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ATB Extraction in the Box System*

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ABSTRACT

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This study critically examines the well-established analyses of across-the-board (ATB) extraction, ranging from movement-based to copy-based to Merge-based approaches, within the framework of the Strong Minimalist Thesis (SMT). Merge, considered the most economical structure building operation, is expected to meet Minimal Yield (MY) by introducing the fewest possible new items into the workspace (WS). Adherence to this principle aligns Merge with SMT, whereas the previous accounts for ATB extraction deviate from MY. Chomsky (2021) provides an account for ATB extraction within the Merge framework while maintaining the segregation of A/A'-movement. However, issues stemming from this segregation lead Chomsky (2023a) to propose the box theory, aiming to eliminate distinctions between A/A'-movement. This study will delve into the box theory, identifying challenges related to ATB extraction. Utilizing precise definitions of eligibility and accessibility, we will argue that the specifier of INFL (SPEC-INFL) remains accessible to phase heads with restriction of Phase Impenetrability Condition (PIC) despite being ineligible for Merge. Additionally, we will incorporate Mizuguchi's (2019) proposal that posits a phonetically null complementizer forms a composite head with INFL. With these refinements, ATB extraction can be successfully explained within the box system, adhering to SMT. Our analysis aligns with Chomsky's (2023a) perspective of eliminating successive-cyclic A/A'-movement, effectively eliminating distinctions between A/A' movement.

KEYWORDS

across-the-board (ATB), cyclicity, box theory, Merge, Strong Minimalist Thesis (SMT)

1. Introduction to Key Approaches on ATB

Ross (1967) proposes the Coordination Structure Constraint (CSC): 'In a coordinate structure, no conjunct may be moved, nor may any element contained in a conjunct be moved out of that conjunct.' However, there is an exceptional extraction known as across-the-board (ATB), where extraction takes place out of each conjunct. Analyses of ATB extraction vary from movement theory to copy theory to Merge. Because extraction takes place from each conjunct, movement-based analyses of ATB extraction are far from the general cyclic movement. Copy-based approaches seem to fall short of Strong Minimalist Thesis (SMT), the thesis that I-language is generated by the simplest operations.[1] Merge-based approaches could provide an optimal account to ATB extraction if they conform to SMT. There are representative approaches in each theory: Williams's (1978) factorization, Nunes's (2001) Sideward Movement, and Citko's (2005) Parallel Merge. All of these offer counter-cyclic explanations and, as a result, deviate from SMT. The essential ideas of these analyses are briefly outlined as follows.

Williams (1978) proposes a parallel movement approach, where an identical set of simultaneous factors undergo movement and deletion. There is only one application of movement. For example, in (1), the identical *who* in each conjunct moves to SPEC-COMP (SPEC-C) in parallel, and both the underlying factors are simultaneously deleted.

(1) a. Who John saw and Bill hit
b. who C [[John saw ~~who~~]$_S$ and [Bill hit ~~who~~]$_S$]$_S$

(2) a. I know the man who John likes and we hope will win
b. COMP $\left[\begin{array}{lll} \text{[John likes} & \text{who]}_S & \\ \text{[we hope} & \text{[who} & \text{will win]}_S\ ]_S \end{array}\right]$

Example (2) deviates from parallelism as the object is extracted from the first, and the subject is extracted from the second conjunct (refer to Williams for further instances of parallelism deviations). Nonetheless, Williams asserts that both conjuncts are split, and the left brackets are aligned in the same factor. Due to this alignment, the extraction of identical factor *who* becomes possible.

Another approach is Nunes's (2001) Sideward Movement, which is grounded in the copy theory. An element is copied from a conjunct K and merged with a syntactic object L, composing another conjunct M. The two conjuncts K and M are completed in separate workspaces (WS) independently, but share the same element by means of Sideward Movement.

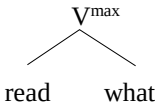
(3) Which paper did John file and Mary read
(i) a. K = [$_{TP}$ did [$_{vP}$ Mary v [$_{VP}$ read [which paper]]]] ← Copy *which paper*
b. L= file
(ii) a. K = [$_{TP}$ did [$_{vP}$ Mary v [$_{VP}$ read [which paper]$_i$]]]
b. M= [$_{vP}$ John v [$_{VP}$ file [which paper]$_i$]] ← Merge *which paper* with *file*
(iii) [$_{CP}$ [which paper]$_3$ did$_3$ + Q [$_{andP}$ [$_{TP}$ John ~~did$_2$~~ file ~~[which paper]~~$_2$] [$_{and'}$ and [$_{TP}$ Mary ~~did$_1$~~ read ~~[which paper]~~$_1$]]]] ← Form Chain and Chain Reduction

[1] SMT is also understood as the thesis that the Faculty of Language (FL) is an optimal solution to certain language-specific conditions (Chomsky et al. 2023).

