Processing two types of ditransitive sentences in Turkish: Preliminary results from a self-paced reading study

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Abstract In Japanese sentence processing, Miyamoto and Takahashi (2002, 2004) showed that the [NOM>DAT>ACC] order is easier to process than the [NOM>ACC>DAT] order, and argued that the filler-gap dependencies which is driven by the case markers can explain the processing difficulty of scrambled ditransitives. On the other hand, Sakai et al. (2009) showed that the animacy has also impact on the processing of ditransitives. Yet, it is unknown whether case markers and animacy affect the processing of ditransitive sentences and their word order alternations in other languages as well. In the present study, by manipulating the animacy of DAT-noun in Turkish, we first investigated how ditransitive sentences are processed through two self-paced reading experiments. We then evaluated whether the case markers and animacy affect the processing of ditransitives and their word order alternations in Turkish. The results of Experiment1 showed that when the DAT-noun was animate, the [NOM>DAT>ACC] order was read faster than that of the [NOM>ACC>DAT]. This result is consistent with Miyamoto and Takahashi’s, and the filler-gap dependency can account for. On the other hand, when the DAT-noun was inanimate, the [NOM>ACC>DAT] order was read faster than the [NOM>DAT>ACC] order. This result cannot be accounted for by the case driven filler-gap dependencies. Overall, our study indicates that semantic factors such as animacy also have an impact on the processing of ditransitive sentences in Turkish.

Keywords Scrambling, Ditransitives, Sentence processing, Case-markers, Animacy, Turkish, Self-paced reading
1.2. Previous studies in Japanese

Miyamoto and Takahashi (2002, 2004) investigated the processing of ditransitive sentences and their word order alternations in Japanese to answer a fundamental question: “Why are canonical sentences easier to process than their scrambled counterparts?” and attempted to explain the processing constraints that govern the processing difficulty of scrambled sentences [7][8]. Assuming the [ NOM>DAT>ACC] (nominative, dative, and accusative, respectively) order is the canonical word order, Miyamoto and Takahashi (2002, 2004) compared the time course of the sentences like “Waitress-NOM cashier-DAT book-ACC introduced” vs “Waitress-NOM book-ACC cashier-DAT introduced” (The waitress introduced the cook to the cashier), through a self-paced reading experiment. The results revealed that the [NOM>DAT>ACC] order was read faster than the [NOM>ACC>DAT] order immediately before the verb.

In another attempt, Miyamoto and Takahashi reported that the grammatical information from case markers, the animacy information to make predictions and decisions about the sentence structure in process. In addition to case markers, also incrementally utilizes animacy is also an important processing constraint in Japanese, and when they controlled the animacy of ACC and DAT nouns, the formation difficulty of filler-gap dependencies. They claim that, since no argument moves in the [NOM>DAT>ACC] order, there is no filler-gap dependency. On the other hand, since ACC-noun moves in front of DAT-noun in [NOM>ACC>DAT] order, the parser, based on the information from case markers, attempts to establish a filler-gap dependency between the ACC-noun and its original position at the DAT-noun position. Therefore, the [NOM>DAT>ACC] order was easier to process than the [NOM>ACC>DAT] order. Further, Miyamoto and Takahashi reported that the distance between the filler and the gap also affects the processing difficulty [10]. From Miyamoto and Takahashi’s point of view, the case markers play a crucial role on the incremental processing of filler-gap dependencies. In other words, the grammatical information, which is obtained from the case markers, is an important processing constraint that governs the comprehension of ditransitives in Japanese.

In a recent study, Sakai et al. (2009) compared the processing of Japanese ditransitive sentences with inanimate objects like: [Mother-NOM sauce-ACC ketchup-DAT mixed] (Mother mixed the sauce into the ketchup) vs. [Mother-NOM sauce-DAT ketchup-ACC mixed] (Mother mixed the ketchup into the sauce), through an ERP study [9]. The results showed that an LAN (left anterior negativity) component was elicited at the ACC-noun immediately before the verb. In other words, unlike previous studies in Japanese [6][7][8], the [NOM>ACC>DAT] order was easier to process than the [NOM>DAT>ACC] order [9].

