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Multiple Scrambling in Japanese: An Experimental Investigation*

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1 Introduction

In his seminal studies of scrambling in Japanese, Saito (1985, 1989) argues that scrambling is an adjunction process. One of the arguments for the analysis is that scrambling appears to occur recursively. For example, it is reasonable to analyze that (1b) is derived from (1a) with two instances of NP scrambling, one of the direct object, *tegami-o* 'letter-ACC', followed by one of the indirect object, *Hanako-ni* 'H-DAT', as in (1c).

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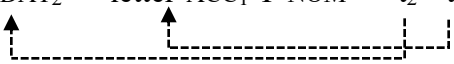
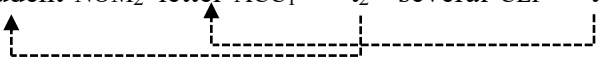
(1) a. Taroo-ga Hanako-ni tegami-o kai-ta
T-NOM H-DAT letter-ACC write-PST
'Taro wrote Hanako a letter.'
b. Hanako-ni tegami-o Taroo-ga kai-ta
H-DAT letter-ACC T-NOM write-PST
'Taro wrote Hanako a letter.'
c. H-DAT$_2$ letter-ACC$_1$ T-NOM t_2 t_1 write-PST



However, observations from previous studies suggest that multiple scrambling is not without restrictions. First, Kuno (1978) and Saito (1985) note that ditransitive sentences with both indirect and direct objects scrambled to precede the subject, like (1b), are degraded compared to similar sentences where only the direct or indirect object is scrambled (see also Agbayani et al. 2012, 2015). Second, Haig (1980) and Kuroda (1980) independently observe that the direct object cannot intervene between the subject and a numeral classifier phrase that is associated with it (2b). If multiple scrambling is freely allowed, (2b) should be derivable from (2a) by first scrambling the direct object, followed by the subject, stranding the numeral classifier phrase *in situ* (2c).

(2) a. Gakusee-ga suu-nin tegami-o kai-ta
student-NOM several-CLF letter-ACC write-PST
'Several students wrote the letter.'
b. ?*Gakusee-ga tegami-o suu-nin kai-ta
student-NOM letter-ACC several-CLF write-PST
('Several students wrote the letter.') (Haig 1980; 1068, (13b) and (13c))
c. Student-NOM$_2$ letter-ACC$_1$ t_2 several-CLF t_1 write-PST



This study aims to experimentally examine predictions of two existing analyses of scrambling, the Cyclic Linearization (CL) approach (Ko 2007, Davis 2020) and the Phonological Scrambling (PS) approach (Agbayani et al. 2012, 2015), with respect to the acceptability of four possible orders among the subject, the direct object, and a *v*P-external adverb, in a transitive sentence.

(3) a. A(dverb) S(ubject) O(bject)
b. AOS
c. OSA
d. SOA

Under the assumption that (3a) represents the base-generated order, (3b) involves a single instance of *v*P-internal scrambling of the direct object, whereas (3c) and (3d), where both subject and direct object precede the adverb, involve *v*P-external scrambling of two constituents. Our review of CL and PS approaches reveals that, while PS predicts both (3c) and (3d) to be derivable, CL only admits (3c) and rules out (3d) (Section 2). In order to test these predictions, we designed two experiments. Experiment 1 examined native speakers' preferred positions for two types of potential *v*P-external adverbs: tense and modal adverbs (Koizumi 1993). The results show that modal

adverbs are preferred in the sentence-initial position, whereas speakers' preferences for tense adverbs split between sentence-initial and after subjects. We conclude that modal adverbs are *v*P-external while the status of tense adverbs is unclear (Section 3). Experiment 2 asked participants to judge the acceptability of transitive sentences with either a modal or tense adverb in the four word orders in (3a–d). The results show that, while the mean acceptability judgment of (3a) (ASO) is significantly higher than the others, the mean acceptability judgments for (3b–d) are not significantly different from each other, contradicting CL's predictions (Section 4). We conclude that our findings pose a significant challenge to CL while they motivate several new predictions that the PS approach makes, which should be tested in future studies (Section 5).