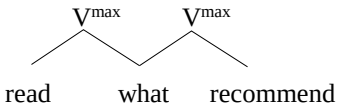
Which paper in (3) is copied from conjunct K and merged with syntactic object L, forming conjunct M. Once two conjuncts are established, they are coordinated and then *which paper* is copied and merged into ongoing derivation. Chain formation and reduction of copies take place subsequently. As a result of Form Chain between copies in c-command condition and Chain Reduction, the lower copies are deleted in the phonological component (i.e., ([which paper]$_3$, [~~which paper~~]$_2$), ([which paper]$_3$, [~~which paper~~]$_1$) and (did$_3$, ~~did~~$_2$), (did$_3$, ~~did~~$_1$))

A third approach is Parallel Merge suggested by Citko (2005). A shared element merges with two distinct objects simultaneously and takes them as its mother nodes. In (4), a single object *what* is merged simultaneously with two verbs, *recommend* and *read*, and each verb is projected forming a double peak structure.

(4) I wonder what Gretel recommended and Hansel read.
(i) Merge *read* and *what*, project *read*



(ii) Parallel-merge *recommended* and *what*, project *recommended*



The consequence of Parallel Merge is that two Agree operations occur in parallel. Besides, Parallel Merge exhibits properties of both External Merge and Internal Merge in that the object *what*, after being externally merged with a syntactic object (SO), is merged with another SO.

All of these approaches do not fit into SMT. Williams' movement approach needs to be reanalyzed from minimalist viewpoint since it raises issues related to Inclusiveness Conditions (Chomsky 1995). Both Sideward Movement and Parallel Merge need to be justified based on economy principles because they employ anomalous non-standard structures, setting aside the issue of two Agree operations (whether they occur subsequently or simultaneously). The next section will examine an economy principle called Minimal Yield (MY) and how Chomsky (2021) accounts for ATB with satisfying the principle. We will also explore how Chomsky's (2023a, 2023b) box system can be applied to ATB extraction. Section 3 clarifies two notions, eligibility and accessibility, regarding the box system and presents a revision to Chomsky's box theory to accommodate ATB extraction. Section 4 concludes this study.

2. ATB under Chomsky's Perspectives

2.1 Merge and Minimal Yield (MY)

Merge,[2] as the most economical structure building operation, satisfies SMT (Strong Minimalist Thesis). One

[2] We use the term 'Merge' to refer specifically to the simplest binary structure building operation, responsible for generating

condition that Merge must meet is Minimal Yield (MY): Merge should construct the fewest possible new items that are accessible for further operation (Chomsky 2020, 2021). The number of new resources is restricted to one, no more than one. This minimizes the required search, subsequently reducing computation. Chomsky, therefore, argues that other extensions of Merge, such as Parallel Merge, Sideward Movement, and Late Merge, are ruled out because these operations add more than one new item. Consequently, only two subcases of Merge, IM (Internal Merge) and EM (External Merge), observe MY.

Let us briefly explore how IM and EM adhere to MY. In Chomsky (2020), when mapping WS to the next WS, the number of accessible items can increase only by one.[3] Consider an object-*wh* question in the standard system (Chomsky 2021) below. I will stick to essentials and use labels for expository convenience.

(5) Who did John meet
i. WS= [John, meet, who]
ii. EM (meet, who) = WS'= [{meet, who}, John]
iii. EM ({meet, who}, John) = WS'' = [{John, {meet, who}}]
iv. IM of *who* = WS''' = [{$_{v*P}$ who$_2$, {$_{v*P}$ John, {meet, who$_1$}}}]
v. IM of *John* = WS'''' = [{$_{INFLP}$ John$_2$, {$_{v*P}$ who$_2$, {$_{v*P}$ John$_1$, {meet, who$_1$}}}}]
vi. IM of *who* = WS''''' = [{$_{CP}$ who$_3$, {$_{INFLP}$ John$_2$, {$_{v*P}$ who$_2$, {$_{v*P}$ John$_1$, {meet, who$_1$}}}}}]

At each step, only one new item is added. When mapping (i) to (ii), {meet, who} is added to [John, meet, who]. On mapping (ii) to (iii), {John, {meet, who}} is added to [{meet, who}, John], and so forth. So, how can we externalize this sentence? The copies resulted from IM form a pair at the phase level (i.e., copy relation), and then the lower copy is automatically deleted.

(6) {$_{CP}$ who$_3$, {$_{INFLP}$ John$_2$, {$_{v*P}$ ~~who$_2$~~, {$_{v*P}$ ~~John$_1$~~, {meet, ~~who$_1$~~}}}}}

In other words, in the copy pair < who$_3$, who$_2$>, *who$_2$* is deleted, in < who$_2$, who$_1$> *who$_1$* is deleted, and in <John$_2$, John$_1$> *John$_1$* is deleted.

In the next subsection, we will examine how ATB can be explained under Chomsky's Merge system while adhering to MY.

