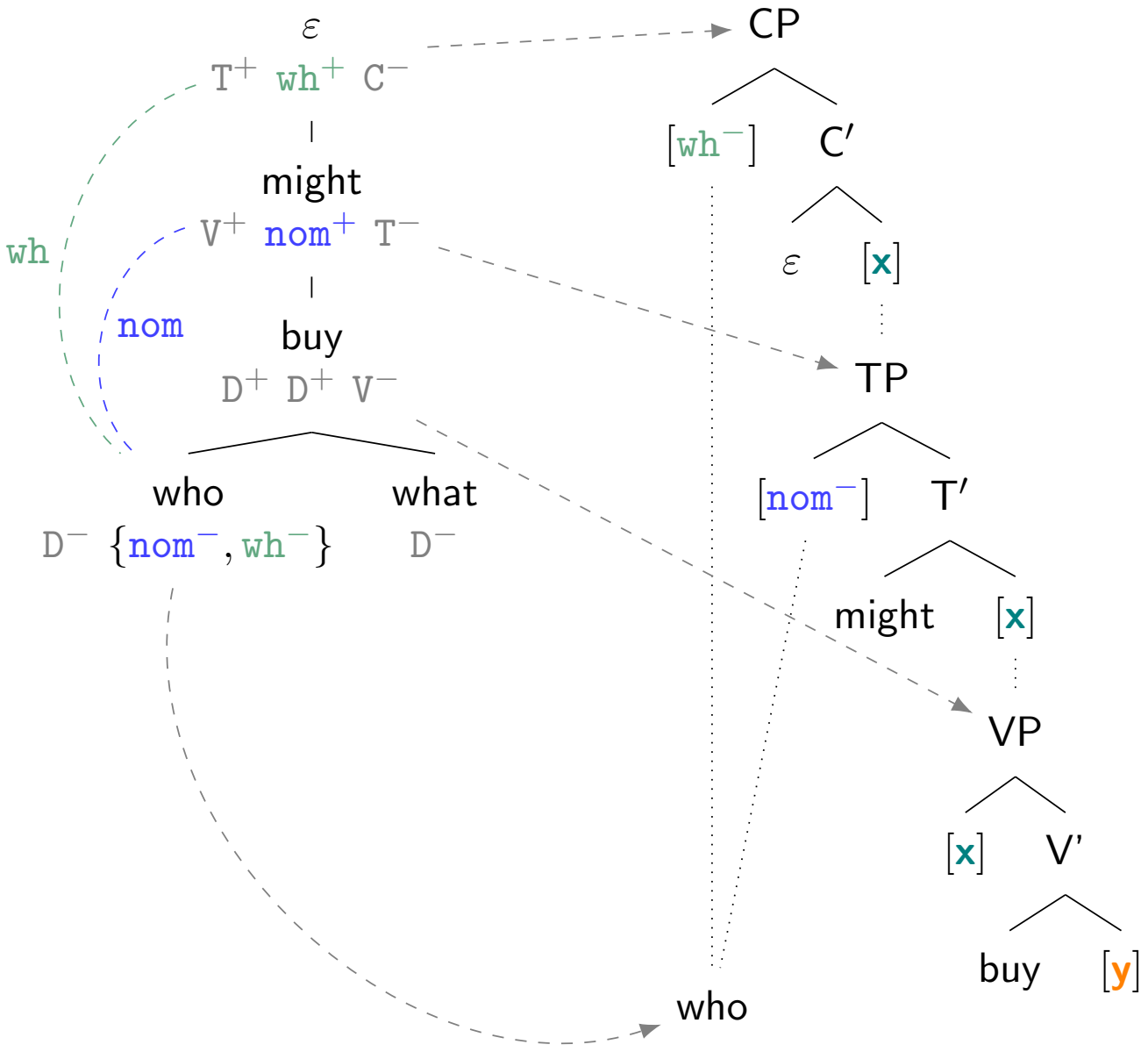

