How to Generate Adjuncts by MERGE*

Takanori Nakashima

Fukuoka University

1. Introduction

It has been a long-standing puzzle in generative syntax why human language uses a category called an adjunct, which behaves as if it were not in the structure, apart from its interpretation and pronunciation. Minimalism has demonstrated that hierarchical structure and displacement in human language are captured by a single operation called Merge, an operation taking two objects α and β to form an unordered set {α, β}. However, it remains to be seen whether an independent operation is required to capture the properties of adjuncts, in addition to Merge.

Chomsky (2004) proposes two types of structure-building operations, (Set-)Merge and Pair-Merge. He argues that the argument/adjunct dichotomy is reduced to the minimal difference between an unordered set and an ordered set: Merge takes two syntactic objects (SOs) α and β to create a symmetric unordered set {α, β}, whereas Pair-Merge takes α and β to create an ordered pair <α, β>. The asymmetric nature of adjunction is essentially reduced to the asymmetry between α and β in the ordered pair <α, β>. Chomsky (2004) tries to account for some basic properties of adjuncts in terms of Pair-Merge. He claims that the structure generated by Set-Merge, which is called simple structure, is in a primary plane, whereas α attached to β by Pair-Merge is in a separate plane. Since syntactic relations are defined in terms of the simple structure in the primary plane, adjuncts placed in the secondary plane do not establish any relationships such as c-command with elements in the primary plane during the computational process. For adjuncts to be interpreted at the interfaces, they must undergo the operation SIMPL, which converts a pair-merged structure <α, β> into a set-Merged structure {α, β} when <α, β> is transferred to the interfaces.

With this, Chomsky (2008) attempts to reduce the Adjunct Condition like (1) to the "invisibility" of adjuncts.

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(1) *[$_{CP}$ Who did [$_{TP}$ they leave] [$_{CP}$ *t'* before speaking to *t*]]?

Since the adjunct CP in (1) is placed in a separate plane, the *wh*-phrase in the adjunct is impervious to extraction in the primary plane.

Chomsky (2004) also tries to explain the argument/adjunct asymmetry with respect to reconstruction as known as the Freidin-Lebeaux Generalization illustrated in (2) (Freidin (1986); Lebeaux (1988); Fox (2002), among others).

(2) a. *Which report that John$_i$ was incompetent did he$_i$ submit *t*?
b. Which report that John$_i$ made did he$_i$ submit *t*? (Freidin (1986: 179))

In (1a), the argument CP *John was incompetent* is introduced by Merge. Then, *John* in the base copy enters into a c-command relation with *he*, violating Binding Condition C. In (1b), on the other hand, the adjunct CP *that John made* is introduced by Pair-Merge to form the ordered pair <CP, report>. Chomsky assumes that SIMPL is optional. Consequently, *John* in the base copy does not enter into a c-command relation with *he* if <CP, report> does not undergo SIMPLE, thereby circumventing a potential Binding Condition C violation. After *wh*-movement, <CP, report> in the landing site undergoes SIMPL to be interpreted at the interfaces.

Pair-Merge has many important consequences in minimalist syntax, but it is not without problems. First, as Chomsky, Gallego and Ott (CGO) (2019) point out, it raises a problem of evolvability. Evolvability is a criterion that any theory of UG must meet: "the mechanisms and primitives ascribed to UG […] must be sufficiently sparse to plausibly have emerged as a result of what appears to have been a unique, recent, and relatively sudden event on the evolutionary timescale" (p. 230). Ideally, it is desirable to show that Pair-Merge is eliminable from the theory of UG, since a "rich" theory of UG incorporating Pair-Merge as well as Merge makes it more difficult to address the problem of the evolution of UG.[1] Second, the notion of "separate plane" in Chomsky (2004) is not clarified. Since the notion of plane is not formally defined in Chomsky (2004) and subsequent literature, it leaves unanswered the question of why adjuncts become "invisible" to operations on the simple structures.