2.2 ATB in the GK System[4] (Chomsky 2021)

Chomsky (2021) proposes that, alongside the core set-formation operation (FS)[5], an additional operation called FormSequence (FSQ) is necessary for specific syntactic structures, such as conjunction. These operations follow a sequential order; first, the set-formation operation selects X_1, …, X_n from WS and forms a set Y. Subsequently, the Merge of & and Y forms W. Finally, FSQ is applied to W, yielding P.

thoughts. It is distinct from 'merge' as used in concepts like 'Parallel Merge' or 'Late Merge'.

[3] Sideward Movement introduces two workspaces (WS), leading to IM occurring between these two spaces.

[4] In this study, we will denote Chomsky's paper published in the Gengo Kenkyu in 2021 as the GK system.

[5] Merge represents the simplest binary set-formation, as stated in the GK system. However, Chomsky (2023a) draw a distinction between Merge and binary FS (FormSet), noting that FS lacks theta-related properties. [FST (FORMSET) in Chomsky (2021) and FS (FormSet) in Chomsky (2023a) refer to the same set-formation operation.] Nonetheless, like Merge, FS is a free operation applicable to WS.

(7) WS= [X_1, …, X_n, …]
i. FS= (X_1, …, X_n) = Y= {X_1, …, X_n}
ii. Merge (&, Y) = W = {&, {X_1, …, X_n}}
iii. FSQ (W) = P = <&, X_1, …, X_n>

The CSC is seen as rigorous matching constraint on sequences, allowing extraction if performed from each conjunct. Let's examine ATB extraction from two coordinated INFLPs: Two INFLPs form a set, followed by the merging of &. The extraction of *what* from the set occurs before the application of FSQ. [It is impossible to extract from FSQ after forming the sequence.]

(8) a. (I wonder) what John bought and Bill handed to Tom
b. (I wonder) [{John bought $what_1$}, {Bill handed $what_2$ to Tom}]
c. (I wonder) [{$what_3$, {C, {&, {{John bought $what_1$}, {Bill handed $what_2$ to Tom}}}}}]
d. (I wonder) [{$what_3$, {C, <&, {John bought ~~$what_1$~~}, {Bill handed ~~$what_2$~~ to Tom}>}}]

Copy relations are established between two copies in a c-command configuration (cc-configuration) at each phase. *$What_3$* can form a copy pair with *$what_1$* and *$what_2$* due to their identical structure.[6,7] Consequently, either *$what_1$* or *$what_2$* can raise to *$what_3$*, and whichever raises, both *$what_1$* and *$what_2$* can form a copy pair with *$what_3$*: <$what_3$, $what_1$>, <$what_3$, $what_2$>. Both *$what_1$* and *$what_2$* are deleted under externalization. Unlike in (8), where extraction occurs from both conjuncts, in (9), *what* is extracted from only one conjunct, violating the CSC.

(9) a. *(I wonder) what John bought and Bill handed a sandwich to Tom
b. (I wonder) [$what_1$, C, <&, {John bought $what_2$}, {Bill handed a sandwich to Tom}>]

Consider (10). Both conjuncts contain an identical copy, which could be extracted from each conjunct. However, ATB extraction is deemed illegitimate.

(10) *(I wonder) [{$_3$ who_3 {{$_1$ John met who_1} and {$_2$ who_2 insulted Bill}}}]

In Chomsky (2021), the illegitimacy is attributed to VMH (Vacuous Movement Hypothesis, George 1980, Chomsky 1986). According to this hypothesis, movement from SPEC-INFL to SPEC-C is not allowed. Considering the matching condition in coordination, both conjuncts {$_1$ and {$_2$ are INFLP. Either *who_1* or *who_2* can raise to *who_3* in SPEC-C, but raising *who_2* from SPEC-INFL to SPEC-C is considered vacuous movement. Consequently, *who_2* cannot raise but remains in SPEC-INFL, provoking CSC violation since extraction takes place only from the first conjunct.

Now, let us compare (11) with (10). ATB extraction succeeds in (11) despite both examples containing a subject *who* in the second conjunct. How can the subject *who_2* be extracted from the second conjunct in (11)?

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[6] For the sake of simplicity, we have omitted the discussion of object raising to the edge of the v*-phase in each INFLP.
[7] In 2023 Keio-EMU lectures, Chomsky offers a precise definition of structural identity. According to him, a lexical item (LI) consists of formal and semantic features and phonological features. The former is relevant only to the interpretation at CI (Conceptual-Intentional interface), while the latter pertains to externalization at SM (Sensory-Motor medium). Structural identity between two items implies that their formal and semantic features are identical, irrespective of differences in their phonological features.