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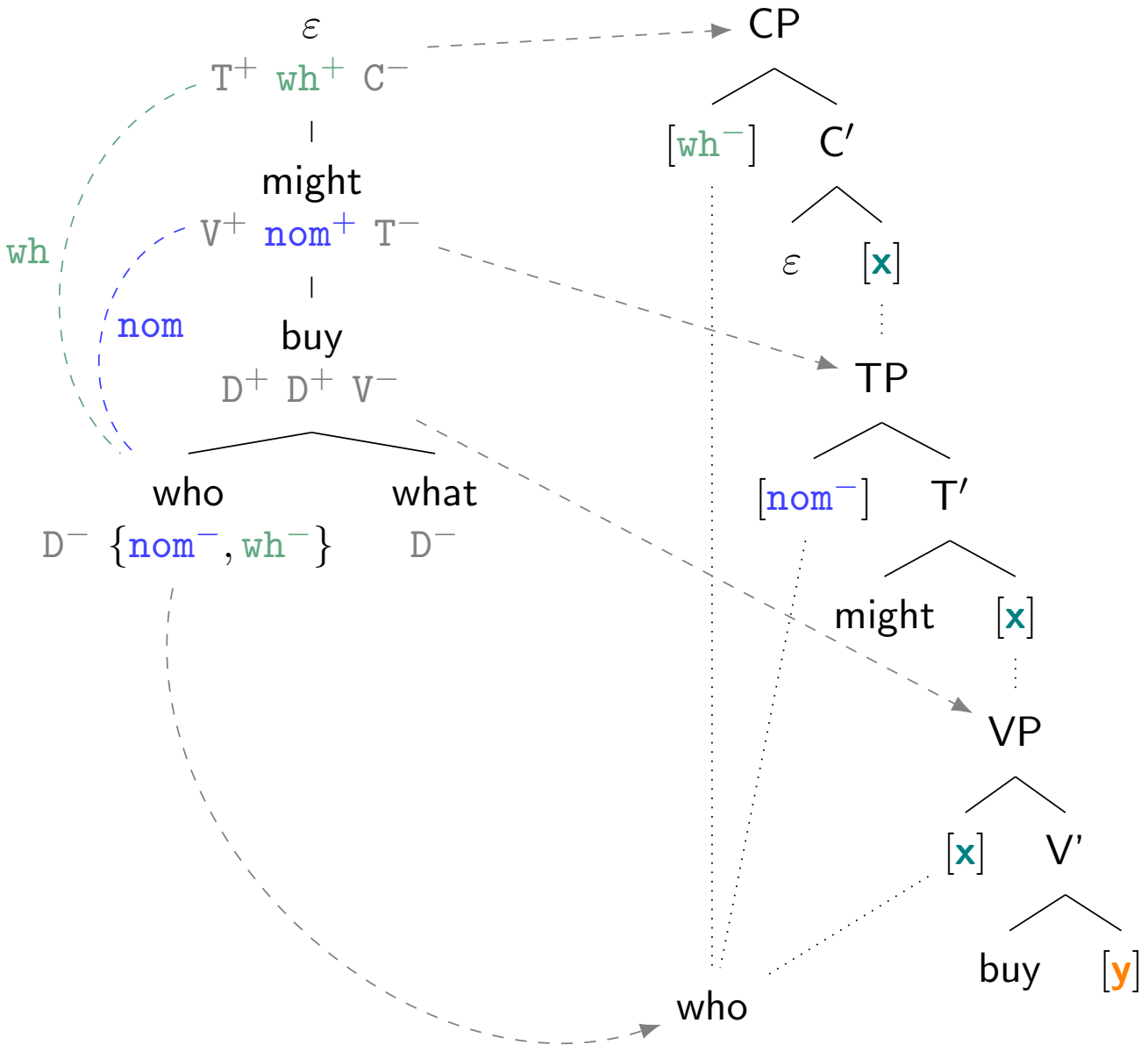

