Move and Echo What?

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Internal merge (IM) of wh-DPs to a CP-edge creates direct wh questions (DQ). IM of a wh-vP to a CP-edge creates echo questions (EQ). EQs are questions in the usual sense with the phonetics, syntax, and semantics we attribute to the algorithm involving the feature [Q] on C in DQ. "What did John eat? (↓; DQ)" means "For which individual x such that John ate x?" "John ate what? (↑; EQ)" and "What did John eat? (↑; EQ)" mean "For which proposition $p \supset x$ such that $p =$ (John ate x)?" The analysis solves EQ/D(iscourse)-linking puzzles regarding superiority and scope. The result of the island diagnostic supports the dichotomy. All that is required are the conditions of minimal computation (e.g. superiority condition), phase theory equipped with linear correspondence axiom (LCA) and anti-LCA, and the language-as-virus-check hypothesis. The analysis offers a solution to recalcitrant superiority problems in Japanese.

1 Introduction

Direct wh questions (DQs) and echo questions (EQs) have different structures, which yield distinct phonetics and semantics at the sensorimotor system (SM) level and the conceptual-intentional system (CI) level respectively.[1)] In DQs, wh-DPs internally merges (IMs) to a CP-edge. A DQ example is as follows.

(1) What did John eat? (falling intonation; ↓)
'For which x, x an individual, such that John ate x?'

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1) See Hendrick and Rochemont (1982) for a contrary hypothesis. Unlike their analysis, we treat multiple DQs (e.g. "Who saw what? (↓)") and EQ (e.g. "Who saw what? (↑)") differently: the former involves IM of wh-DPs, while the latter involves IM of wh-vP.

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The variable x corresponds to the wh-DP. EQ examples are as follows.

(2) a. John ate what? (rising intonation; ↑)
b. What did John eat? (↑)
'For which p, p a proposition ∋ an individual x, such that p = (John ate x)?'

In an EQ, a wh-vP IMs to a CP-edge. Proposition p corresponds to a wh-vP containing wh-DPs. Contrary to Adger (2003: 352), EQs involve the phonetics, syntax, and semantics that we attribute to the algorithm involving the feature [Q] on C in DQ. EQ puzzles as follows (Sobin 2010) are solvable without C_{EQ} and the scope operator.

(3) a. Superiority problem: apparent violation of superiority (Chomsky 1973)
b. Absent-wh-move problem: apparent T-to-C move of Aux without a wh-move
c. Scope problem: Wide scope requirement only for EQ-introduced wh-phrases

The superiority puzzle of D(iscourse)-linked questions (Pesetsky 1987) and long-standing superiority problem in Japanese is also solvable.
The remainder of this paper is structured as follows. Section 2 provides the theoretical background. Section 3 presents the DQ and EQ structures. Section 4 solves the EQ puzzles regarding superiority and scope. Section 5 concludes the paper.

2 Theoretical Background

Minimal computation The computational system of human natural language (CHL) is a natural object that generates structures by eliminating uninterpretable features (uF). CHL is connected with SM and CI. The condition of minimal computation (MC) keeps an open system such as CHL in order.[2)]

2) See Chomsky (1965; 1991; 2005; 2016) for MC. Chomsky (1965: 59) suggested we consider seriously "millions of years of evolution" of CHL and "principles of neural organization that may be even more deeply grounded in physical law [MC]." "Nature distributes the currents to minimize the heat loss [error]" (Strang 2009: 428). Our universe computes information. The second law of thermodynamics (entropy law; EL) creates disorder. EL and MC compete in open systems. Piattelli-Palmarini and Uriagereka (2008: 219-220) propose that the elegant syntactic molecule (edges + (head + complement)) is generated by two opposing forces: repulsion and gluing forces. Edges undergo merge on derivational buffers in the dimension. The gluing force transfers the complement for equilibrium, while the repulsive force grows structures. EL creates equilibrium; MC breaks symmetry.

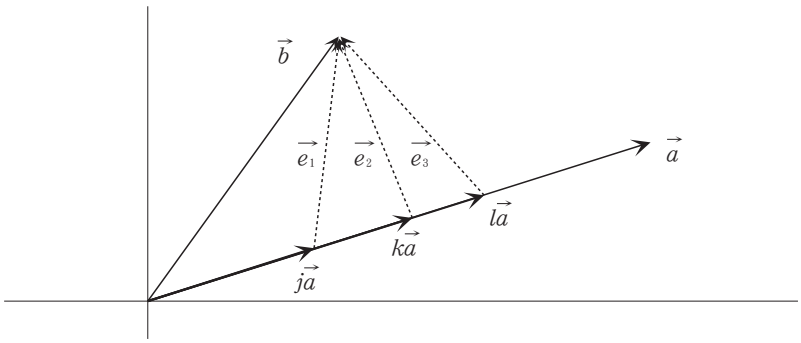
(4) *MC*: Minimize error.

If CHL obeys MC, the strongest minimalist thesis (SMT) holds (Chomsky 2000: 96).

(5) *SMT*: Language is an optimal solution to legibility conditions (LC).

The old-timers SM and CI impose LC on the newcomer CHL. CHL must solve LC. SMT requires CHL to solve LC optimally. CHL obeys MC. We visualize SMT.

(6) *Image of SMT*: $k\vec{a}+\vec{e_2}=\vec{b}$ *realizes SMT*.



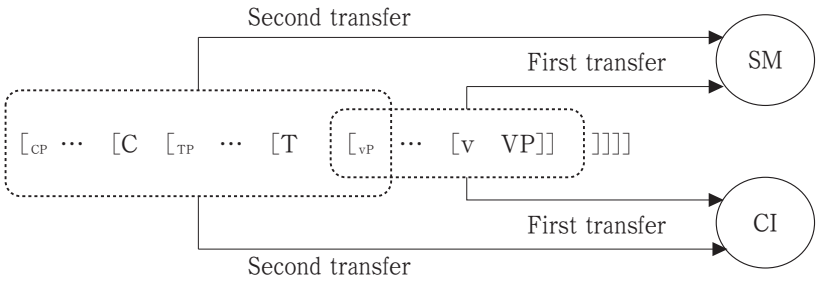
Vector $\vec{b}$ expresses an LC problem. Vector $\vec{a}$ contains infinite possible solutions such as $j\vec{a}$, $k\vec{a}$, and $l\vec{a}$. Error vectors $\vec{e_1}$, $\vec{e_2}$, and $\vec{e_3}$ show how CHL can generate error. $\vec{e_2}$ is perpendicular to $\vec{a}$: the error is minimized. Vector $k\vec{a}$ is the optimal solution. The same coordinates visualize the minimalist program (MP). $\vec{b}$ is an MP problem. $\vec{a}$ contains infinite possible solutions. $\vec{e_1}$, $\vec{e_2}$, and $\vec{e_3}$ indicate how we can err. $\vec{e_2}$ is the minimal error. Equation $k\vec{a}+\vec{e_2}=\vec{b}$ yields an MP solution $k\vec{a}=\vec{b}-\vec{e_2}$.[3)]

Phase theory We visualize phase theory (Chomsky 2001).[4)]

3) When a problem $Ax=b$ has no solution, where a function A acts on input x to yield output b, we approximate $Ax=b$ to $A\hat{x}=p$, where A acts on $\hat{x}$ (read as "x-hat") to yield an optimal p. p is $k\vec{a}$, which is an alter ego of $\vec{b}$. The Pythagorean theorem (PT) favors $k\vec{a}+\vec{e_2}=\vec{b}$ because $||\vec{b}||^2=||k\vec{a}||^2+||\vec{e_2}||^2$. PT connects $\vec{b}$, $k\vec{a}$, and $\vec{e_2}$ so tightly that we can consider them identical: they are easy to recover, owing to PT. MC assures invertibility: the computation is traceable or undone. Nature has a mathematical structure. MC and PT govern Nature. See Strang (2009) and Tegmark (2014).