(11) (I wonder) [{who$_3$ {{$_1$ John met ~~who$_1$~~} and {I think {$_2$ ~~who$_2$~~ insulted Bill}}}}]

Two INFLPs form a coordination structure. From {$_2$, *who$_2$* raises from SPEC-INFL not directly to SPEC-C immediately above but to a higher SPEC-C, circumventing the locality issue (i.e., VMH). As a consequence, either *who$_1$* or *who$_2$* can raise to *who$_3$*, and the lower copies in a cc-configuration are deleted. The GK system appears to successfully account for ATB extraction.

However, it remains unclear whether *who$_3$* in an A'-position can form a copy pair with *who$_2$* in an A-position because Chomsky (2021) segregates A- and A'-movement. In this segregation, he posits that from an A-position, copy formation rule applies to a copy in A-positions, without explicitly addressing about 'from an A'-position'. This leads to unresolved issues in forming copy pairs.

Chomsky (2023a, 2023b) replaces FSQ with a second application of FS (FormSet), emphasizing that FSQ is not accommodated within SMT. More importantly, he makes an attempt to eliminate the segregation of A- and A'-movement, noting that the basis for ATB in the GK system remains unchanged. There is a significant shift in Chomsky (2023a, 2023b) comparing the GK system; there is no longer successive-cyclic movement not only in A-movement but also in A'-movement. By dispensing with A- and A'-movement, the core system is left with IM and EM. The next subsection will introduce the box system (Chomsky 2023a, 2023b) and its implication for ATB extraction.

2.3 ATB in the Box System (Chomsky 2023a, 2023b)

Chomsky (2023a, 2023b) emphasizes that I-language functions as a system for generating thoughts, and there are *propositional* and *clausal* categories relevant to this thought-related language structure. The theta-structure is associated with propositional, while force- and information-related structures pertain to clausal, highlighting duality of semantics. Therefore, I-language must conform with principle T.

> Principle T: All relations and structure-building operations are thought-related, with semantic properties interpreted at CI (Chomsky 2023a, p. 5).

Merge (EM and IM), a structure-building operation, should be thought-related. EM, applied to members of WS, constructs a theta-structure. IM selects a member X and its term Y, with the term Y always being a member of a theta-structure. Notably, Merge exclusively operates on theta-structures: EM produces a theta-structure to which IM is applied. In this way, Merge observes the principle T.

IM carries an element in transit from the propositional to the clausal domain. The element subjected to IM does not interact with the structures generated by EM (which constitute the propositional domain) or with the operations taking place there, signifying the segregation of IM and EM. To simplify the explanation, Chomsky suggests that the *IMed element to the phase edge* is put in a box. The boxed element is separate from the ongoing derivation (D) but is only accessible to D by phase heads for interpretation at the interfaces. Importantly, there is no successive-cyclic movement.

In summary, a significant distinction between the two systems, the GK system and the box system, centers around whether an element undergoes successive-cyclic movement through phase edges. As demonstrated in the preceding subsection, the GK system adheres to conventional A'-movement standards. Consequently, if an element X is internally merged to Y and subsequently moves to a higher phase Z, a copy relation is established between Z and Y, as well as between Y and X, in cc-configurations. Conversely, in the box system, once X is

internally merged to Y, it does not raise any further.

To illustrate, compare a *wh*-question in the GK system (12a) and in the box system (12b).[8]

(12) a. {who$_3$, {John, {$_{v*P}$ ~~who$_2$~~, {met ~~who$_1$~~}}}}
b. {C, {John, {$_{v*P}$ who$_2$, {met ~~who$_1$~~}}}}

In both systems, a copy relation is established between *who$_2$* and *who$_1$*, given their cc-configuration. The lower copy, *who$_1$*, is deleted under externalization. In the GK system (12a), another copy relation is formed between *who$_3$* and *who$_2$* in a cc-configuration, and externalization deletes the lower copy *who$_2$*, in the context of standard successive-cyclic movement. In contrast, in the box system (12b), *who$_2$* does not undergo further raising. The raised object, *who$_2$*, is put in a box, separated from the ongoing derivation. The boxed object must remain accessible at every phase level, meaning that the higher phase head C consults the box. With the consulted information, the phase head is interpreted at CI and also at SM, as it is the criterial position.[9] Thus, externalization is determined at the matrix level.

Regarding ATB extraction, Chomsky (2023a) omits the details, so let us illustrate how it can be explained. Initially, we assume how a coordinate structure is formed. Following Chomsky's insight, it is evident that coordinate structures are not formed by EM or IM; rather, they are created by another free operation, FS (FormSet), as coordination is not theta-related. FS does not apply to theta-positions, nor is it theta-related, whereas Merge applies to theta-positions and is therefore theta-related (see footnote 5). An unbounded coordination is formed by FS, and its sequence is determined by a second application of FS. (The impossibility of extracting from conjunction is not due to FSQ, contrary to our assumptions in subsection 2.2.) Let us reconsider ATB examples we have discussed above in the box system. In example (13), it appears that two INFLPs form a set as illustrated in (c), the coordinator & merges with the set as in (d), followed by the Merge of C[Q] as in (e), and either *what$_1$* or *what$_2$* merges to SPEC-C as in (f).