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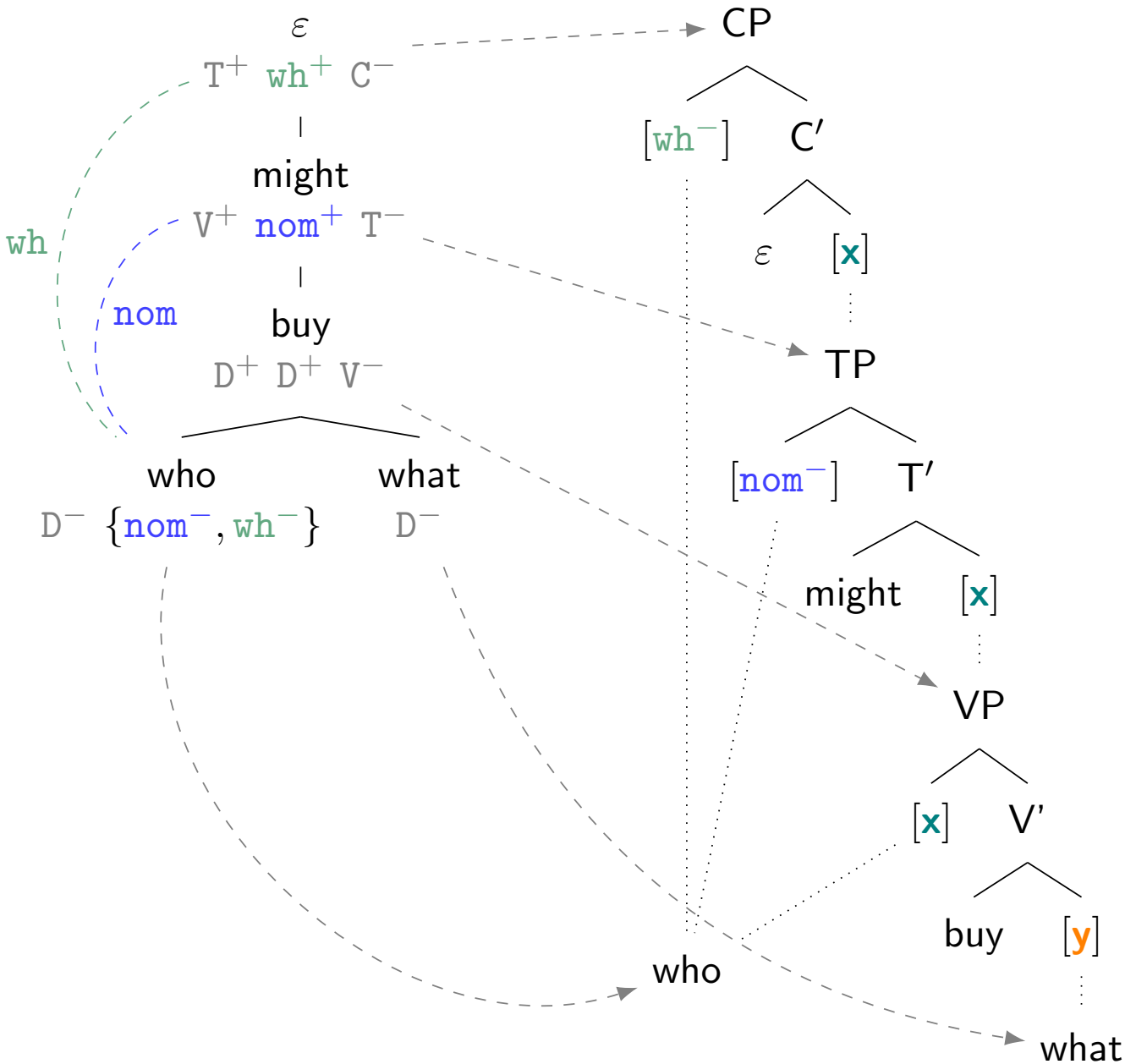