4) We have adapted a figure in Ko (2014: 4).

(7)



CP and vP are strong phases. A strong head C assigns features to the weak head T below (Chomsky 2008). T externally merges (EMs) with a vP, and C and T act on the vP-edge and v. Then, the vP is transferred to SM and CI.[5] The phase impenetrability condition (PIC) is an MC that forces minimal search (Chomsky 2001: 13).

(8) *PIC*: [For a strong phase HP with a head H,] the domain [complement] of H is not accessible to operations outside HP; only H and its edge are accessible.[6]

H is C or v. T inherits [Q] from C. [Q] in T sees vP-edge and v. PIC and uF-checking with wh-DP IM operate conspiratorially. Assume the CI-priority condition.

(9) *CI-Priority Condition*: Narrow syntax (NS) serves CI primarily.[7]

Superiority condition Chomsky's (1973) superiority condition (SC) is roughly as follows. In [...X...[...Z...[...Y...]]], X must act on Z, not Y.[8] A copy-theoretic translation is that IM of wh-phrase pronounced at CP-edge must not cross over another pronounced wh-phrase. MC subsumes SC.

LCA and anti-LCA LCA and anti-LCA map 2-dimensional (dim) structures to 1-dim linear

5) Given PIC, VP-transfer is unnecessary. We can be more minimalistic than Chomsky (2001).
6) An edge includes elements outside H, specifiers (edges) of H, and elements adjoined to HP.
7) See Chomsky (2007: 14) and Epstein, Kitahara, Seely (2010).
8) Superiority condition: (a) No rule can involve X, Y in the structure ...X...[...Z...WYV...]... where the rule applies ambiguously to Z and Y, and Z is superior to Y; (b) the category A is superior to category B if every major category dominating A dominates B as well but not conversely (Chomsky 1973). The following suggests that the empty category principle (ECP; Chomsky 1981; Lasnik and Saito 1992) cannot subsume SC (Hendrick and Rochemont 1982, Pesetsky 1982; Bošković 1997).

(i) ?* What did you tell whom to read?

strings (Kayne 1994, Uriagereka 1999: 252).[9]

(10) *LCA*: a. If α commands β, α precedes β, or
b. If γ precedes β and γ dominates α, α precedes β.[10]

In SM, LCA measures sentence-phrase structures and determines the order among heads and phrases. As to a word-internal order, anti-LCA determines the order.

(11) *Anti-LCA*: If α externally merges earlier than β, α precedes β.

LCA pronounces downward, while anti-LCA pronounces upward. Consider the word "predictability" and the corresponding Japanese word "yosoku-kanoo-see."

(12) a. $[_N[_A[_V$ Ø $[_V$ predict]] $[_A$ able]] $[_N$ ty]] (English)
b. $[_N[_A[_V$ Ø $[_V$ yosoku]] $[_A$ kanoo]] $[_N$ see]] (Japanese)

The empty set Ø exists in structure-building space at the first step.[11] Ø EMs with a V, forming a new V. The new V EMs with an A, forming a new A. The new A EMs with N, which forms a new N. The order is <Ø, V, A, N>, which is the order of EM.[12]

CHL as virus check system We assume that CHL is a virus-check (VC) system, as a computer is (Piattelli-Palmarini and Uriagereka 2004).[13] VC consists of two steps.

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9) Uriagereka (1999) solved the problem of LCA: how does a term x in a higher phrase YP precede terms dominated by YP's sister ZP? His solution is to spellout YP first, and then ZP.

10) *Command and domination* are defined as follows. We abbreviate α commanding β as $\alpha \curvearrowright \beta$.

(i) α *commands* β iff: a. every γ that dominates α dominates β, and
b. α and β are disconnected. (Chomsky 1995: 339-340)
(ii) α *dominates* β if every segment of α dominates β. (Chomsky 1986: 9)

Klima (1964) introduced *command*, which was modified by Langacker (1969), Lasnik (1976), Reinhart (1976), Stowell (1981), and Aoun and Sportiche (1981), among many others.

11) This is similar to "node zero" in graph theory. Any starting node presupposes invisible node zero.

12) Other examples are "talk-ed" (<V, T>) and "tabe-ta" (eat-past; <V, T>). LCA orders terms in reverse of EM. Anti-LCA orders terms as they EM. LCA is expensive, whereas anti-LCA is costless. LCA involves parameters, while anti-LCA does not. LCA sees heads and phrases, which are easily distinguishable. LCA has room (spare memory) for parameters. Anti-LCA sees heads everywhere; they are difficult to distinguish. Anti-LCA has no room for parameterization.

13) "Virus" means information that disturbs a system. The newcomer CHL lives in symbiosis with virus (uF). However, the old-timers CI and SM require CHL eliminate virus. The human brain has created computers. The former can make use of electrical (digital) and chemical (analog) information, while

(13) Step 1: Antibody [A] ∈ H probes the nearest antigen [a] ∈ XP; H ↷ XP.[14]

(14) Step 2: IM of XP to HP-edge eliminates [a].[15]

VC occurs immediately when possible. "The uFs compel phases to be as small as possible, and they impose cyclicity of transfer, given PIC, thus reducing memory load in computation; they contribute to SMT (Chomsky 2007: 24)."

3 A Proposal: DQ and EQ Have Different Derivations

3.1 Structure of DQ

Let us begin with an English DQ (15) with the structure (16) and the algorithm (17).[16]

(15) What did John eat? (↓)[17]
'For which x, x an individual, such that John ate x?'[18]

(16) [$_{CP}$ ***what*** [$_{C'}$ C ***did*** [$_{TP}$ ***John*** [$_{T'}$ T [$_{vP}$ John [$_{v'}$ what [$_{v'}$ [$_{v}$ v ***eat***] [$_{VP}$ eat what]]]]]]]

(17) ① Infinitival verb V *eat* assigns θ-role [patient] to EMed *what* (Hereafter, θ_p: V → *what*). V internally IMs with v (Hereafter, IM (V, v)).[19]
② The agentive light verb v has antibody [ACC] and probes antigen [acc] in EMed *what* (Probe: $[ACC]_v$ ⇝ $[acc]_{what}$). The antibody-antigen reaction forces IM (*what*, vP).

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the latter can use electrical only. Any system is a VC system.

14) Based on the idea that the uninterpretability of Φ-features such as person, number, and gender is a sign of a virus, Piattelli-Palmarini and Uriagereka (2004: 362-363) assume that DPs contain antibodies, and heads contain antigens. However, Φ-features of DPs do not contribute to meaning: they are distinct from semantic roles such as [patient] and [agent]. The genuine viral features are structural Case. DPs contain antigens, and heads contain antibodies. Heads build the backbone of sentence structures.

15) Abe's (2017) search and float approach for IM is compatible with the C_{HL}=VC hypothesis.

16) SM externalizes terms in ***bold italics***. The non-bold non-italic lower-case terms are present, but silent. The underline highlights the difference between DQ and EQ and between English and Japanese.

17) See Section 4.2 for distinct derivations of a multiple DQ ("Who ate what? (↓)) and a multiple EQ ("Who ate what? (↑)).

18) Karttunen (1977: 3-4) proposes to assimilate DQ such as "What did Mary eat?" with an indirect wh question (IDQ) such as "I ask you (to tell me) what Mary ate." Then, EQ as "Mary ate what?" would semantically be identical to "I ask you (to *repeat*) what Mary ate." Wells (2006: 56) calls EQ as 'please-repeat wh question'. We do not adopt the reduction because DQs and IDQ are too different syntactically. See chapter 9 of Dowty, Wall, and Peters (1981: 269) for future research.

19) V adjoins to v (Adger 2003, Chomsky 2013). English V does not adjoin to T while French V does (Chomsky 1991), as the following examples indicate. Assume an adverb EMs with vP.