2 Two Existing Proposals and Their Predictions

This section critically reviews two approaches to scrambling, the Cyclic Linearization (CL) approach (Ko 2007, Davis 2020) and the Phonological Scrambling (PS) approach (Agbayani et al. 2012, 2015), focusing on their predictions for the acceptability of (3a–d) above. Since both approaches predict (3a) and (3b) to be derivable, our discussion below focuses on their predictions for (3c) and (3d).

2.1 CL Approach

Ko (2007) and Davis (2020) adopt an approach to the linearization of syntactic objects known as Cyclic Linearization, or CL (Fox & Pesetsky 2005a, 2005b). According to CL, the linearization of syntactic objects applies cyclically to specific domains, such as *v*P and CP, and once the linear ordering of syntactic objects is fixed in a cycle, it cannot be erased in subsequent cycles. Under this approach, Ko (2007) accounts for, among other empirical observations, (2) in the following way. Under the assumptions that scrambling is triggered by a head that c-commands the scrambled constituent, Ko (2007) proposes that *v*P-internal scrambling of the direct object is triggered by *v*, as in (4a). Importantly, the subject does not undergo *v*P-internal scrambling because *v* does not c-command its specifier. At this point, the linear order among the relevant constituents is {the direct object < the subject < the numeral classifier} (4a). Suppose that scrambling of the subject is triggered by the head of a higher cycle, C, as in (4b). Now the order among the relevant constituents is {the subject < the direct object < the numeral classifier}. This creates an ordering contradiction, since the order between the subject and the object is reversed. Therefore, (4b) is ruled out.

(4) a. [$_{vP}$ letter-ACC$_1$ [$_{vP}$ student-NOM several-CLF t_1 write *v*] T] {O < S < NC}

b. [$_{CP}$ Student-NOM$_2$ [$_{vP}$ letter-ACC$_1$ [$_{vP}$ t_2 several-CLF t_1 write-PST *v*] T] C] {S < O < NC]}

Generalizing CL to account for A-bar movement in general, Davis (2020) argues that CL requires successive-cyclic movement through the edge of each linearization cycle, because, if a constituent is allowed to move from a position that is not the edge of a cycle, ordering conflicts will result. For example, if the object *wh*-phrase in (5a) is allowed to move to [Spec, CP] directly, an ordering conflict results between the order among the constituents in *v*P (5a) and their respective order in CP (5b). If the *wh*-phrase first moves to the edge of *v*P (6a), the same issue would not arise (6b).

(5) [CP **What$_1$** did Mary [vP give the cat **t$_1$**]]
a. vP = {give < the cat < what}
b. CP = {what < did < Mary < give < the cat} (Davis 2020: 31–2, (34), (35), (36))

(6) [CP **What$_1$** did Mary [vP **t$_1$** give the cat **t$_1$**]]
a. vP = {what < give < the cat}
b. CP = {what < did < Mary < give < the cat} (Davis 2020: 32, (37), (38), (39))

Now, if scrambling must precede successive-cyclically, in order to derive (3c) with OSA and (3d) with SOA, the direct object must move to the edge of vP so that it can undergo further movement in a higher cycle (6a). This results in {O < S} order. In order to derive (3c), after the adverb is merged, the subject first undergoes scrambling, followed by scrambling of the direct object, in CP. This establishes {O < S < A} as the order of the constituents in CP, which is consistent with (6a). In contrast, the derivation of (3d) requires the direct object to undergo scrambling first, followed by scrambling of the subject, in CP (6c). This result in {S < O < A}, which contradicts (6a).