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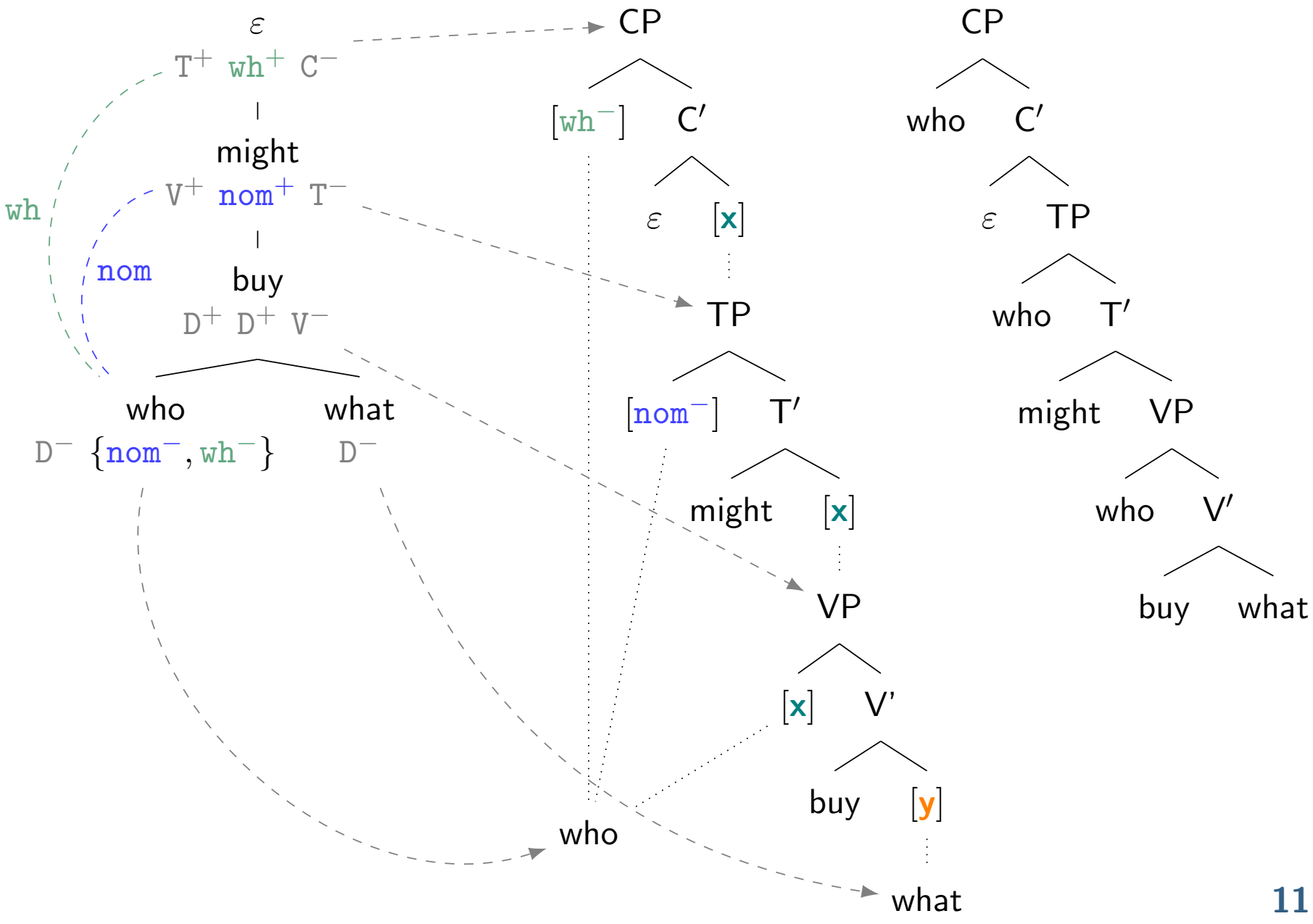
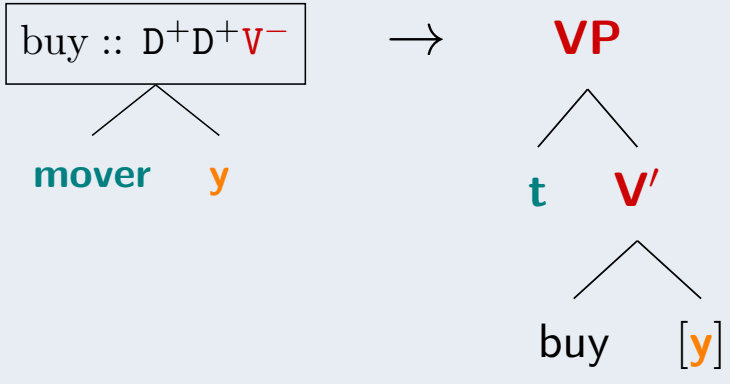