(i) a. John often kisses Mary. vs. * John kisses often Mary.
b. * Jean souvent embrasse Marie. vs. Jean embrasse souvent Marie.

[ACC] and [acc] delete (VC_{acc}).

③ *John* EMs at the vP-edge, and v assigns θ-role [agent] to *John* (θ_a: v→*John*).

④ vP＋VP is transferred to SM and CI (Chomsky 2001). SM: LCA inactive.[20] CI interprets vP as a proposition (Hereafter, CI: vP＝p).

⑤ Probe: $[NOM]_T$ ⇝ $[nom]_{John}$. IM (*John*, TP). VC_{nom}.

⑥ Probe: $[Q]_C$ ⇝ $[q]_{what}$.[21] IM (*what*, CP). VC_q.

⑦ Transfer (CP＋TP). SM: LCA active; ↓. T connecting v, T cannot valuate infinitival *eat* as past. T attempts to connect with C, but pronounced *John* disconnects C and T. As the last resort, do-support is invoked at C.[22] CI-derivation converges as a DQ (Hereafter, CI: DQ).

Consider a DQ in Japanese (18) with the structure (19) and the algorithm (20).

(18) John-ga nani-o tabe-ta-no? (↑)[23]
John-nom what-acc eat-past-Q
'For which x, x an individual, such that John ate x?'

20) LCA works minimally. An alternative is to parameterize English such that transfer is delayed at vP. "The phasehood of heads is a parametric choice made by languages (D'Alessandro and Scheer 2015: 601)." Since SM generates variation, we parameterize LCA activity rather than the mode of transfer.

21) T inherits [Q] from C. [Q] in T probes [q] in *what* at vP-edge (Chomsky 2000, 2001). In Chomsky (2000: 128–129), an uninterpretable wh feature (uwh) and uQ in a wh-move correspond to uCase and uφ in a non-wh move, respectively. Sobin (2010: 139, 145) distinguishes the interrogative C and C_{EQ}. C bears [Int, Q, *u*wh*, B^{WH}], where Int＝interpretable interrogative force feature (vs. [Decl(arative)]), Q ＝ T-to-C move triggering feature, *u*wh* ＝ EPP, and B^{WH} ＝ binding feature. C_{EQ} bears [Int, B^{EQ}]. The binding function for DQ is B^{WH} (XPi, $_{WH}$) → S_i, where S ＝scope operator. The binding function for EQ is B^{EQ} (XPi, $_{i\text{-}m}$) → S_i, where i-m ＝ interrogative-marked. Our analysis is simpler, i.e., all that is necessary is a C bearing uF [Q] probing the nearest matching [q] in the commanding area.

22) The chain and pronouncing tense rule (PTR) (Adger 2003: 192–194) are unnecessary. Assume that a pronounced term disconnects C & T and T & v in SM. The relevant examples are the following.

(i) a. John did not eat sushi.
b. Eat sushi, John did.
c. Did John eat sushi? ((Is p true or false: p ＝ (John ate sushi)?; yes/no question)
d. John ate sushi? (Is p_2 true or false: $p_2 = p_1$ (John ate sushi) is true?; additional p embedding)

In (i-a), the pronounced Neg *not* disconnects T & v, inducing do-support at T. In (i-b), the declarative vP IMs to the CP-edge. T attempts to connect with v, which is not pronounced. However, T cannot valuate a silent term, inducing do-support at T. In (i-c), a silent wh-operator Op_{wh} EMs at CP-edge (Adger 2003: 354). At CP-transfer, LCA determines <*John* at TP-edge, *eat* at v, and *sushi* in VP>. T attempts to connect with v, but T's past tense is incompatible with infinitival *eat*. T attempts to connect with C to emit T's tense. However, the pronounced *John* disconnects T and C, inducing do-support. In the EQ (i-d), T connects with v and values v as past. The wh-vP IMs to the CP-edge.

23) With the falling intonation, the speaker knows or presupposes that *John* ate something (＝ EQ).

(19) [$_{CP}$ nani-o [$_{C'}$ [$_{TP}$ John-ga [$_{T'}$ [$_{vP}$ ***John-ga*** [$_{v'}$ ***nani-o*** [$_{v'}$ [$_{VP}$ nani-o tabe] [v ***tabe*** v]]]] T ***ta***]] C ***no***]]

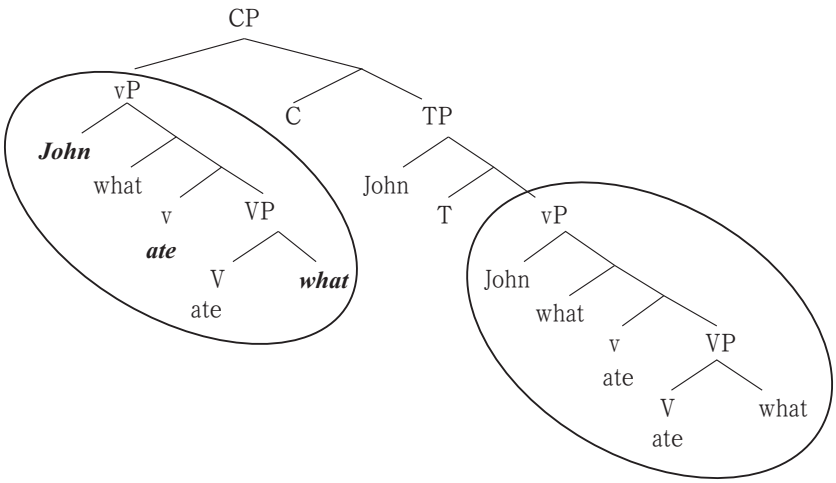
(20) ① θ_p: V → nani 'what'. IM (V, v).
② Probe: [ACC]$_v$ ⇝ [acc]$_{\text{Case particle } o}$. IM (*nani-o*, vP). VC_{acc}.
③ θ_a: v → *John*.
④ Transfer (vP + VP). SM: LCA active. Anti-LCA active. CI: vP = p
⑤ Probe: [NOM]$_T$ ⇝ [nom]$_{\text{Case particle } ga}$. IM (*John-ga*, TP). VC_{nom}.
⑥ Probe: [Q]$_C$ ⇝ [q]$_{nani}$. IM (*nani-o*, CP). VC_q.
⑦ Transfer (CP + TP). SM: LCA inactive. Anti-LCA active[24]; ↑. CI: DQ.

3.2 Structure of EQ

Consider an EQ without do-support. Unlike Sobin (2010: 143), we claim that what freezes is a wh-vP in an EQ, not the CP in the preceding statement.

(21) John ate what? (↑)
'For which $p \ni x$, such that p = (John ate x)?'

(22)



24) We assume that V, v, T, and C form a complex head in a different dimension (structure-computing space) in SM. Anti-LCA kicks in when LCA halts. Let [$_v$ V v] the structure of v. The first node dominating V is the lowest v', which dominates v. The first node dominating v is the lowest v', which dominates V. By definition, V and v are "sisters," which LCA fails to order. Anti-LCA orders as <V, v>. At C, anti-LCA looks at a complex head [$_C$ [$_T$ [$_v$ V v] T] C] and orders as they EM: <V, v, T, C>.

(23) ① ~ ③: the same as (17)

④ Transfer (vP + VP). SM: LCA inactive. T valuates *ate* as past. CI: vP = p

⑤ Probe: $[\text{NOM}]_{T} \rightsquigarrow [\text{nom}]_{\text{John}}$. IM (*John*, TP). VC_{nom}.

⑥ Probe: $[Q]_{C} \rightsquigarrow [q]_{\text{wh-vP}}$. IM (wh-vP, CP). VC_{q}.[25]

⑦ Transfer (CP + TP). SM: LCA active; do-support at C is unnecessary because T has valuated *ate* as past; ↑. CI: EQ.