(6) a. [vP **Obj$_1$** [vP Subj t$_1$ V v]] {O < S}
b. [CP **Obj$_1$** [CP **Subj$_2$** Adv [vP t$_1$ [t$_2$ t$_1$ V v]] C] {O < S < A}
c. [CP **Subj$_2$** [CP **Obj$_1$** Adv [vP t$_1$ [t$_2$ t$_1$ V v]] C] {S < O < A}

Therefore, CL predicts that, while (3c) is derivable, (3d) is not.

2.2 PS Approach

Agbayani et al. (2012, 2015) propose that scrambling takes place either in syntax (therefore obeying syntactic constraints) or in Phonological Form (PF) (therefore not being subject to syntactic constraints). If a target of scrambling is a syntactic constituent, it must be scrambled in syntax. If the target constitutes multiple syntactic constituents, it must form a prosodic phrase (a Major Phrase, or MajP) and scramble in PF. Both types of scrambling move only a single phrase, syntactic or prosodic. As for Kuno's (1978) and Saito's (1985) observations about the degraded status of examples like (1b)—ditransitive sentences with both direct and indirect objects scrambled—Agbayani et al. (2012, 2015) observe that their acceptability improves if the scrambled elements form a MajP and are pronounced as such (Agbayani et al. 2015: 68).

Under the PS approach, both (3c) with OSA and (3d) with SOA must involve an instance of prosodic scrambling, as they involve the scrambling of two constituents. Importantly, the PS approach predicts both orders to be derivable. The order in (3c) can be derived by the subject and the object forming a MajP, indicated with the parentheses in (7a), and phonologically scrambled (7b). The order in (3d) can be derived by first syntactically scrambling the direct object vP-internally (8a). After the adverb is merged, the direct object and the subject form a MajP (8b), and phonologically scramble (8c).

(7) a. Adv [vP **(Subj Obj)** V v]
b. **(Subj Obj)** Adv [vP (~~Subj Obj~~) V v]

(8) a. [$_{v}$P **Obj$_1$** [$_{v}$P Subj t$_1$ V *v*]]
b. Adv [$_{v}$P **(Obj$_1$ Subj)** t$_1$ V *v*]
c. **(Obj$_1$ Subj)** Adv [$_{v}$P (~~Obj$_1$ Subj~~) t$_1$ V *v*]]

Table 1 below summarizes the predictions by CL and PS for (3a–d).

	(3a) ASO	(3b) AOS	(3c) OSA	(3d) SOA
CL	✓	✓	✓	×
PS	✓	✓	✓	✓

Table 1: Predicted Acceptability of (3a–d)

In order to examine the predictions of CL and PS for (3a–d), we first conducted Experiment 1 to identify *v*P-external adverbs in Japanese, in order to be confident that scrambling of the subject and the direct object that crosses over the adverb in question is indeed *v*P-external scrambling.

3 Experiment 1

Inspired by Koizumi (1993), who argues that (i) Japanese has a modal phrase (MP) between CP and TP, and (ii) Japanese clausal adjuncts are classified into VP-, TP-, and MP-adjuncts, we hypothesized that tense and modal adverbs, presumably adjoined to TP and MP, respectively, are *v*P-external adverbs. In order to test this hypothesis, we developed a production experiment in which participants were shown transitive sentences with one of the adverbs listed in (9) in the six possible orders, as shown with the tense adverbs in (10), and instructed to reorder the subject, the object, and the adverb in each sentence into what they considered the most natural order.

(9) a. Modal adverbs: *mochiron* 'certainly', *tashikani* 'surely', *osoraku* 'probably'
b. Tense adverbs: *ototoi* 'day before yesterday', *senshuu* 'last week', *sengetsu* 'last month'