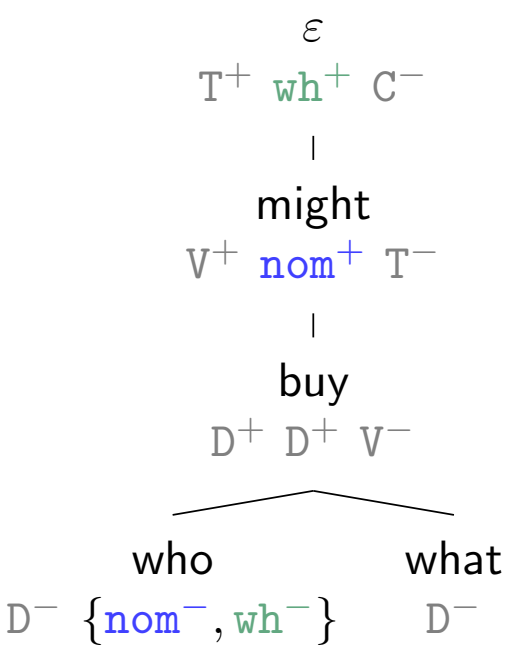
Linearization/traces: tricky

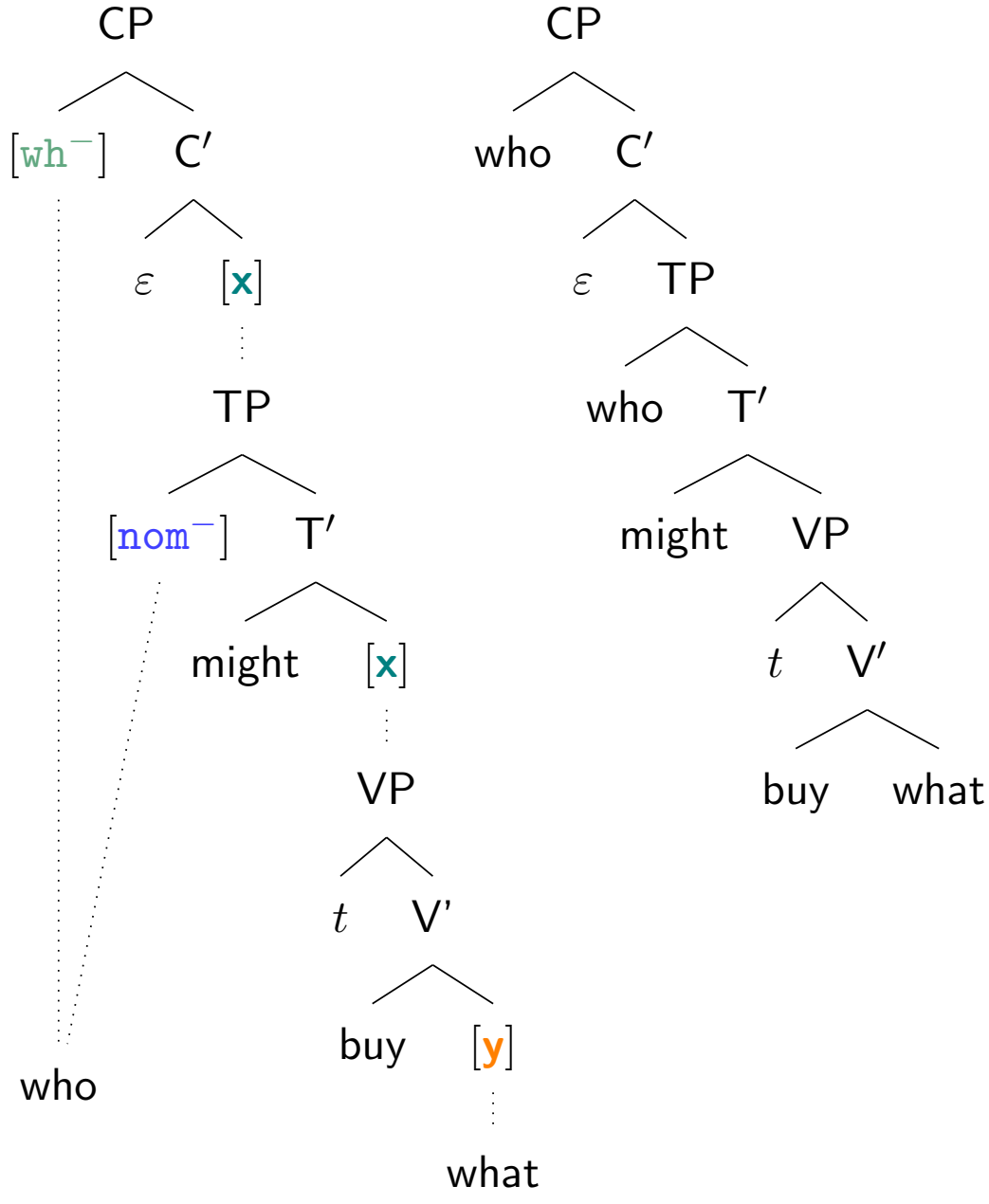
- Copies don't tell us how to pronounce the tree.
- **Traces**: unpronounced landing sites of movers

A delinking rule for base positions



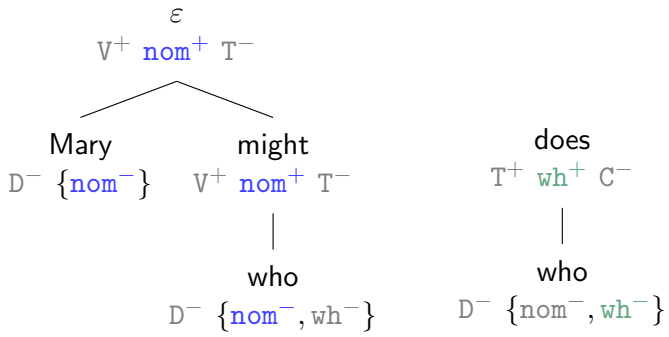
Base delinking example





Lexical predictability

- Given two landing sites **x** and **y** on different tiers, one cannot tell from the tiers whether **x** or **y** is higher.
- We **cannot distinguish final from non-final landing sites**.



Lexical predictability requirement of delinking

Delinking works only if one knows whether to

1. insert a copy, or
2. insert a trace.