This article aims to solve these problems, based on the concept of MERGE proposed by CGO (2019) and Chomsky (2019, 2020). To be more specific, I propose that adjuncts are generated by mapping of a workspace WS = [α, β] onto WS' = [{α, β}, α]. The intuitive idea is this: The asymmetric nature of adjunction is reduced to asymmetry between α and β within [{α, β}, α], where {α, β} includes every occurrence of β, but it does not include every occurrence of α. Crucially, adjunction characterized in this way is actually the null hypothesis: if MERGE is defined as mapping of WS involving α and β onto another WS' including the set {α, β}, we get both substitution (mapping of WS = [α, β] onto WS' = [{α, β}]) and adjunction (mapping of WS = [α, β] onto WS' = [{α, β}, α]) as logical possibilities of MERGE. If this proposal is correct, adjunction, as well as

[1] See also Omune (2018), which tries to reduce an adjunction structure <α, β> to the set-theoretically equivalent form {α, {α, β}} derived by Merge. If this approach is on the right track, there is no complication of UG. This article attempts to provide a different solution to the evolvability problem, based on the conception of MERGE discussed below.

hierarchical structure and displacement, is a consequence of MERGE, the single operation attributed to UG.

This article is organized as follows. Section 2 briefly outlines the theory of MERGE. Section 3 proposes a MERGE-based theory of adjunction, demonstrating that it captures basic properties of adjuncts, such as the invisibility of adjuncts in terms of labeling, theta-relation, extraction, and binding. Section 4 concludes this paper.

2. MERGE

2.1 From Merge to MERGE

CGO (2019) and Chomsky (2019, 2020) reformulate Merge into MERGE, proposing that it operates on syntactic objects placed in a workspace (WS), a set of syntactic objects at a point of derivation. They define MERGE as an operation mapping a WS containing terms P and Q onto WS' containing the set {P, Q}, as in (3).

(3) $WS = [X_1, \ldots, X_n] \rightarrow WS' = [\{P, Q\}, X_1, \ldots, X_m]$

MERGE as defined above must meet several third-factor conditions. First, MERGE must satisfy the No-Tampering Condition, which prevents SOs from being modified during computation. Given this, no terms of $X_1, \ldots, X_n$ may disappear during mapping of WS onto WS'. Second, MERGE must observe Inclusiveness, which bars introduction of extraneous objects. So, $X_1, \ldots X_m$ in WS' cannot include anything absent from $X_1, \ldots, X_n$.

With the definition of MERGE above, CGO (2019) and Chomsky (2019, 2020) argue that it maps WS in (4a) not onto (4b) but onto (4c).

(4) a. WS = [α, β]
b. WS' = [{α, β}, α, β]
c. WS' = [{α, β}]

(4c) is a standard recursion used in proof systems. Chomsky observes that recursion in human language is different from the one in the proof system in that it does not access any objects generated in a previous step of derivation. If it could, the derivation circumvents any island conditions, because we can get island-violating movement of α from the set {α, β} by re-merging α left in the WS with any arbitrary complex object containing the set {α, β}. To ensure that derivation proceeds from (4a) to (4b), Chomsky proposes Resource Restriction (RR), a third factor condition that minimizes the number of accessible terms generated by MERGE. RR allows MERGE to increase the number of accessible objects by exactly one. In the derivation from (4a) to (4c), the number of accessible terms increases from two to five, hence violating RR. In the derivation from (4a) to (4b), by contrast, the number of accessible terms increases from two to three, observing RR. For this reason, Chomsky reject the derivation where MERGE leaves the "old" SOs in WS'.

2.2 Determinacy

For this reason, CGO (2019) and Chomsky (2019, 2020) reject the derivation where MERGE leaves the "old" SOs in WS' as in (4b). This article challenges this view, demonstrating that MERGE incorporating the principle of Determinacy in the sense of Goto and Ishii (2019, 2020) makes it possible to derive the four types of WSs in (5).

(5) WS = [α, β] →
 a. WS' = [{α, β}]
 b. WS' = [{α, β}, α]
 c. WS' = [{α, β}, β]
 d. WS' = [{α, β}, α, β]

Determinacy is a principle to bar ambiguous rule application so that subsequent derivation proceeds in a deterministic way. In contrast to CGO (2019) and Chomsky (2019), which claim that Determinacy governs the *output* of MERGE, Goto and Ishii propose that it is applied on the *input* of MERGE.[2] To see this, consider the mapping from (6a) to (6b) derived by Internal MERGE of γ with {α, {β, γ}}.