Syntactic vs. pseudo EQ, C_{EQ} vs. interrogative C, and scope function for EQ (Sobin 2010) are unnecessary. Upon SM and CI receiving vague information, CI demands C_{HL} build an EQ-structure, where [Q] in C eliminates [q] in wh-vP. Unlike Sobin (2010: 144), all EQs are syntactic. Consider another EQ.

(24) What did John eat? (↑)[26]

'For which $p \ni x$, such that p = (John ate x)?'[27]

25) An internal merge of vP in an echo question is different from vP/VP-fronting (scrambling) as in the following examples.

(i) a. John wanted to win the race, and [win the race]$_1$ he did t_1.
b. They swore that John might have been taking heroin, and [taking heroin]$_1$ he might have been t_1! (Akmajian, Steele and Wasow (1979))

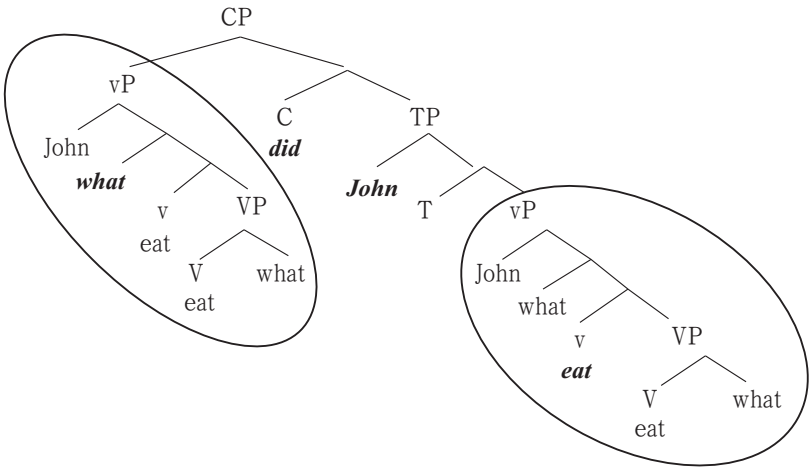
Crucially, vP/VP-scrambling requires declarative/exclamatory C, not interrogative C. See footnote 22.

26) Wells (2006: 56) observes an interesting contrast in EQ. The externalization process is unclear.

(i) a. Sophie's brought her friend (↓) along. … Who? (↓) (= Which friend? (↓))
b. Sophie's brought her friend (↓) along. … Who? (↑) (= Who has? (↑))

27) Hamblin (1973: 41) distinguishes two kinds of denotation-set: D_{prn} (a) vs. D_{fml} (a). D_{prn} (a) indicates the denotation-set of proper name a that is an individual, while D_{fml} (a) indicates the denotation-set of formula a that is a proposition. Wh-DPs are "interrogative proper nouns." We may call syntactic wh-vP as "interrogative proposition." "Pragmatically speaking a question sets up a choice-situation between a set of propositions, namely, those propositions that count as answers to it (ibid. 48)."

(25)



(26) ① ～ ③: the same as (17)

④ Transfer (vP + VP). SM: LCA inactive. CI: vP = p

⑤ ～ ⑥: the same as (23)

⑦ Transfer (CP + TP). SM: LCA active; do-support at C; ↑. CI: EQ.

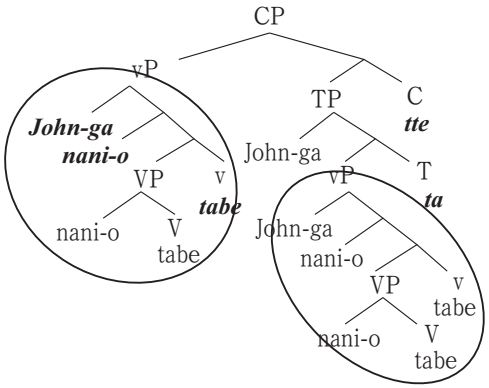
NS serves CI primarily. MC wins over SM's LCA here. All CI requires at CP-edge for EQ is "what." Externalizing "what" is sufficient.[28] Consider an EQ in Japanese.

(27) John-ga nani-o tabe-ta-tte? (↑; *↓)

John-nom what-acc eat-past-Q

'For which $p \ni x$, such that $p =$ (John ate x)?'

(28)



28) SM externalizes every term in the non-wh-vP at CP-edge in "John ate sushi did Mary say."

(29) ① ~ ③: the same as (20)

④ Transfer (vP + VP). SM: LCA inactive. CI: vP = p

⑤ Probe: $[\mathrm{NOM}]_{T} \rightsquigarrow [\mathrm{nom}]_{ga}$. IM (*John-ga*, TP). VC_{nom}.

⑥ Probe: $[Q]_{C} \rightsquigarrow [q]_{\underline{\text{wh-vP}}}$. IM (wh-vP, CP). VC_{q}.

⑦ Transfer (CP + TP). SM: LCA active; Anti-LCA active; ↑. CI: EQ.

The complex-NP island diagnostic verifies the dichotomy.[29] Consider the following contrast. Keep the neutral intonation (😐): no arbitrary change in pitch, stress, and pause. The idealization is extremely important because phonetic change signals structural difference.

(30) a. * Mary-wa [$_{NP}$ [$_{CP}$ John-ni naze hon-o ageta] hito]-ni atta-no? (↑; 😐) (DQ)
Mary-top John-dat why book-acc gave person-to met-Q
'For which reason x; Mary met the person that gave a book to John for x?'

b. Mary-wa [$_{NP}$ [$_{CP}$ John-ni naze hon-o ageta] hito]-ni atta-tte? (↑; 😐) (EQ)
Mary-top John-dat why book-acc gave person-to met-Q
'For which $p \ni x$; p = (Mary met the person that gave a book for x)?

In DQ, adjunct extraction is costly.[30] In EQ, IM of wh-vP to the CP-edge saves the example.

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29) See Ross (1967), Huang (1982), and Lasnik and Saito (1992: 174) for island diagnostic.

30) We do not adopt overt vs. covert distinction. Unlike an adjunct variable disconnected with V, a pronounced argument variable is recoverable in an island (i-a, b). A silent argument variable is not recoverable (i-c). SM externalization matters.

(i) a. Mary-wa [$_{NP}$ [$_{CP}$ John-ni nani-o ageta] hito]-ni atta-no? (↑; 😐) (Japanese)
Mary-top John-dat what-acc gave person-to met-Q
'For which y, y an individual, such that Mary met the person that gave y to John?'

b. Who met [$_{NP}$ the man [$_{CP}$ that bought what]]? (Brody 1995)
c. * What did Mary meet [$_{NP}$ the man [$_{CP}$ that bought (what)]]?

Our analysis explains why a D-linked wh-in-situ in WH-island takes the matrix scope.

(ii) Who knows [$_{CP}$ where we bought which books]? (Lasnik and Saito 1992: 171)
'For which $p \ni (x, y)$, such that p = (x knows where we bought y)?'

The wh-vP [$_{vP}$ who … [$_{CP}$ where [$_{C'}$ … which books]]] IMs to matrix CP-edge, and CI computes "who" and "which books" in the moved wh-vP at the matrix CP-edge. Aggressive-non-D (AgnD)-linking (Pesetsky 1987) nullifies the contrast.

(iii) a. * Mary-wa [$_{NP}$ [$_{CP}$ John-ni ittai nani-o ageta] hito]-ni atta-no? (↑; 😐)
Mary-top John-dat what.the.hell gave person-to met-Q
'For what the hell x; Mary met the person that gave x to John?' (Lasnik and Saito 1992: 173)

Contrary to the complex-NP-pied-piping hypothesis (Choe 1987, Nishigauchi 1986; 1990, Pesetsky 1987), we claim that wh-DPs IM to the matrix CP-edge in DQs. The pied-piping of a vP nullifies the island effect in an EQ.

4. Solutions to EQ Puzzles[31]

4.1 A Solution to the Superiority Problem

Consider a multiple DQ with the superiority effect.