(13) a. (I wonder) what John bought and Bill handed to Tom
b. (I wonder) [{John bought what$_1$}, {Bill handed what$_2$ to Tom}]
c. (I wonder) [{{John bought what$_1$}, {Bill handed what$_2$ to Tom}}]
d. (I wonder) [{&, {{John bought what$_1$}, {Bill handed what$_2$ to Tom}}}]
e. (I wonder) [{C[Q], {&, {{John bought what$_1$}, {Bill handed what$_2$ to Tom}}}}]
f. (I wonder) [{what$_3$, {C[Q], {&, {{John bought what$_1$}, {Bill handed what$_2$ to Tom}}}}}]

In the box system, *what$_1$* in the first conjunct internally merges into the v*-phase edge from its theta-structure and is subsequently boxed. Analogously, in the second conjunct, *what$_2$* from the theta-structure internally merges into the v*-phase edge and is also boxed. The higher phase head C has the capability to access both boxes in the set, and [Q] of *wh*-phrase in each conjunct is valued. This can be considered as adhering to CSC if CSC is interpreted as a matching constraint. Here, CSC should not pertain to the matching constraint on sequences but rather on sets, as sequences are formed under externalization. Consider (14), which violates this constraint.

[8] There has been a modification in the position for IM of internal argument and EM of external argument at the v*-phase edge. Previously, the internal argument raises after the external argument is externally merged, as illustrated in (5) and (6). However, Chomsky (2023a, 2023b) proposes that the external argument is merged into outer SPEC-v* subsequent to the raising of the internal argument. This adjustment allows for the avoidance of forming illegitimate copy pairs (refer to Chomsky (2021)).

[9] Chomsky (2023a) notes that interpretation of the phase head at SM typically occurs at the matrix (criterial) position, with the remaining positions being optional. See Rizzi (2007) for criterial positions.

(14) a. *(I wonder) what John bought and Bill handed a sandwich to Tom
b. (I wonder) [{what$_1$, {C, {&, {{John bought what$_2$}, {Bill handed a sandwich to Tom}}}}}]

It contravenes CSC by having the higher phase head C exclusively consult the box of the first conjunct. There is no consultation taking place in the second conjunct. While there might be the shifted object, if any, it results in a mismatch of what is boxed, and therefore a mismatch in consulting information. Let us think about another impossible ATB extraction in (15).

(15) *(I wonder) [{$_3$ who$_3$ {{John met ~~who$_1$~~} and {who$_2$ insulted Bill}}}]

In (15), two INFLPs are coordinated. From the first conjunct, *who$_1$* internally merges to the v*-phase edge, after which it is placed into a box. The higher phase head C can access the box, enabling the valuation of [Q] for *who$_1$*. In the second conjunct, *who$_2$* externally merges to the v*-phase edge to be assigned a theta-role and then internally merges to SPEC-INFL (for EPP). Notably, *who$_2$* is not boxed in the second conjunct. This implies that the higher phase head C cannot obtain any instructions from the second conjunct according to the box system.

Lastly, consider the ATB extraction in (16) within the box system. Similar to (15), there is a *wh*-object in the first conjunct and a *wh*-subject in the second conjunct. However, in contrast to (15), (16) displays plausible ATB extraction.

(16) (I wonder) [{who$_3$ {{John met ~~who$_1$~~} and {I think {~~who$_2$~~ insulted Bill}}}}]

In the first conjunct, externally merged *who$_1$* at V-complement raises to the edge of the v*-phase and is boxed. The boxed *who$_1$* can be consulted by the higher phase head C. As observed in (15), in the second conjunct of (16), *who$_2$* externally merges into the v*-phase edge to be theta-marked and then it internally merges into SPEC-INFL. Notably, nothing is placed into a box in the second conjunct. If none of *who* copies in the second conjunct were accessed by the higher phase head C, it would violate CSC. This is what happens in the second conjunct in (15). However, one of the *who* copies in the second conjunct in (16) is accessible. In fact, as mentioned above, the one at SPEC-INFL is not accessible at later phases because it is phase internal. If the v*-phase edge is accessible, similar to the box, allowing the externally merged *who$_2$* at the edge of the v*-phase to be accessible, why does the same not occur in the second conjunct of (15)? The difference between the two examples lies in whether the extracted site is embedded in the second conjunct. What determines the (im)possibility of ATB extraction in (15) and (16) in the box system? The current box system appears unable to address this question. ATB extraction, which the GK system could account for, seems challenging to explain within the box system. In the next section, we will present a solution to the ATB puzzle under the box theory.