(6) a. WS = [{α, {β, γ}}]
 b. WS' = [{γ, {α, {β, γ}}}]

Determinacy governing the output of MERGE dictates that γ and its terms cannot undergo MERGE after (6b) (unless {α, {β, γ}} is rendered inaccessible to MERGE owing to the Phase Impenetrability Condition (PIC)), because there are two occurrences of γ in (6b). With this notion of Determinacy, Goto and Ishii account for the Subject Condition illustrated in (7).

(7) * Who did [pictures of *t*] please you?

(7) is structured as in (8) when the subject is raised to Spec-T.

(8) $[_{TP}$ [pictures of who] T $[_{v^*P}$ [pictures of who] v* …]]

(8) involves two occurrences of *pictures of who*. So, Determinacy prevents *who* from undergoing further extraction.

Returning to (5), an RR violation is circumvented thanks to Determinacy governing the *input* of MERGE. In (5a), the number of accessible objects increases by one, observing RR. In (5b), the number of accessible terms increases by zero, because both α in the set {α, β} and α left in the WS' are rendered inaccessible to MERGE owing to Determinacy, so that accessible terms are only β and {α, β}. Similarly, in (5c), accessibility is reduced by zero because two βs are inaccessible to MERGE. In (5d), again, accessibility is reduced by one because α and β are rendered inaccessible to MERGE.

Notice that the NTC and Inclusiveness do not preclude generation of all cases in (5), and they are obtained as logical consequences of MERGE of α and β. That is, (5a) is

[2] Goto and Ishii (2022) reformulate Determinacy as a condition on Search procedure. My future study must examine whether the proposed system naturally fit with this view.

obtained if the newly created set {α, β} "replaces" both α and β. (5b) is derived if {α, β} "replaces" β but not α. (5c) is generated if {α, β} "replaces" α but not β. If nothing is "replaced" by {α, β}, (5d) is obtained, although (5d) is always ruled out thanks to a labeling failure, as discussed in section 3.2.

3. Accounting for Basic Properties of Adjuncts

With this framework, this article proposes that adjuncts are introduced by MERGE as in (5b, c). Let us call it Asymmetric MERGE (AM). It is asymmetric in that either α or β is left in the WS. Notice that AM, as well as External MERGE (EM) and Internal MERGE (IM), is an instantiation of MERGE: if nothing is stipulated, AM follows from MERGE, as EM and IM do. The next subsections demonstrate that the basic properties of adjuncts are accounted for by AM.

3.1 The Adjunct Condition

Let us first see how the proposed system accounts for the Adjunct Condition in (1), repeated here as (9), whose derivation is illustrated in (10).

(9) $[_{CP}$ Who did $[_{TP}$ they leave] $[_{CP}$ *t'* before speaking to *t*]]?

(10) a. WS_1 = [TP, CP]
b. WS_2 = [{TP, CP_1}, CP_2]
c. WS_3 = [{C, {TP, CP_1}}, CP_2]
d. *WS_4 = [{who, {C, {TP, CP_1}}}, CP_2]

(10a) shows the stage of derivation before the adjunct CP = $[_{CP}$ who $[_{C'}$ before [speaking to *t*]]] is introduced. AM of CP with TP maps onto (10b), where one occurrence of the adjunct CP is left in the WS_2. Next, EM of C with {TP, CP} maps (10b) onto (10c). However, we cannot derive (10d) from (10c), because Determinacy blocks IM of *who* in the adjunct Spec-C to the matrix Spec-C: the computation cannot uniquely determine which of the two occurrences of *who*, *who* in CP_1 or *who* in CP_2, must undergo IM. Thus, the Adjunct Condition is accounted for as a Determinacy violation. Recall that the Subject Condition is also explained in terms of Determinacy by Goto and Ishii, as discussed in section 2.2. If this is on the right track, the Subject Condition and the Adjunct Condition are uniformly characterized as Determinacy violations.[3]

[3] Stepanov (2007) claims that the Subject Condition and the Adjunct Condition cannot be unified, demonstrating that the former is frequently violated in some languages, whereas the latter holds cross-linguistically. Goto and Ishii, however, note that lack of the Subject Condition in Japanese is accounted for in terms of lack of subject raising from Spec-v* to Spec-T, because there is no Determinacy violation in the structure where the subject may stay in Spec-v*. If this approach is on the right track, cross-linguistic variation of the Subject Condition might be attributed to structural differences of the subject positions. On the other hand, cross-linguistic consistency of the Adjunct Condition might be accounted for by universality of AM: Given the proposed system, elements introduced by AM always block extraction out of them.