(10) a. *Ototoi* kokku-ga karee-o tsukut-ta ASO
day.before.yesterday cook-NOM curry-ACC make-PST
'The day before yesterday, the cook cooked curry.'
b. *Ototoi* dansu-o geesha-ga hajime-ta AOS
day.before.yesterday dance-ACC geisha-NOM begin-PST
'The day before yesterday, the geisha started to dance.'
c. Niwashi-ga *sengetsu* usagi-o tsukamae-ta SAO
gardener-NOM last.month rabbit-ACC capture-PST
'Last month the gardener captured a rabbit.'
d. Gyoosha-ga geemu-o *sengetsu* kaihatsushi-ta SOA
company-NOM model-ACC last.week develop-PST
'Last month the company developed a game.'
e. Moderu-o ekaki-ga *senshuu* kai-ta OSA
model-ACC painter-NOM last.week draw-PST
'The painter drew a model last week.'
f. Kuruma-o *senshuu* soori-ga kat-ta OAS
car-ACC last.week prime.minister-NOM buy-PST
'The prime minister bought a car last week.'

Each adverb was used twice to create 12 experimental items, and they were mixed with twelve filler and six practice items, making the total number of items 30. Because Japanese speakers are known to prefer having longer constituents before shorter ones (e.g. Yamashita & Chang 2001), the items were constructed so that all constituents, except for verbs, were four mora long. Except for the six practice items, which were always presented at the beginning of the experiment, all other items were pseudorandomized so that a filler item always followed an experimental item. The experiment was set up online using Google Forms. Sixty self-proclaimed Japanese native speakers participated. We hypothesized ASO to be the preferred order for transitive sentences with a *v*P-external adverb. However, we also suspected that some speakers might use the adverb first order as a heuristic for ordering the relevant constituents regardless of adverb types. Thus, we counted the frequency of the six orders produced by each participant, and removed 17 participants who produced ASO order 10 times or more out of the 12 items. Figure 1 below shows the frequencies of the six orders divided by the two adverb types, based on the remaining 43 participants.

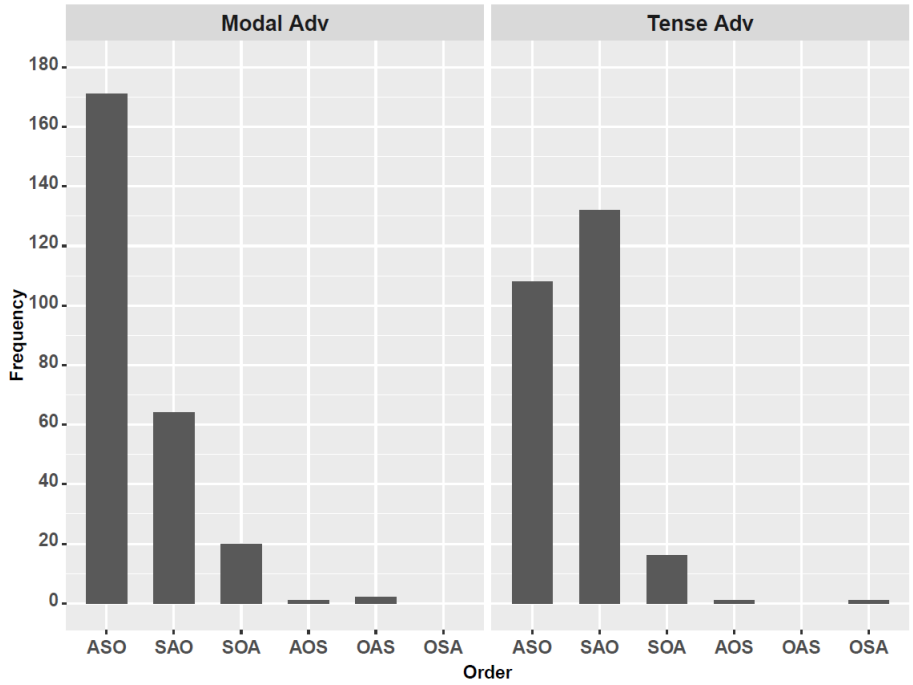


Figure 1: Frequencies of the Six Orders with Tense and Modal Adverbs from Experiment 1

With the modal adverbs, ASO is clearly the preferred order, and this pattern is also seen with each of the three individual modal adverbs. With the tense adverbs, participants' preferences seemed to split equally between ASO and SAO, and again this tendency is observed with all three tense adverbs. We take these observations as evidence that modal adverbs are *v*P-external adverbs, while we cannot rule out the possibility that tense adverbs can be *v*P-internal (e.g. adjoined to *v*P) because of the relatively high frequency of SAO. Despite the unclear status of tense adverbs, we will use both modal and tense adverbs in Experiment 2 to see if the choice of adverbs affects the acceptability of transitive sentences with these adverbs in different orders.