3. Revision to the Box System and ATB

3.1 Revisiting the Issue of ATB in the Box

Reconsidering ATB examples (15) and (16) in the box system, two INFLP conjuncts are coordinated. Both have *who$_1$* in the first conjunct, boxed after internally merging to the edge of the v*-phase from theta-structures. Both also have *who$_2$* in the second conjunct, externally merging to the edge of the v*-phase and assigned theta-role. It

then internally merges to SPEC-INFL. Neither of the copies of *who* (i.e., one at the v*-phase edge and the other at SPEC-INFL) in the second conjunct is placed into the box because they are not internally merged to the phase edge. Only the internally merged element to the phase edge is boxed (see subsection 2.3). Nonetheless, there is a distinction between (15) and (16) regarding the possibility of ATB extraction.

(15) *(I wonder) [{who$_3$ {{John met ~~who$_1$~~} and {who$_2$ insulted Bill}}}]
(16) (I wonder) [{who$_3$ {{John met ~~who$_1$~~} and {I think {~~who$_2$~~ insulted Bill}}}}]

Both (15) and (16) contain a *wh*-subject in the second conjunct. Let us briefly contemplate structures containing *wh*-subjects. (17a) is a simple structure, and (17b) is complex, where a *wh*-subject is externally merged in the embedded clause.

(17) a. who read the book
C[Q] {who$_1$ {INFL who$_2$ read the book}}
b. who do you think read the book
C[Q] do you think {who$_1$ {INFL {who$_2$ read the book}}}

Reviewing the two examples, in the GK system, where successive cyclic A'-movement is permitted, although A-movement is a one-fell-swoop process, *who$_1$* in (17a) remains in SPEC-INFL without raising to SPEC-C[Q]. This adheres to the Vacuous Movement Hypothesis (VMH), signifying that in (17b), *who$_1$* raises to the matrix SPEC-C[Q] from the embedded SPEC-INFL, bypassing the embedded SPEC-C in line with VMH (ban on raising from SPEC-INFL to SPEC-C). In the box system, devoid of successive-cyclic movement, nothing raises to SPEC-C[Q] in both (17a) and (17b). Let us assume, for the moment, that the phase head C[Q] consults *who$_2$* in the v*-phase edge, rather than *who$_1$* at SPEC-INFL, for interpretation. SPEC-INFL is not accessed at later phases since it is not at the phase level (Chomsky 2023a). In the box system, VMH is not a consideration. This raises a question: why does Minimal Search (MS)[10] overlook *who$_1$* at SPEC-INFL and instead detect the lower *who$_2$* at the v*-phase edge? Could it be because *who$_2$* is positioned at the v*-phase edge, thereby allowing the higher phase head C to access *who$_2$* rather than *who$_1$*?

Now, returning to ATB extraction, if C[Q] can consult externally merged *who$_2$* at the v*-phase edge in the second conjunct, as seen in (15) and (16), what makes ATB extraction (im)possible? The box system needs to address these issues by elucidating the concept of accessibility. The next section will refine Chomsky's box system and provide solutions to the ATB puzzle of concern.

3.2 Eligibility and Accessibility

In accordance with Chomsky's box theory and his postulation that Merge applies to theta-structure, it can be asserted that elements occupying theta-related positions are ***eligible*** for Merge, and the boxed element is ***accessible*** to higher phase heads. Correspondingly, during the discussion session of Keio-EMU lectures (henceforth, Chomsky 2023b), Seely notes that once a noun phrase raises to non-theta position, it is no longer *eligible* for Merge. Consequently, a noun phrase raised to either SPEC-v* or SPEC-INFL is no longer *eligible* for Merge. Nevertheless,

[10] Minimal Search (MS), as an economy condition, stops its search within the c-command domain upon encountering the first element (i.e., the head of a chain). See Chomsky (2013, 2015, 2020, 2021).

the noun phrase raised to SPEC-v* remains *visible* to higher phases, while the one raised to SPEC-INFL is not *visible* because it is not at the phase edge but rather inside the phase. Chomsky adds that an element moves into SPEC-INFL is not *accessible* (*eligible* in Seely's terminology) for Merge because it lacks a theta-role. Instead, it determines how it is interpreted at each subsequent phase, serving as a substitute for successive-cyclic movement. To elucidate, consider the definitions of the terms below.

(18) Eligibility
When an element is theta-marked, it is ***eligible*** for Merge.

(19) Accessibility (or Visibility)
When an element is boxed or positioned at phase edges, it is ***accessible (visible)*** to higher phases.

Chomsky refers to an element being put into a box for ease of exposition once the element is internally merged to the phase edge. Considering when an element is eligible for Merge, IM takes place only once as does EM, and thus the notion of successive-cyclic movement is removed. Boxed elements are not eligible for Merge because they are not theta-marked, but they are accessible. The element that is internally merged to the phase edge should be internal arguments; in particular, internal arguments of a transitive structure raises to the edge of the v*-phase. Other arguments, such as internal arguments of unaccusatives or external arguments, are not internally merged to the phase edge but to SPEC-INFL. Even over a long distance, as in (20a), the external argument *John* moves from its theta-position to the matrix SPEC-INFL in one-fell-swoop fashion (see Chomsky 2021). Let us reconsider (20b).