3.2 Labeling

Let us next consider why an adjunct does not provide a label. In (11), for example, the adjunct PP cannot be the label of {v*P, PP}; instead, it is labeled v*P.

(11) John [$_{v*P}$ met Mary] [$_{PP}$ in the garden].

According to Chomsky (2013, 2015), SOs created by MERGE undergo labeling to be interpreted at the CI interface and to be externalized. Chomsky proposes that the label of an SO is provided by a fixed algorithm, the Labeling Algorithm (LA). LA is an instantiation of Minimal Search (MS) to detect a lexical item (LI) that serves as a label. Given SO = {H, XP}, where H is a head and XP is a phrase, MS selects H as its label. When an SO is {XP, YP}, MS cannot uniquely locate a head that provides a label, but there are two ways to determine the label of the XP-YP structure. One case is when XP is moved out of the XP-YP structure. In this case, the lower copy of XP is not "in the domain" of {XP, YP}. Chomsky defines this notion of domain as follows.

(12) α is ''in the domain D'' if and only if every occurrence of a is a term of D.
(adapted from Chomsky (2013: 44))

Given this, XP in {XP, YP}, a proper subpart of a discontinuous element/whole chain, does not provide a label, since not every occurrence of XP is in the domain of {XP, YP}. Then, the XP-YP structure is labeled YP. Another case is when X and Y, heads of XP and YP, are "identical" in some relevant sense: they involve identical agreement features [F]. Then, LA finds the heads X and Y, providing <F, F>, a pair of features shared between X and Y as its label.

With this much, consider how the SO in (13) is labeled.

(13) WS = [{v*P, PP}, PP]

The PP does not provide the label of {v*P, PP}, because PP is not in the domain of the set {v*P, PP}. There are two occurrences of PPs in the WS, but {v*P, PP} does not include every occurrence of the PPs. Thus, the set {v*P, PP} is labeled v*P.

Notice also that in (5d), neither α nor β provides a label, because both α and β are not in the domain to be labeled. Although MERGE does not preclude the generation of (5d) it always results in a labeling failure. Thus, labeling limits available options to (5a-c).

3.3 Theta Relations

Let us next consider the question of why adjuncts do not enter theta relations. In (11), the verb *meet* assigns a theme role to the argument *Mary*, but it does not assign a theta-role to the adjunct *in the garden*.

Assume that a category in a certain "theta-related" position is interpreted as an argument receiving a theta-role (the configurational approach to theta theory, Hale and Keyser (1993)). For example, an external argument base-generated in Spec-v* is interpreted as Agent at the CI-interface. Notice that theta-related interpretation is assigned to an element introduced by EM. Consider (14), which has the structure in (15).

(14) Who did John meet *t* in this garden?

(15) WS = [{who, {C, {John, {T, {John, {v*, {meet, who}}}}}}}]

In (15), there are two occurrences of *who*, the highest copy in Spec-C and the lowest one in Comp-V. The lowest copy is associated with a theta-role, whereas the highest one is related to an operator-like interpretation. This property is captured by the duality of semantics put forth by Chomsky (2004, 2007) and GGO (2019).

(16) EM within the vP phase gives rise to configurations expressing generalized argument structure, whereas IM at the CP cycle yields chains that enter into the determination of scope/discourse properties. (GGO (2019: 241-242))

This article suggests that duality of semantics accounts for why an adjunct introduced by AM does not receive a theta-role. To see this, consider the structure of the v*P-area of (11) illustrated in (17).

(17) WS = [{PP, {John {v*, {meet, Mary}}}}, PP]

The PP *in the garden* is introduced by AM. Although one copy of PP occupies a theta-related position, Spec-v*, another copy is left in the WS. Given the duality of semantics, CI interprets the lowest copy as an argument receiving a theta-role and the highest copy as a scope-related element. In (17), however, neither the PP in Spec-v* nor the PP left in the WS qualify for the lowest copy: Since they do not c-command each other, structural height cannot be defined for these PPs. Thus, the CI-interface does not provide a theta-related interpretation to the PP.