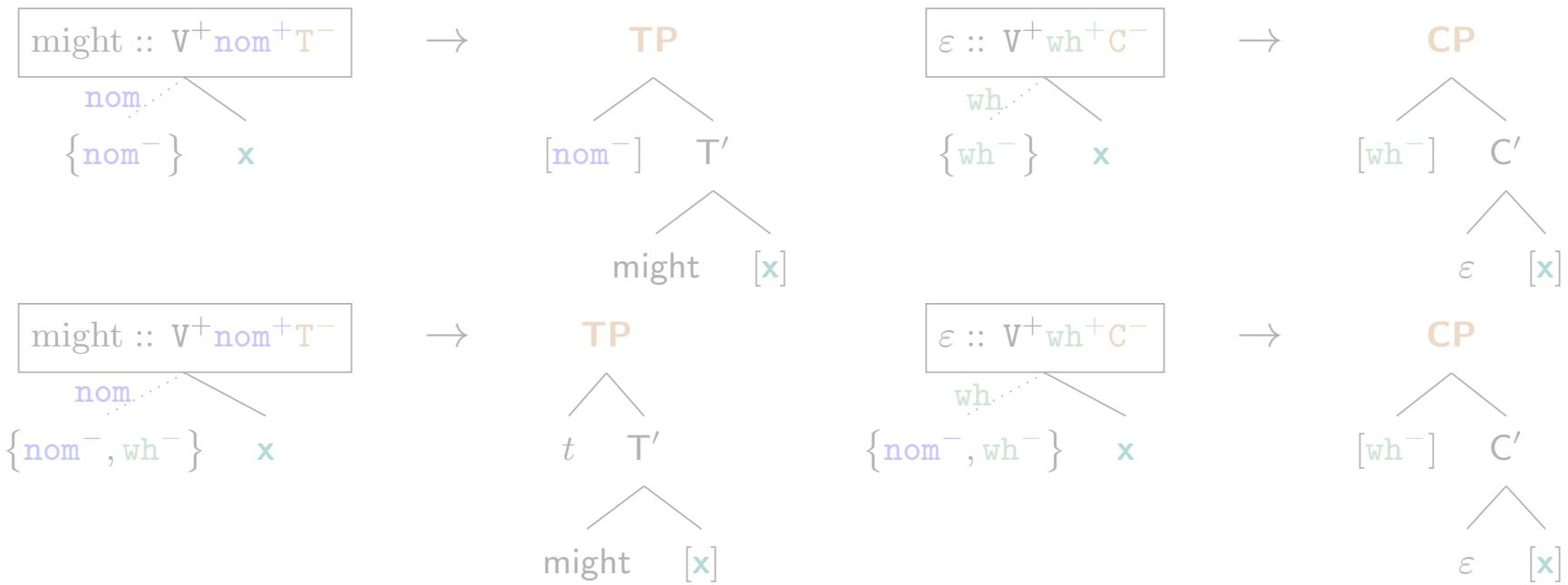
Due to the limitations of tiers,
this must be **inferable directly from the mover**.

Empirical support

- Lexical predictability holds for nom and wh movement.

Ban on Improper Movement (BoIM)

If a mover undergoes both nom and wh movement, nom movement derivationally precedes wh movement.



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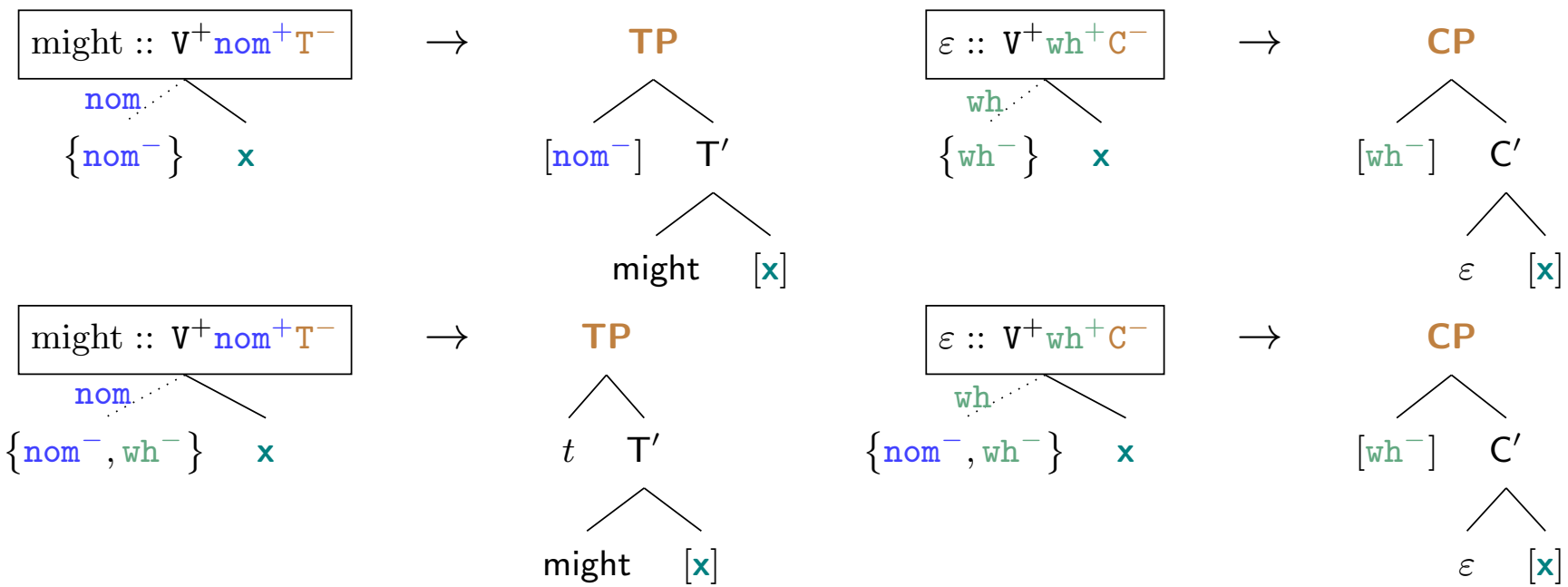