4 Experiment 2

Experiment 2 was an acceptability judgment experiment. Participants were presented with transitive sentences with an adverb in the four different orders in Table 1, ASO, AOS, OSA or SOA, and asked to judge their acceptability using a 7-point scale, with 1 labeled as *kanzen'ni fushizen* 'completely unnatural' and 7 *kanzen'ni shizen* 'completely natural'. We created transitive sentences with 12 different adverbs: the four modal adverbs in (11a); the four tense adverbs in (11b); and four adverbs that are believed to be VP-adverbs (we will not discuss these items). These sentences were presented in the four orders, generating a total of 48 items. These target sentences were embedded under the same bridge verb *it-ta* 'say-PST', in order to make them more plausible. The experimental items were split into two lists and mixed with the same 30 filler items and six practice items. Except for the practice items, which were always presented at the beginning of the experiment, their orders were pseudorandomized, so that there was always at least one filler item between two experimental items. The examples in (12) show the four orders with two of the modal adverbs, *osoraku* 'probably' (12a–b) and *tashikani* 'surely' (12c–d).

(11) a. Modal adverbs: *mochiron* 'certainly', *tashikani* 'surely', *osoraku* 'probably', *zettai* 'absolutely'
b. Tense adverbs: *ototoi* 'day before yesterday', *senshuu* 'last week', *sengetsu* 'last month', *sakunen* 'last year'

(12) a. Keebu-wa [*osoraku* furyoo-ga naifu-o nage-ta]-to it-ta
detective-TOP probably delinquent-NOM knife-ACC throw-PST-COMP say-PST
'The detective said that the delinquent probably threw a knife. [ASO]
b. Kyooshi-wa [*osoraku* shoojo-o kozoo-ga ijime-ta]-to it-ta
teacher- TOP [probably girl-ACC boy-NOM bully-PST-COMP say-PST
'The teacher said that the boy probably bullied the girl.' [AOS]
c. Naasu-wa [nezumi-o juui-ga *tashikani* shinsatsushi-ta]-to it-ta
Nurse-TOP mouse-ACC veterinarian-NOM surely examine-PST-COMP say-PST
'The nurse said that the veterinarian surely examined the mouse.' [OSA]
d. Josee-wa [danshi-ga *tashikani* hakama-o ki-te i-ta]-to it-ta
Woman-TOP boy-NOM surely kimono-ACC wear-GER be-PST-COMP say-PST
'The woman said that the boy was surely wearing kimono.' [SOA]

Experiment 2 was also set up online using Google Forms. Sixty self-proclaimed Japanese native speakers participated. Collected ratings were *z*-score transformed before being analyzed with linear mixed effects models using R (Bates et al. 2015) with WORD ORDER (ASO, ASO, AOS, OSA or SOA) and ADVERB (modal vs. tense adverb) as fixed factors and participants and items as random factors. We calculated *p*-values using the lmerTest package (Kuznetsova et al. 2017).

For the factor WORD ORDER, we ran two separate models. The first model included all four word orders. We expected that there would be a significant difference in mean *z*-scores between ASO, which by our hypothesis does not involve scrambling, and the other three orders, which by our hypothesis include at least one instance of scrambling. The second model only included the scrambling conditions AOS, OSA, and SOA. Under PS, all three orders are admissible; therefore, no significant difference in their mean *z*-scores is predicted. Under CL, only SOA is inadmissible. Therefore, the mean *z*-score for SOA is predicted to be significantly lower than the mean *z*-scores

of the other orders. As for the factor ADVERB, predictions depend on the status of tense adverbs. If both modal and tense adverbs are *v*P-external, it is not predicted to be a significant predictor of acceptability of the items within the four word orders. If tense adverbs are *v*P-internal, CL predicts that the linear ordering established in *v*P would have to be either ASO (13a) or OAS (13b).