(31) * What did who eat? (↓) (Superiority effect observed)

(32) [$_{CP}$ ***what*** [$_{C'}$ who [$_{C'}$ C ***did*** [$_{TP}$ ***who*** [$_{T'}$ T [$_{vP}$ who [$_{v'}$ what [$_{v'}$ [$_{v}$ v ***eat***] [$_{VP}$ eat what]]]]]]]]]

(33) ① ~ ③: the same as (17)
④ Transfer (vP + VP). SM: LCA inactive. CI: vP = p
⑤ Probe: $[NOM]_T$ ⇝ $[nom]_{who}$. IM (*who*, TP). VC_{nom}.
⑥ Probe: $[Q]_C$ ⇝ $[q]_{who}$. IM (*who*, CP).[32] $VC_{q\ in\ who}$. [Q] alive.
⑦ Probe: $[Q]_C$ ⇝ $[q]_{what}$. IM (*what*, CP). $VC_{q\ in\ what}$. SC violation.[33]
⑧ Transfer (CP + TP). SM: LCA active; do-support invoked at C; ↓. CI: DQ.

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b. * Mary-wa [$_{NP}$ [$_{CP}$ John-ni ittai naze hon-o ageta] hito]-ni atta-tte? (↑; ☹)
Mary-top John-dat why.the.hell book-acc gave person-to met-Q
'For which $p \ni$ why the hell y; p = (Mary met the person that gave a book to John for y)?'

The example (iii-a) is similar to (i-c): "ittai nani-o" (what the hell) is obligatorily interpreted at the matrix CP-edge, thereby disconnected with the embedded V. In (iii-b), AgnD-linked wh-DP IMs to the matrix CP-edge, which is incompatible with EQ.

31) Sobin's (2010) "absent-wh-move problem" disappears, because EQs involve IM of wh-vP.

32) C must attract distant "what" first in order to exclude the example by antecedent government of ECP (Kayne 1981, Chomsky 1981, Jaeggli 1982). However, the step looks ahead and violates MC.

33) Consider other superiority contrast (Huang 1982). The structures follow respectively.

(i) a. Why did you buy what? (↓)
b. * What did you buy why? (↓)

(ii) a. [$_{CP}$ what [$_{C'}$ ***why*** [$_{C'}$ C ***did*** [$_{TP}$ ***you*** [$_{T'}$ T [$_{vP}$ why [$_{vP}$ you [$_{v'}$ what [$_{v'}$ [$_{v}$ v ***buy***] [$_{VP}$ buy ***what***]]]]]]]]]
b. [$_{CP}$ ***what*** [$_{C'}$ why [$_{C'}$ C ***did*** [$_{TP}$ ***you*** [$_{T'}$ T ***buy*** [$_{vP}$ ***why*** [$_{vP}$ you [$_{v'}$ what [$_{v'}$ [$_{v}$ v buy] [$_{VP}$ buy what]]]]]]]]]

(ii-a) obeys SC, while (ii-b) violates it. IM of V to T in (ii-b) is unmotivated, violating MC. Takita, Fuji, Yang (2007: 110) reports that Chinese lacks superiority contrast. The structures follow respectively.

In contrast, a multiple EQ lacks the superiority effect. We shade the wh-vP copies.

(34) What did who eat? (↑) (No superiority effect observed)

(35) [$_{CP}$ [$_{vP}$ who [$_{v'}$ ***what*** [$_{v'}$ [$_{v}$ v eat] [$_{VP}$ eat what]]]] [$_{C'}$ C ***did*** [$_{TP}$ ***who*** [$_{T'}$ T [$_{vP}$ who [$_{v'}$ what [$_{v'}$ [$_{v}$ v ***eat***] [$_{VP}$ eat what]]]]]]]]

(36) ① ~ ③: the same as (17)
④ Transfer (vP + VP). SM: LCA inactive. CI: vP = p
⑤ Probe: [NOM]$_{T}$ ⇝ [nom]$_{who}$. IM (*who*, TP). VC$_{nom}$.
⑥ Probe: [Q]$_{C}$ ⇝ [q]$_{wh\text{-}vP}$. IM (wh-vP, CP). VC$_{q}$.[34] No SC violation.
⑦ Transfer (CP + TP). SM: LCA active; do-support at C; ↑. CI: EQ.

The derivation obeys SC. The same reasoning applies to the superiority amelioration in D-linked wh questions (Pesetsky 1987, Adger 2003: 366).[35] All that is required for CI to compute the

(iii) a. ni weishenme mai na-ben-shu ne?
you why buy that-CL-book Q
'Why did you buy that book?'

b. * ni weishenme mai shenme ne?
you why buy what Q
'Why did you buy what?'

c. * shenme ni weishenme mai ne?
what you why buy Q
'(Lit.) What did you buy why?'

(iv) a. [$_{CP}$ weishenme [$_{TP}$ ***ni*** [$_{T'}$ T [$_{vP}$ ***weishenme*** [$_{vP}$ ni [$_{vP}$ na-ben-shu [$_{v'}$ [$_{v}$ v ***mai***] [$_{VP}$ mai ***na-ben-shu***]]]]]]] C ***ne***]
b. * [$_{CP}$ shenme [$_{C'}$ weishenme [$_{C'}$ C [$_{TP}$ ***ni*** [$_{T'}$ T [$_{vP}$ ***weishenme*** [$_{vP}$ ni [$_{v'}$ shenme [$_{v'}$ [$_{v}$ v ***mai***] [$_{VP}$ mai ***shenme***]]]]]]]]] C ***ne***]
c. * [$_{CP}$ ***shenme*** [$_{C'}$ weishenme [$_{C'}$ C [$_{TP}$ ***ni*** [$_{T'}$ T [$_{vP}$ ***weishenme*** [$_{vP}$ ni [$_{v'}$ shenme [$_{v'}$ [$_{v}$ v ***mai***] [$_{VP}$ mai shenme]]]]]]]]] C ***ne***]
c'. [$_{CP}$ weishenme [$_{C'}$ shenme [$_{C'}$ C [TP ***shenme*** [$_{TP}$ ***ni*** [$_{T'}$ T [$_{vP}$ ***weishenme*** [$_{vP}$ ni [$_{v'}$ shenme [$_{v'}$ [$_{v}$ v ***mai***] [$_{VP}$ mai shenme]]]]]]]]]] C ***ne***]

In (iv-b), (shenme ↷ weishenme) at CP-edge and (weishenme ↷ shenme) at vP-edge: a contradiction. If Chinese lacks scrambling: "shenme" is pronounced at CP-edge (iv-c), SC correctly rules (iii-c) out. If Chinese has scrambling: "shenme" adjoins to TP (iv-c'), our analysis incorrectly rules (iii-c) in. We assume (iv-c). Alternatively, Chinese simply cannot tolerate <O, S, adjunct, V> order of (iii-c). Tsai's (1994) unselective binding and Richards' (1997) tucking in are unnecessary.

34) Wh-vP crossing over wh-DP does not violate Rizzi's (1990) relativized minimality.

35) Questions in quiz shows are D-linked and involve IM of a wh-vP to a CP-edge for [q]-elimination.

(i) They thought JFK was assassinated in which Texas city? (Chomsky 2013: 44)
'For which $p \ni x$, such that $p =$ (they thought JFK was assassinated in x)?'

structure as an EQ is "what" at CP-edge, which CI microscopically sees. SM respects CI, pronouncing only "what" at CP-edge (CI-priority condition). SM compensates costly do-support with costless externalization at CP-edge. In (22), without costly do-support, SM needs not minimize cost, pronouncing all terms in the moved vP. Japanese DQs exhibit a superiority contrast (Watanabe 1991; 1992).