Output-oriented Ban on Improper Movement

- BoIM is a particular instance of a more general requirement.

Output-oriented Ban on Improper Movement (OOBoIM)

- Let l be an arbitrary lexical item with $\{\mathtt{f}^-, \mathrm{g}_0^-, \ldots, \mathrm{g}_n^-\}$.
- If l's final movement step is f-movement in **some** derivation, then l's final movement step is f-movement in **all** derivations.

- Kenneth Hanson's analysis of MG corpus supports **even stronger version**:
  if $\mathtt{f} \prec \mathrm{g}$ for l in some derivation,
  then $\mathtt{f} \prec \mathrm{g}$ for l in all derivations.
- OOBoIM permits BoIM violations
  hyperraising

Kenneth Hanson

More complex movement

- **Overt/covert**
  - MGs allow for covert movement, which does not affect linearization.
  - This is fine as long as lexical predictability holds, e.g. because overt/covert distinction is on licensee features
- **Sideward movement**
  - Pretty much the same, but uses tier sibling relation instead of tier daughter relation
- **Persistent features**
  - Persistent $\mathtt{f}^-$ can check multiple $\mathtt{f}^+$
  - used for successive cycle movement
  - Persistent movement is still a TSL dependency
  - But with transductions, we get a complexity swap: we can handle traces, but not copies
  - My hunch: that's a good thing

Example with persistent features

Persistence seems to be likely to be discussed

$$\varepsilon :: \mathtt{V}^{+}\mathtt{nom}^{+}\mathtt{T}^{-}$$
$$|$$
$$\text{seems} :: \mathtt{T}^{+}\mathtt{V}^{-}$$
$$|$$
$$\text{to} :: \mathtt{V}^{+}\mathtt{snom}^{+}\mathtt{T}^{-}$$
$$|$$
$$\text{be likely} :: \mathtt{T}^{+}\mathtt{V}^{-}$$
$$|$$
$$\text{to} :: \mathtt{V}^{+}\mathtt{snom}^{+}\mathtt{T}^{-}$$
$$|$$
$$\text{be discussed} :: \mathtt{D}^{+}\mathtt{V}^{-}$$
$$|$$
$$\text{persistence} :: \mathtt{D}^{-}\,\{\mathtt{nom}^{-}\}$$