(13) a. [$_{vP}$ Adv Subj Obj V] {Adv < S < O}
b. [$_{vP}$ **Obj$_1$** Adv Subj t$_1$ V] {O < Adv < S}

This would mean that neither AOS, OSA, nor SOA order can be derived in the next cycle (i.e. CP). Under PS, SOA can be derived by phonologically scrambling the subject and the object in (13a) together as a MajP (14a), and AOS can be derived from (13b) if adverbs can scramble (14b). However, OSA is predicted to be underivable, as it would have to involve two separate instances of scrambling, with either (13a) or (13b) as the source, as can be seen in (15).

(14) a. **(Subj Obj)** [$_{vP}$ Adv ~~Subj Obj~~ V]
b. **Adv$_1$** [$_{vP}$ Obj$_1$ t$_1$ Subj t$_1$ V]

(15) a. **Obj$_2$ Subj$_1$** [$_{vP}$ Adv t$_1$ t$_2$ V] (from (13a))
b. **Obj$_1$ Subj$_2$** [$_{vP}$ t$_1$ Adv t$_2$ t$_1$ V] (from (13b))

In other words, some of the four word orders are predicted to be underivable if tense adverbs are *v*P-internal. Therefore, there might be an interaction between WORD ORDER and ADVERB.

Figure 2 below shows the condition means from Experiment 2, split between the modal adverb conditions on the left panel and the tense adverb conditions on the right panel.

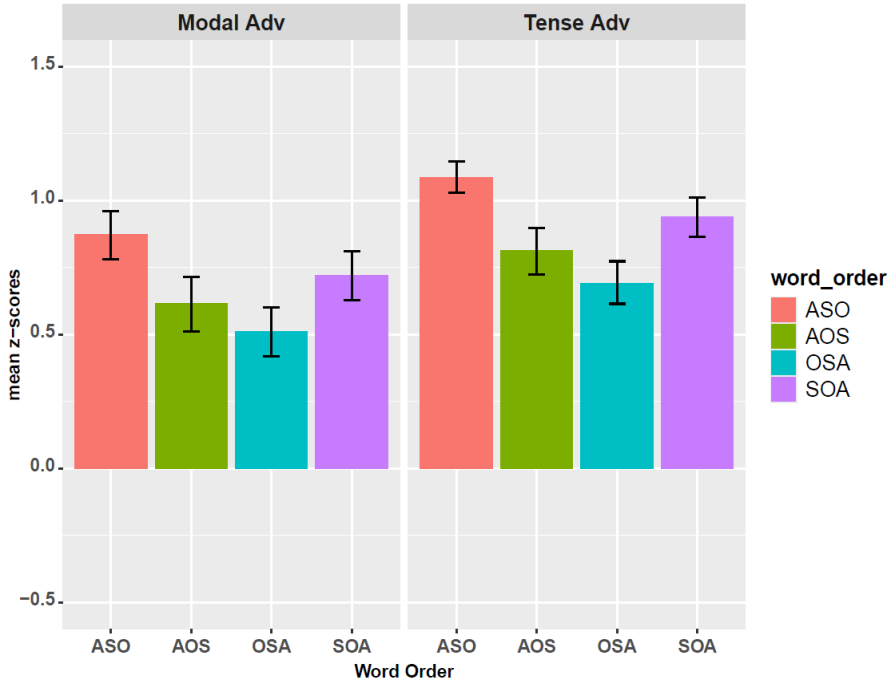


Figure 2: Mean *z*-scores from Experiment 2

A visual inspection of Figure 2 reveals the following. First, all eight condition means are above the zero *z*-score, that is, the middle-of-the-scale rating for each of the participants, indicating that all four sentence types with both types of adverbs are relatively acceptable. Second, the distribution of the four condition means with modal adverbs on the left panel and with tense adverbs on the right panel show very similar numerical patterns: The mean *z*-score for ASO appears to be the highest, followed by the mean *z*-scores of SOA, AOS, and OSA, in that order.