(37) a. John-ga nani-o naze tabe-ta-no? (↑ and 😐; no superiority effect)
John-nom what-acc why eat-past-Q
'What is individual x, what is reason y, such that John ate x for y?'

b. * John-ga naze nani-o tabe-ta-no? (↑ and 😐; superiority effect)
John-nom why what-acc eat-past-Q
'What is individual x, what is reason y, such that John ate x for y?'

The structure and the algorithm of (37a) are as follows.

(38) [$_{CP}$ naze [$_{C'}$ nani-o [$_{C'}$ [$_{TP}$ ***John-ga*** [$_{T'}$ [$_{vP}$ ***nani-o*** [$_{vP}$ ***naze*** [$_{vP}$ John-ga [$_{v'}$ nani-o [$_{VP}$ nani-o tabe] [$_{v}$ ***tabe*** v]]]]] T ***ta***]] C ***no***]]]

(39) ① ~ ③: the same as (20)
④ EM (*naze* (why), vP).
⑤ Probe: [FOC]$_{v}$ ⇝ [foc]$_{nani\text{-}o}$. IM (*nani-o*, vP). VC$_{foc}$.
⑥ Transfer (vP + VP). SM: LCA active. CI: vP = p
⑦ Probe: [NOM]$_{T}$ ⇝ [nom]$_{ga}$. IM (*John-ga*, TP). VC$_{nom}$.
⑧ Probe: [Q]$_{C}$ ⇝ [q]$_{nani}$. IM (*nani-o*, CP). VC$_{q\ in\ nani}$. [Q] alive.
⑨ Probe: [Q]$_{C}$ ⇝ [q]$_{naze}$. IM (*naze*, CP). VC$_{q}$.
⑩ Transfer (CP + TP). SM: LCA active; no contradiction: (naze ↷ nani-o) at CP-edge and the same relation is available at vP-edge; SM minimally pronounces TP. Anti-LCA active; ↑. CI: DQ.

LCA takes a contradiction in relative sense. LCA does not detect a contradiction as long as rele-

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The embedded C without [Q] fails to eliminate [q], as in (ii-a). A labeling algorithm is unnecessary.

(ii) a. * They thought [$_{\alpha}$ in which Texas city [$_{\beta}$ C [JFL was assassinated]]]?
b. They wondered [$_{\alpha}$ in which Texas city [$_{\beta}$ C [JFL was assassinated]]]. (ibid., 45)

vant command relation is available. LCA calculation and actual SM pronunciation are divorced.[36] Consider the structure and the algorithm of (37b).

(40) [$_{CP}$ nani-o [$_{C'}$ naze [$_{C'}$ [$_{TP}$ ***John-ga*** [$_{T'}$ [$_{vP}$ ***naze*** [$_{vP}$ John-ga [$_{v'}$ ***nani-o*** [$_{VP}$ nani-o tabe] [$_{v}$ ***tabe*** v]]]] T ***ta***]] C ***no***]]][37]

(41) ① ~ ③: the same as (20)
④ EM (*naze*, vP).
⑤ Transfer (vP + VP). SM: LCA active. CI: vP = p
⑥ Probe: $[NOM]_T$ ⇝ $[nom]_{ga}$. IM (*John-ga*, TP). VC_{nom}.
⑦ Probe: $[Q]_C$ ⇝ $[q]_{naze}$. IM (*naze*, CP). $VC_{q\ in\ naze}$. [Q] alive.
⑧ Probe: $[Q]_C$ ⇝ $[q]_{nani}$. IM (*nani-o*, CP). $VC_{q\ in\ nani}$.
⑨ Transfer (CP + TP). SM: LCA active; a contradiction: (nani-o ↷ naze) at CP-edge vs. (naze ↷ nani-o) at vP-edge: SM-derivation crashes. SM minimally pronounces TP. Anti-LCA active; ↑. CI: DQ.

Step ⑨ causes the ungrammaticality.[38] The example (37b) becomes grammatical if we stress wh-DPs and insert pauses, which is indicated by ☹ hereafter.

(42) John-ga, NAZE, NANI-o, tabeta-no? (↑; ☹)
John-nom why what-acc ate-Q
'(Lit.) John ate WHAT WHY?'

The structure is different from (40). "Naze" and "nani-o" have undergone focus IM.

36) Our analysis is a flexible version of cyclic linearization (the linear ordering of syntactic units is affected by EM and IM within a Spell-out domain, but is fixed once and for all at the end of each Spell-out; Fox and Pesetsky 2005a; 2005b, Ko 2014: 8).

37) If NS respects MC, a general relation preservation principle (RPP) incorrectly allows (37b): the closer "naze" IMs first. To exclude it, RPP analysis must state that the distant "nani-o" adjoins to Op_{wh} first. However, MC bars this step.

38) Watanabe's (1991; 1992) anti-SC (ASC) states that wh-phrase undergoing the first IM to CP-edge must cross over another wh-phrase undergoing the second IM to CP-edge. ASC violates MC: C attracts the distant wh-phrase. Watanabe's analysis based on RPP and seg(ment)-command has problems. x does not seg-command y if x is adjoined to y (y contains x). x seg-command z if z is adjoined to y first and then x is adjoined to y (y contains x and z)). Given (38), RPP analysis incorrectly excludes (37a). To rule (37a) in, RPP analysis must state that a silent wh-operator Op_{wh} generated at edge of adjunct wh-DP "naze" IMs to CP-edge first to satisfy antecedent government (lookahead). Next, "naze" adjoins to Op_{wh}, followed by "nani-o" adjoining to Op_{wh}, forming an Op_{wh} amalgam at CP-edge (locality violation). Prior to wh-IM, "nani-o" seg-commands "naze," which seg-commands "nani-o." RPP demands "nani-o" adjoin to Op_{wh}, then "naze," and "nani-o," forming [$_{Op}$ naze [$_{Op}$ nani-o [$_{Op}$ naze Op]]] (ad-hoc).

(43) [$_{CP}$ nani-o [$_{C'}$ naze [$_{C'}$ [$_{TP}$ ***John-ga*** [$_{T'}$ [$_{vP}$ ***naze*** [$_{vP}$ ***nani-o*** [$_{vP}$ naze [$_{vP}$ John-ga [$_{v'}$ nani-o [$_{VP}$ nani-o tabe] [$_{v}$ ***tabe*** v]]]]]] T ***ta***]] C ***no***]]]

The command relation (*nani-o* ↷ *naze*) at CP-edge is available at vP-edge. LCA detects no contradiction. Focus IM widens grammaticality. We will observe more examples later. The superiority contrast disappears in EQ in Japanese, as in English.

(44) a. John-ga nani-o naze tabe-ta-tte? (↑ and 😐; no superiority effect)
John-nom what-acc why eat-past-Q
'What is the proposition ($p \ni \{x, y\}$); p = (John ate x for some reason y)?'

b. John-ga naze nani-o tabe-ta-tte? (↑ and 😐; no superiority effect)
John-nom why what-acc eat-past-Q
'What is the proposition ($p \ni \{x, y\}$); p = (John ate x for some reason y)?'

The structure of EQ in (44a) is as follows. Since the wh-vP IMs to CP-edge, the command relation of wh-phrases is identical at vP-edge and CP-edge.

(45) [$_{CP}$ [$_{vP}$ nani-o [$_{vP}$ naze [$_{vP}$ …]] [$_{C'}$ [$_{TP}$ ***John-ga*** [$_{T'}$ [$_{vP}$ ***nani-o*** [$_{vP}$ ***naze*** [$_{vP}$ John-ga [$_{v'}$ nani-o [$_{v'}$ [$_{VP}$ nani-o tabe] [$_{v}$ ***tabe*** v]]]]]] T ***ta***]] C ***tte***]]

(46) ① ~ ③: the same as (20)
④ EM (*naze*, vP).
⑤ Probe: [FOCUS]$_{v}$ ⇝ [focus]$_{nani\text{-}o}$. IM (*nani-o*, vP). VC$_{focus}$.
⑥ Transfer (vP + VP). SM: LCA active. CI: vP = p
⑦ Probe: [NOM]$_{T}$ ⇝ [nom]$_{ga}$. IM (*John-ga*, TP). VC$_{nom}$.
⑧ Probe: [Q]$_{C}$ ⇝ [q]$_{wh\text{-}vP}$. IM (wh-vP, CP). VC$_{q}$.
⑨ Transfer (CP + TP). SM: LCA active; no contradiction. SM minimally pronounces TP. Anti-LCA active; ↑. CI: EQ.