Example with persistent features

Persistence seems to be likely to be discussed

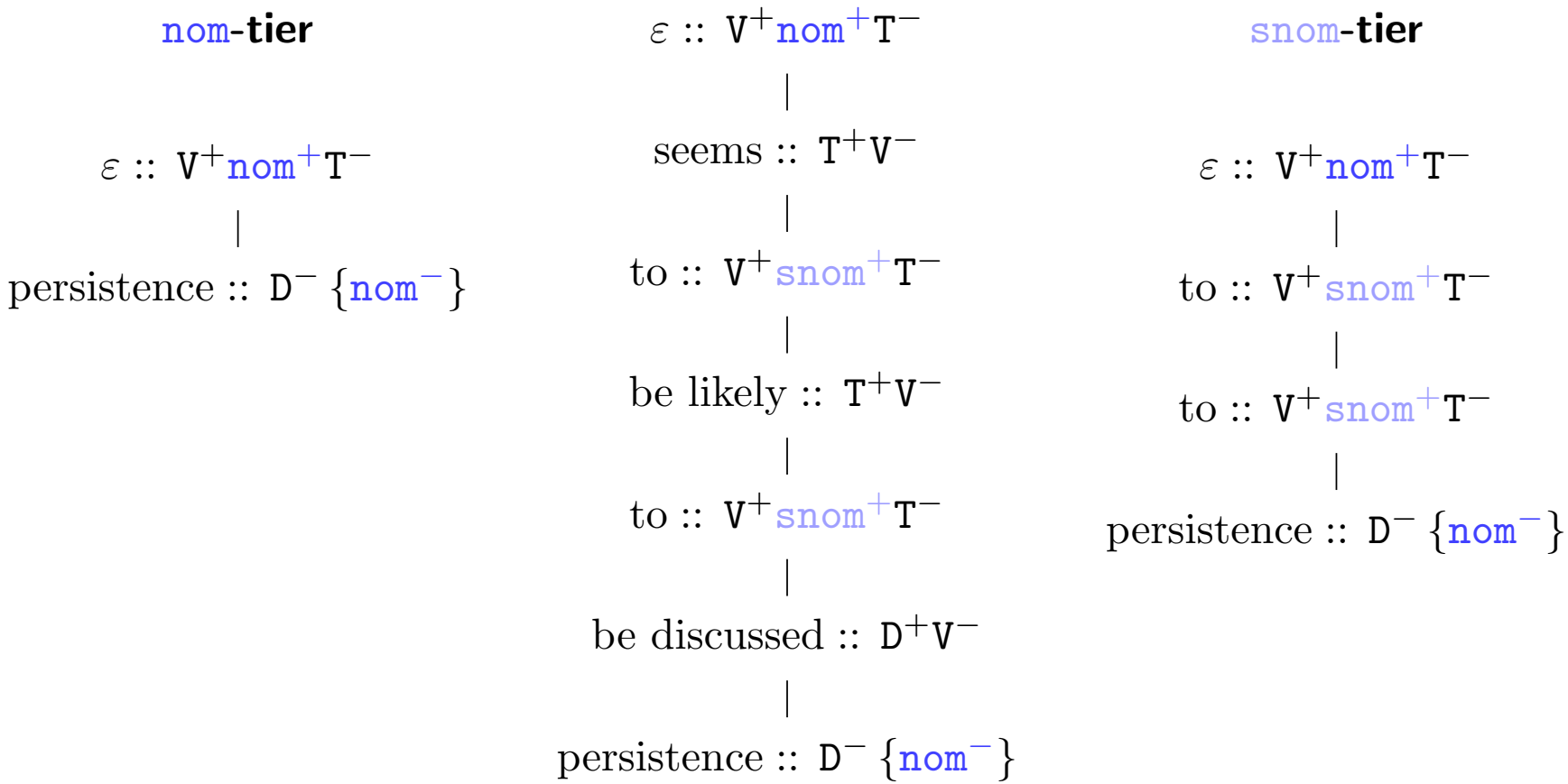
nom-tier

$\varepsilon :: \mathtt{V}^{+}\mathtt{nom}^{+}\mathtt{T}^{-}$
|
persistence :: $\mathtt{D}^{-}\,\{\mathtt{nom}^{-}\}$

$\varepsilon :: \mathtt{V}^{+}\mathtt{nom}^{+}\mathtt{T}^{-}$
|
seems :: $\mathtt{T}^{+}\mathtt{V}^{-}$
|
to :: $\mathtt{V}^{+}\mathtt{snom}^{+}\mathtt{T}^{-}$
|
be likely :: $\mathtt{T}^{+}\mathtt{V}^{-}$
|
to :: $\mathtt{V}^{+}\mathtt{snom}^{+}\mathtt{T}^{-}$
|
be discussed :: $\mathtt{D}^{+}\mathtt{V}^{-}$
|
persistence :: $\mathtt{D}^{-}\,\{\mathtt{nom}^{-}\}$

Example with persistent features

Persistence seems to be likely to be discussed



Conclusion

- Movement is both a syntactic dependency and an operation.
- In both cases the core of movement is **local over tiers**.
- Identifying mover with all landing sites (copies)
  easier than identifying output-relevant landing sites (traces)

Outlook: Bringing it all together

- TSL perspectives of all movement types
  covert, successive-cyclic, sidewards, multiple wh
- Tiers for islands, extraction morphology and path conditions
  Wolof u-chains, floating quantifiers, Germanic wh-copying
- Learning
  SL learning of Merge features, ??? for Move features

Acknowledgments

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