(20) a. John seems to hit Bill.
John$_2$ {INFL seem {to appear {to ~~John$_1$~~ hit Bill}}}
b. who do you think read the book
who$_3$ {C[Q] do you think {~~who$_1$~~ {INFL {~~who$_2$~~ read the book}}}}

As we have discussed in the subsection above, Chomsky's box system sees that C[Q] accesses *who$_2$* at the lower phase edge, not *who$_1$* at SPEC-INFL, which is phase internal. This ignores MS, an economy condition (see footnote 10). MS should stop searching as soon as it identifies the first element in the c-command domain. MS sees *who$_1$* first and does not search further. Therefore, we suggest that an element at SPEC-INFL, though ineligible for Merge, be *accessible* to higher phases.

(21) Accessibility (revised)
(i) Once an element internally merges to the phase edge, it is boxed and *accessible* to later phases. [clausal domain]
(ii) Once an element internally merges inside the phase, it is not boxed but *accessible* to later phases, restricted to PIC. [propositional domain]

The boxed element at the phase edge belongs to the clausal domain, whereas the element at SPEC-INFL belongs to the propositional domain. Elements within the propositional domain are restricted to PIC (Chomsky 2023b). Consequently, the accessibility of the element at SPEC-INFL is bound to its phase domain.

The element at SPEC-INFL, having undergone internal Merge from the theta-structure, remains accessible within the phase domain. Keeping this in mind, examine (22). In both (a) and (b), *who$_2$* internally merges into

SPEC-INFL from its theta-position at the v*-phase edge. After this internal Merge, *who$_1$* at SPEC-INFL becomes ineligible for further Merge. There is a difference between (a) and (b): they are distinct in the presence of an overt complementizer. In (a), where the complementizer is absent, the matrix C[Q] can access *who$_1$* at SPEC-INFL. Conversely, in (b) featuring the complementizer, C[Q] cannot access *who$_1$* at SPEC-INFL.

(22) a. who do you think read the book
who$_3$ {C[Q] {you think {who$_1$ {INFL {who$_2$ read the book}}}}}
b.*who do you think that read the book
C[Q] {you think who$_3$ {C that {who$_1$ {INFL {who$_2$ read the book}}}}}

The embedded C, lacking an overt complementizer, loses its phasal status (i.e., de-phased, see Chomsky 2015). Consequently, in (a), no phase boundary exists between the matrix C[Q] and the embedded INFL.[11] This absence of a phase boundary allows *who$_1$* at SPEC-INFL to be accessible to the higher phase C[Q]. In contrast, in (b), the embedded C, realized with an overt complementizer, servers as a phase head. This indicates that *who$_1$* at SPEC-INFL is impeded by PIC, preventing access by the matrix C[Q] to *who$_1$*. Why does MS fail to identify *who$_3$* at the phase edge? MS searches only for objects that are either eligible or accessible, regardless of whether the objects are at phase edges. Therefore, *who$_3$*, within the box system, is neither eligible nor accessible, despite its position at the phase edge.

Now, let us delve into the so-called *who left* puzzle, which revolves around the placement of the *wh*-subject in either SPEC-INFL or SPEC-C. To avoid violating VMH or the anti-locality condition, substantial evidence supports the notion that the *wh*-subject should appear in either SPEC-INFL or SPEC-C. See George (1980), Chomsky (1986, 2007, 2008), Grohmann (2000), McCloskey (2000), Epstein et al. (2012), Erlewine (2016), Bošković (2008, 2019, 2021), Mizuguchi (2023) among many. While one might assume that the *wh*-subject should raise to SPEC-INFL, considering Empty Category Principle (ECP) as evident in (22b), the presence of an overt complementizer complicates confirming that it raises to SPEC-INFL. In cases where there is no overt complementizer, such as in (22a) and (23), determining the specific location of the *wh*-subject becomes less clear.

(23) who read the book
who$_3$ {C[Q] {$_{\text{INFLP}}$ who$_1$ {INFL {$_{\text{v*P}}$ who$_2$ read the book}}}}

As per Mizuguchi (2019), the presence of the *wh*-subject at either site poses a problem. If the *wh*-subject, as an operator, does not raise to SPEC-C, it fails to acquire operator interpretation. Conversely, if the *wh*-subject does not raise to SPEC-INFL, the labeling of INFLP becomes impossible; according to the labeling algorithm, SPEC-INFL must be filled to be labeled because it is regarded as a weak head. In light of these considerations, Mizuguchi suggests a composite head <C, INFL> for the null complementizer.[12] This composite head operates as a phase head similar to C. Following this proposal, in (23'), *who$_2$* internally merges to SPEC-<C, INFL> from its theta-position v*-phase edge, and *who$_1$* has its [Q] valued at SPEC-<C, INFL>.