The structure of (44b) is as follows.

(47) [$_{CP}$ [$_{vP}$ naze [$_{vP}$ John-ga [$_{v'}$ nani-o …]]] [$_{C'}$ [$_{TP}$ ***John-ga*** [$_{T'}$ [$_{vP}$ ***naze*** [$_{vP}$ John-ga [$_{v'}$ ***nani-o*** [$_{v'}$ [$_{VP}$ nani-o tabe] [$_{v}$ ***tabe*** v]]]]] T ***ta***]] C ***tte***]]

(48) ① ～ ③: the same as (20)
④ EM (*naze*, vP).
⑤ Transfer (vP + VP). SM: LCA active. CI: vP = p
⑥ Probe: $[\text{NOM}]_T$ ⇝ $[\text{nom}]_{ga}$. IM (*John-ga*, TP). VC_{nom}.
⑦ Probe: $[Q]_C$ ⇝ $[q]_{\text{wh-vP}}$. IM (wh-vP, CP). VC_q.
⑧ Transfer (CP + TP). SM: LCA active; no contradiction. SM minimally pronounces TP. Anti-LCA active; ↑. CI: EQ.

IM of the capsulated vP to the CP-edge signals EQ to SM and CI.
Our analysis solves long-standing recalcitrant superiority problems in Japanese. SC does not work here: no wh-phrase is pronounced at CP-edge. Our analysis is simple. Given multiple wh-DPs prior to IM (wh-DP_2 commanding wh-DP_1), C attracts the closest wh-DP_2 first, and IM respects cyclicity. If LCA detects a contradiction, the derivation crashes in SM. Argument wh-DPs are superiority-free.

(49) a. dare-ga nani-o tabeta-no? (↑) (basic order)
who-nom what-acc ate-Q
'Who ate what?'

b. nani-o dare-ga tabeta-no? (↑) (foc(us) IM of 'nani-o')
what-acc who-nom ate-Q
(Lit.) What did who eat?'

(50) a. [$_{CP}$ nani-o [$_{C'}$ dare-ga [$_{TP}$ dare-ga [$_{vP}$ ***dare-ga*** [$_{v'}$ ***nani-o*** [[$_{VP}$ nani-o tabe] [$_{v}$ v ***tabe***]]]]] T ***ta***] C ***no***]] (= 49a)

b. [$_{CP}$ nani-o [$_{C'}$ dare-ga [$_{TP}$ dare-ga [$_{vP}$ ***nani-o*** [$_{vP}$ ***dare-ga*** [$_{v'}$ nani-o [[$_{VP}$ nani-o tabe] [$_{v}$ v ***tabe***]]]]]] T ***ta***] C ***no***]] (49b)

In (50), LCA is active at vP-transfer, while it is inactive at CP-transfer (MC). Thus, LCA detects no contradiction. We should consider phonological properties seriously when we perform thought experiment of grammaticality with examples as in Watanabe (1991; 1992). A change in NS causes a change in SM and CI.

(51) a. dare-ga nani-o naze katta-no? (↑; ☹) (foc movement of 'nani-o')

who-nom what-acc why bought-Q
'Who bought what why?'

b. * dare-ga naze nani-o katta-no? (↑; 😐)
who-nom why what-acc bought-Q
'Who bought what why?'

c. DARE-ga, NAZE, NANI-o, katta-no? (↑; ☹; foc IM of 'naze' and 'nani-o')
who-nom why what-acc bought-Q
'(Lit.) WHO bought WHAT WHY?'

(52) a. [$_{CP}$ naze [$_{C'}$ nani-o [$_{C'}$ dare-ga [$_{TP}$ ***dare-ga*** [$_{vP}$ ***nani-o*** [$_{vP}$ ***naze*** [$_{vP}$ dare-ga [$_{v'}$ nani-o [$_{VP}$ nani-o kaw] [$_{v}$ v ***kaw***]]]]] T ***ta***] C ***no***] (= 51a)

b. [$_{CP}$ nani-o [$_{C'}$ naze [$_{C'}$ dare-ga [$_{TP}$ ***dare-ga*** [$_{vP}$ ***naze*** [$_{vP}$ dare-ga [$_{v'}$ ***nani-o*** [$_{VP}$ nani-o kaw] [$_{v}$ v ***kaw***]]]] T ***ta***] C ***no***] (= 51b)

c. [$_{CP}$ nani-o [$_{C'}$ naze [$_{C'}$ dare-ga [$_{TP}$ ***dare-ga*** [$_{vP}$ ***naze*** [$_{vP}$ ***nani-o*** [$_{vP}$ naze [$_{vP}$ dare-ga [$_{v'}$ nani-o [$_{VP}$ nani-o kaw] [$_{v}$ v ***kaw***]]]]]] T ***ta***] C ***no***] (= 51c)

Let a command relation at a CP-edge is (a ↷ b ↷ c). LCA examines whether (a ↷ b) and (b ↷ c) are available at vP-edge. LCA looks at two terms at a time (MC). In (52a), (*naze* ↷ *nani-o*) and (*nani-o* ↷ *dare-ga*) at CP-edge are available at vP-edge: no contradiction. In (52b), (*nani-o* ↷ *naze*) and (*naze* ↷ *dare-ga*) are at CP-edge. At vP-edge, (*naze* ↷ *dare-ga*) is available; (*nani-o* ↷ *naze*) is not: a contradiction. In (52c), (*nani-o* ↷ *naze*) and (*naze* ↷ *dare-ga*) at CP-edge are available at vP-edge: no contradiction. Consider another contrast.

(53) a. * naze dare-ga nani-o katta-no? (↑; 😐)
why who-nom what-acc bought-Q
'(Lit.) Why did who buy what?'

b. NAZE, DARE-ga, NANI-o, katta-no? (↑; ☹; foc IM of 'naze' and 'nani-o')
why who-nom what-acc bought-Q
'(Lit.) WHY did WHO buy WHAT?'

(54) a. [$_{CP}$ nani-o [$_{C'}$ naze [$_{C'}$ dare-ga [$_{TP}$ dare-ga [$_{vP}$ ***naze*** [$_{vP}$ ***dare-ga*** [$_{v'}$ ***nani-o*** [$_{VP}$ nani-o kaw] [$_{v}$ v ***kaw***]]]] T ***ta***] C ***no***]]] (= 53a)

b. [$_{CP}$ nani-o [$_{C'}$ naze [$_{C'}$ dare-ga [$_{TP}$ dare-ga [$_{vP}$ ***naze*** [$_{vP}$ ***dare-ga*** [$_{vP}$ ***nani-o*** [$_{vP}$ naze [$_{vP}$ dare-ga [$_{v'}$ nani-o [$_{VP}$ nani-o kaw] [$_{v}$ v ***kaw***]]]]] T ***ta***]] C ***no***]]]]] (= 53b)

In (54a), (*nani-o* ↷ *naze*) and (*naze* ↷ *dare-ga*) are at CP-edge. At vP-edge, (*naze* ↷ *dare-ga*) is available; (*nani-o* ↷ *naze*) is not: a contradiction (the same as (52b)). In (54b), (*nani-o* ↷ *naze*) and (*naze* ↷ *dare-ga*) at CP-edge are available at vP-edge: no contradiction. The superiority effect disappears in the corresponding EQs.