The first statistical model with all four word orders shows that ADVERB is not a significant predictor ($\beta = 0.03$, $p = 0.61$). As for WORD ORDER, AOS ($\beta = -0.26$, $p < 0.01$), OSA ($\beta = -0.37$, $p < 0.01$), and SOA ($\beta = -0.15$, $p < 0.01$) are all significantly different from ASO. The interaction between ADVERB and WORD ORDER is not significant. The second model looked only at the three orders that involve scrambling by hypothesis (AOS, OSA, and SOA). Neither the factor ADVERB ($\beta = 0.02$, $p = 0.8$) nor the interaction between ADVERB and WORD ORDER is significant in the second model. As for WORD ORDER, neither OSA ($\beta = -0.1$, $p = 0.07$) nor SOA ($\beta = 0.1$, $p = 0.08$) is significantly different from SOA.

5 Discussion

Taken together, the findings from Experiments 1 and 2 suggest the following. First, despite the differences between modal and tense adverbs in Experiment 1, similar distributions of the condition means were found between the items with modal adverbs and the ones with tense adverbs in Experiment 2. This suggests that these two types of adverbs are not qualitatively different from each other. Although the condition means appear numerically higher with the tense adverb items than these with the modal adverb items, their distributions are not significantly different. We believe that this finding does not contradict our assumption that modal verbs are *v*P-external, and it may suggest that tense adverbs can also be *v*P-external. Second, the condition means for the three word orders that, by our hypothesis, involve scrambling, AOS, OSA, and SOA, are significantly different from the condition mean for ASO, which is assumed to involve no scrambling. This shows that the presence of scrambling (syntactic or phonological) degrades acceptability of transitive sentences. Third, the condition means among the three word orders that involve scrambling are not significantly different from each other. This finding is compatible with the predictions of the PS approach, according to which all three of them are derivable. In contrast, it contradicts the predictions of the CL approach, according to which SOA is inadmissible and therefore its condition mean should be significantly lower than the condition means of the other word orders.

Thus, we conclude that, to the extent that our understanding of the CL approach is correct, it fails to account for the acceptability of multiple scrambling with Japanese transitive sentence with a *v*P-external adverb. Two comments are in order for the PS approach. First, although the PS approach correctly predicted the relative acceptability of the four word orders that we tested, the problem with the current study is that it failed to test sentence types that are predicted to be unacceptable by the PS approach. For example, the PS approach predicts that SOA and OSA must involve the phonological scrambling of MajPs that consist of two syntactic constituents, as shown in (7) and (8). Therefore, sentences with these word orders must be accompanied by the right prosody, that is, with the subject and the object forming a MajP. In order to test these predictions, we need acceptability judgment experiments with audio stimuli that systematically manipulate the prosody of experimental items. Second, looking at the findings from Experiment 2, one may wonder what accounts for the fact that the items in these four conditions show the same numerical

tendency with the modal adverb conditions and the tense adverb conditions. That is, ASO shows the highest mean, followed by SOA, AOS, and OSA, in that order. Now, under PS, SOA is derived by a single instance of phonological scrambling, and AOS with a single instance of syntactic scrambling, whereas OSA must involve an instance of syntactic scrambling and an instance of phonological scrambling. Thus, the numerical differences among SOA, AOS, and OSA motivate the following hypotheses: (i) Syntactic scrambling incurs greater acceptability degradation than phonological scrambling does, and (ii) Multiple instances of scrambling (syntactic or phono-logical) incur greater acceptability degradation than a single instance of scrambling does. We are currently preparing for experiments that test the predictions of these hypotheses.

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