(23') who$_1$ {<C[Q], INFL> {$_{\text{v*P}}$ who$_2$ read the book}}
Let us reconsider (22a), reiterated as (24).

[11] Bridge verbs, such as *think,* are not recognized as phase heads, as outlined in Epstein et al. (2016).
[12] Adopting Chomsky's (2020) assertion that Tense is a feature of small v, not INFL, we use the notation INFL instead of T.

(24) who do you think read the book
who$_3$ {C[Q] {you think {who$_1$ {<C, INFL> {who$_2$ read the book}}}}}

Who$_2$ externally merges to the v*-phase edge, and then it internally merges to SPEC-<C, INFL> and is boxed because <C, INFL> functions as a phase head. The boxed *who$_1$* is accessible to the matrix C[Q].

The amalgamation of the two heads <C, INFL>, where C is null, appears to successfully resolve the puzzle related to *wh*-subjects.

Following the Keio-EMU lectures, Chomsky (personal communication, April 14, 2023) extends the condition on Merge, as the previously proposed solution has limitations in addressing ECP. According to him, Merge applies only to syntactic objects that are semantically marked, including theta-marked and subject-predicate with its special properties. He also comments that the element at SPEC-INFL can internally merge to SPEC-C[Q]. In short, based on Chomsky's updated version of the box theory, the element at SPEC-INFL, after internally merging from the theta-structure, remains *eligible* for Merge since it possesses a secondary semantic role. In Chomsky (2021), the raised subject carries a semantic role as an argument of predication, akin to *de re* interpretation. In the existential construction (25a), the NP *a fly* lacks a semantic role and does not allow for a *de re* reading. Conversely, in subject position (25b), *a fly* has a semantic role and permits a *de re* interpretation.

(25) a. There is a fly in the bottle.
b. A fly is in the bottle.

Therefore, Chomsky's updated box system allows for the possibility that *who$_1$* at SPEC-INFL in (23) internally merges into SPEC-C[Q], presenting another form of successive-cyclic movement, which Chomsky (2021) and Chomsky (2023a) aim to eliminate. This alternative proposal, within the box system, effectively eliminates successive-cyclic movement. In this regard, our alternative proposal appears theoretically favorable: SPEC-INFL is accessible to its phase head but not eligible for Merge.

Now let us reconsider ATB extraction.

(26) a. *(I wonder) {who$_3$ {{John met ~~who$_1$~~} and {who$_2$ insulted Bill}}}
b. (I wonder) {who$_3$ {{John met ~~who$_1$~~} and {I think {~~who$_2$~~ insulted Bill}}}}

In (26), *who$_1$* in the first conjunct is boxed after internally merging to the edge of the v*-phase, making it accessible to phase heads. The second conjunct contains a *wh*-subject, and there is no overt complementizer. Therefore, we posit a composite head <C, INFL>, to which *who$_2$* internally merges from its theta structure. Additionally, *who$_2$* at SPEC-<C, INFL> is put into a box since the amalgam head is considered a phase head: an internally merged element at the phase edge is boxed. The issue in (26a) is that it violates CSC in that the two conjuncts are distinct in their projection (i.e., label). The first conjunct is INFLP, and the second one is <C, INFL>P. On the other hand, (26b) adheres to CSC since both conjuncts are INFLP. The first conjunct undergoes a similar process to the one discussed in (26a). In the second conjunct, the embedded clause lacks an over complementizer, allowing a composite head <C, INFL> to merge into derivation instead of two distinct heads. To the specifier position of this composite head, *who$_2$* internally merges from its theta-position, and it is boxed there. The matrix C[Q] can access the box in each conjunct.

4. Conclusion

The previous analyses of ATB extraction fall short of adhering to SMT. While Merge, as the primary operation for building structures, adheres to the principle MY by generating the fewest possible new items, prior accounts of ATB extraction deviate from the principle. In adherence to this principle, Chomsky (2021) provides explanations for ATB extraction while keeping to segregation of A/A'-movement. Nevertheless, the segregation of these two types of movement proves challenging. In Chomsky's later works (2023a, 2023b), he introduces the box theory, which appears to entirely eliminate successive-cyclic A/A'-movement.

However, the application of the box theory raises concerns, particularly regarding ECP, preventing the complete elimination of successive-cyclic movement. We have addressed this issue in our analysis of ATB extraction within the framework of the box theory. Based on the distinction between eligibility for Merge and accessibility to phase heads, we have postulated that SPEC-INFL is not eligible for Merge but remains accessible to phase heads with restriction of PIC. Additionally, we suggest that a phonetically null C forms a composite head with INFL, denoted as <C, INFL>, serving as a phase head. With these refinements, our analysis successfully explained ATB extraction within the box system. We have also observed the elimination of successive-cyclic A/A'-movement in our analysis, in accordance with Chomsky's (2023a) perspective.

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Examples in: English
Applicable Languages: English
Applicable Level: Tertiary