(55) a. dare-ga naze nani-o katta-tte? (↑; 😐) (vs. *DQ (51b))
who-nom why what-acc bought-Q
'For which proposition $p \ni x, y, z$, such that $p = (x$ bought y for $z)$?'

b. naze dare-ga nani-o kata-tte? (↑; 😐) (vs. *DQ (53a))
why who-nom what-acc bought-Q
'For which proposition $p \ni x, y, z$, such that $p = (x$ bought y for $z)$?'

An EQ involves IM of the capsulated wh-vP to the CP-edge. The command relation of wh-phrases does not change. Thus, no superiority effect is observed.

4.2 A Solution to the Scope problem

Consider the following multiple DQ with the structure and the algorithm. X taking wide scope over Y is indicated as X > Y.

(56) Who ate what? (↓) (who > what, what > who)
'For which person x, such that x ate which thing y?' OR
'For which thing y, such that which person x ate y?'

(57) [$_{CP}$ what [$_{C'}$ ***who*** [$_{C'}$ C [$_{TP}$ who [$_{T'}$ T [$_{vP}$ who [$_{v'}$ what [$_{v'}$ [$_{v}$ v ***ate***] [$_{VP}$ ate ***what***]]]]]]]]]

(58) ① ~ ③: the same as (17)

④ Transfer (vP + VP). SM: LCA active.[39] CI: vP = p

⑤ Probe: $[NOM]_T$ ⇝ $[nom]$. IM (*who*, TP). VC_{nom}.

⑥ Probe: $[Q]_C$ ⇝ $[q]_{who}$. IM (*who*, CP). VC_q. [Q] alive.

⑦ Probe: $[Q]_C$ ⇝ $[q]_{what}$. IM (*what*, CP). VC_q. No SC violation.

⑧ Transfer (CP + TP). SM: LCA active; ↓. CI: DQ; ambiguous scope.[40]

In contrast, the scope ambiguity disappears in multiple EQs.

(59) What did who eat? (↑) (*who* > *what*, * *what* > *who*)
'For which x, such that x ate a thing y?'

(60) $[_{CP}$ $[_{vP}$ who $[_{v'}$ ***what*** $[_{v'}$ $[_{v}$ v eat] $[_{VP}$ eat what]]]] $[_{C'}$ C ***did*** $[_{TP}$ ***who*** $[_{T'}$ T $[_{vP}$ who $[_{v'}$ what $[_{v'}$ $[_{v}$ v ***eat***] $[_{VP}$ eat what]]]]]]]]

(61) ① ~ ③: the same as (17)

④ Transfer (vP + VP). SM: LCA inactive. CI: vP = p

⑤ Probe: $[NOM]_T$ ⇝ $[nom]_{who}$. IM (*who*, TP). VC_{nom}.

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39) SM respects MC rather than LCA here: all MC demands is to pronounce one copy of 'what'.

40) AgnD-linking of a lower wh-DP in multiple DQs induces ungrammaticality.

(i) * Who read what the hell? (↓) (Lasnik and Saito 1992: 173)
(ii) a. ittai dare-ga nani-o tabeta-no? (↑; ☺) (Japanese)
the hell who-nom what-acc ate-Q
'(Lit.) Who the hell ate what? (↓)'

b. ?* dare-ga ittai nani-o tabeta-no? (↑; ☺)
who-nom the hell what-acc ate-Q
'(Lit.) Who ate what the hell? (↓)'

In (i) and (ii-b), the distant wh-DP IMs first: an MC violation. Multiple EQs disallows AgnD-linking.

(iii) * Who ate what the hell? (↑)
(iv) a. ittai dare-ga nani-o tabeta-tte? (↑) (Japanese)
the hell-who-nom what-acc ate-Q
'(Lit.) Who the hell ate what? (↑)'

b. ?* dare-ga ittai nani-o tabeta-tte? (↑)
who-nom the hell what-acc ate-Q
'(Lit.) Who ate what the hell? (↑)'

In (iv-a), AgnD-linker "ittai" (the hell) attaches to wh-vP, while in (iii) and (iv-b) it attaches to the object wh-DP. A conflict arises: EQ demands IM of vP, while AgnD-linking demands IM of the object wh-DP. Alternatively, the ungrammaticality derives from a WH-island effect: the AgnD-linked wh-DP is extracted from the wh-vP (= WH-island).

⑥ Probe: $[Q]_C$ ⇝ $[q]_{\underline{\text{wh-vP}}}$. IM (wh-vP, CP). VC_q.

⑦ Transfer (CP + TP). SM: LCA active; SM minimally pronounces $<<_{vP}$ ***what***$>$, ***who***, $<_{vP}$ ***eat***$>>$; do-support at C; ↑. CI: EQ; *who* scopes over *what*.

However, the following EQ poses a problem.

(62) Who ate what? (↑) (**who > what, what > who*)
'For which thing y, such that which person x ate y?'

(63) $[_{CP}$ $[_{vP}$ ***who*** $[_{v'}$ what $[_{v'}$ $[_{v}$ v ***ate***$]$ $[_{VP}$ ate ***what***$]]]]$ $[_{C'}$ C $[_{TP}$ who $[_{T'}$ $[_{vP}$ who $[_{v'}$ what $[_{v'}$ $[_{v}$ v ate$]$ $[_{VP}$ ate what$]]]]]]]]$

(64) ① ~ ③: the same as (17)

④ Transfer (vP + VP). SM: LCA inactive; T valuates *ate* as past. CI: vP = p

⑤ Probe: $[NOM]_T$ ⇝ $[nom]_{who}$. IM (*who*, TP). VC_{nom}.

⑥ Probe: $[Q]_C$ ⇝ $[q]_{\underline{\text{wh-vP}}}$. IM (wh-vP, CP). VC_q.

⑦ Transfer (CP + TP). SM: LCA active; SM maximally pronounces every term in the moved vP; do-support at C unnecessary: T valuates *ate* as past; ↑. CI: EQ; 'who' scopes over 'what'.

Step ⑦ contradicts the fact: "what" scopes over "who." For scope calculation, there must be some reason that CI first computes "who" at TP-edge, and then "what" inside the moved wh-vP, yielding scope (*what > who*). We claim that the CI-priority condition is operating: SM respects CI and ignores LCA. In (63), without costly do-support, CI has room for macroscopically looking at the entire CP structure and calculate "who" at TP-edge and "what" at CP-edge, yielding scope (*what > who*). In contrast, in (60), with costly do-support, CI must look inside the moved wh-vP microscopically and yields scope (*who > what*). CI compensates for the costly do-support at C with the costless microscopic computation within the moved vP.[41)]

41) Consider the following dialogues in Japanese.

(i) A: dare-ga dare-o aishiteru-no? (↑; ☺; DQ)
who-nom who-acc love-Q
'Who loves who?'
B: Mary, minna.
Mary everyone
'(Lit.) Mary, everyone loves.'

(ii) A: dare-ga dare-o aishiteru-tte? (↑; ☺; EQ)
who-nom who-acc love-Q
'Who loves who?'
B: # Mary, minna.
Mary everyone
'(Lit.) Mary, everyone loves.'

5 Concluding Remarks

EQs are questions in the usual sense with the phonetics, syntax, and semantics we attribute to the algorithm involving [Q]-[q] virus checking in DQ. A phase-theoretic CI-priority algorithm obeying MC works well. In C_{HL}, IM of wh-DPs to CP-edge creates DQ. In contrast, IM of wh-vP to CP-edge creates EQ. The syntactic dichotomy yields distinct phonetics and semantics. Our analysis with SC and flexible LCA solves the puzzles regarding superiority and scope. Other devices are unnecessary. The analysis provides a fresh perspective on superiority, scope, and the island effect.

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In (i-A), CP-edge has "nani-o" ↷ "dare-ga," allowing an answer to *nani* > *dare* in B. In (ii-A), the vP with "dare-ga" ↷ "nani-o" IMs to CP-edge, disallowing an answer to *nani* > *dare* in B.

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