3.4 The Freidin-Lebeaux Generalization

Let us finally explain the reconstruction asymmetry between arguments and adjuncts illustrated in (2), repeated here as (18).[4]

[4] Bruening and Khalaf's (2019) experimental survey claims that there is no argument-adjunct asymmetry with respect to Binding Condition C, noting that that A'-movement with an argument bleeds Binding Condition C in broader population. Although the stability of the Freidin-Lebeaux Generalization is out of the scope of my article, and I leave this issue for future research, I speculate that some independent factors might render Bruening and Khalaf's (2019) examples acceptable. For example, Kuno (1987) observes that reconstruction effects of Binding Condition C are seen when an R-expression is replaceable with a first or second pronoun in a direct speech (see Büring (2005: 258-259) for discussion). All of the eight experimental items about *wh*-movement with an argument CP in Bruening and Khalaf (2019: 270-271) seem to fall within the cases like this, where the argument CP is presented as an objective statement rather than the matrix subject's subjective point of view. For instance, in their sentence *A female staffer told everyone [which of the announcements [that Hillary Clinton$_i$ was running for president]] she$_i$ had actually authorized t.* (p. 270), "Hillary Clinton was running for president" is not attributed to Hillary's point of view but presented as an objective statement. Thus, it is likely that some discourse-related factor yields improvement of acceptability rate in their

(18) a. *Which report that $John_i$ was incompetent did he_i submit *t*?
b. Which report that $John_i$ made did he_i submit *t*?

The derivation of (18a) is shown in (19).

(19) a. WS_1 = [report, CP]
b. WS_2 = [{report, CP}]
……
c. WS_i = [{he, {v*, {submit, {which, {report, CP}}}}}]
……
d. WS_n = [{{which, {report, CP}}, {C, {he, {v*, {submit {which {report, CP}}}}}}}]

The argument CP is introduced by EM with *report*. At the stage of derivation in (20c), every occurrence of CP is c-commanded by *he*. Let us assume that the Binding Condition C is an everywhere condition: An R-expression cannot be bound by a pronoun at any stage of the derivation (see Sportiche (2017)). Then, this derivation cannot avoid a Condition C violation.

By contrast, (20b) is derived as in (20).

(20) a. WS_1 = [report, CP]
b. WS_2 = [{report, CP}, CP]
……
c. WS_i = [{he, {v*, {submit, {which, {report, CP}}}}}, CP]
……
d. WS_n = [{{which, {report, CP}}, {C, {he, {v*, {submit, {which {report, CP}}}}}}}, CP]

The adjunct CP is introduced by AM, leaving a copy of CP in WS. Crucially, (20) involves no point in the derivation where every copy of *John* is c-commanded by *he*. Suppose that c-command is defined in terms of the domain characterized in (12): α c-commands β iff β is "in the domain D" that is a MERGE-mate (sister) of α. Then, a discontinuous element can enter into a c-command relation, whereas its proper subpart cannot (this is independently attested by Krapova and Cinque (2008), which demonstrates that a proper subpart of a chain does not show *wh*-intervention effects). If this is so, (20) successfully circumvents a Condition C violation, because there is no stage of derivation where every occurrence of CP is in the c-command domain of *he*. Thus, the argument-adjunct asymmetry with respect to reconstruction effects is reduced to the difference between EM and AM.

4. Conclusion

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experiment. Although more extensive investigation is needed to conclude whether Bruening and Khalaf's (2019) claim is tenable, this article provisionally assumes that the Freidin-Lebeaux Generalization is on the right track.

The question of why human language has adjuncts has been a long-standing puzzle in generative syntax. Although previous minimalist literature stipulated Pair-Merge to capture the properties of adjuncts, it raises the serious problem of evolvability. This article argued that Pair-Merge is eliminable, demonstrating that introduction of adjuncts is a subcase of MERGE that maps a workspace WS = [α, β] onto WS' = [{α, β}, α]. This proposal accounts for the invisibility of adjuncts with respect to extraction, labeling, theta-relations, and binding. If this proposal is on the right track, adjunction, as well as hierarchical structure and displacement, is reduced to MERGE, the single operation attributed to UG.

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Takanori Nakashima
takanori.nakashima.c7@alumni.tohoku.ac.jp