Sakai et al. argued that previous studies did not manipulate the animacy in Japanese, and when they controlled the animacy of ACC and DAT nouns, the pattern of processing difficulty was reversed. This indicates that semantic information, which is based on animacy is also an important processing constraint in Japanese ditransitives. In other words, the parser, in addition to case markers, also incrementally utilizes animacy information to make predictions and decisions about the sentence structure in process.

Previous studies in Japanese suggest that both grammatical information from the case markers and semantic information from animacy have an impact on the processing of ditransitives and their word order alternations. However, at this moment we cannot conclude whether these factors are specific to processing of Japanese ditransitives or they are more general processing constraints and affect the processing of ditransitives in other languages as well. If both case markers and animacy are not language specific factors, their effect should be observable in other languages in which both case markers and animacy is related to the structure of canonical word order. In the present study, using Turkish ditransitives, we explored whether the case markers and the animacy are relevant to processing of other languages.

1.3. Ditransitive sentences in Turkish

Turkish is an SOV language and the scrambling of the DAT-noun and the ACC-noun in ditransitives is possible as in Japanese [11][12][13][14][15]. In Turkish, although the NOM-noun does not bear an explicit case marker, the ACC-noun and the DAT-noun bear explicit case markers.1

(1a) Öğretmen kitab-ı öğrenci-ye ver-di. Teacher book-ACC student-DAT give-PAST
‘The teacher gave the book to student.’

(1b) Öğretmen öğrenci-ye kitab-ı ver-di. Teacher student-DAT book-ACC give-PAST
‘The teacher gave the book to student.’

In neutral intonation, the immediately preverbal position is the default focus position associated with emphasis or contrast. In (1a) indirect object öğrenci (student) and in (1b) direct object kitab (book) is focused [13]. However, in both sentences, propositions are identical. In Turkish, scrambling subject and other arguments over the verb is also possible, but in the present study we only focus on the processing of sentences as in (1).

Most researchers assume that (1a) is the canonical word order of the ditransitives, and (1b) is the scrambled order in Turkish [11][12][13][14]. However, this view was based on the researcher’s intuitions and/or their informants’ judgments, and we could not find any systematic explanation in the literature that explains why the [NOM>ACC>DAT] order is the canonical in Turkish. Regarding this problem, Kornfilt (2003) notes that it is hard to answer why native speakers of Turkish judge the [NOM>ACC>DAT] order as the unmarked order compared to the [NOM>DAT>ACC], and she points out a possibility that because the ACC-noun is placed in a hierarchically higher position than the DAT-noun, the [NOM>ACC>DAT] order might be accepted unmarked order in Turkish [12].

Unlike these studies, Öztürk (2004), based on Miyagawa & Tsujiioka’s analysis in Japanese, proposed two types of canonical word order for Turkish ditransitives [15][16]. According to Öztürk, when the goal (DAT-noun) has a possessor interpretation, it precedes the theme (ACC-noun), and hence the canonical word order is [NOM>DAT>ACC] as the unmarked order compared to the [NOM>ACC>DAT]. Öztürk supported this view with following examples in which the antecedent and anaphor relation is found between the goal and theme.

In (2), the possessor goal her adam (every man) is an antecedent, and the theme resminı (his/their picture) is an

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1 In the case of indefinite (non-specific) nouns, the direct object does not bear an overt accusative case, and its scrambling is not allowed (e.g.[11]). However, the specificity of the object noun is beyond the scope of this study.

2 Strictly speaking, Kornfilt and Underhill do not use the term ‘canonical order’, they rather prefer ‘unmarked order’.
anaphor. In (2a), although the goal can bind the theme, in (2b) the theme cannot be bound. This implies that the possessor goal should be in higher position than the theme, and thus the canonical word order is [NOM>DAT>ACC] in the case of possessor goal. Further, the possessor goal should be an animate noun [16].

(2) Possessor goal
   a. Her adam-a, resim-in-i, verdi-m
      Every man-DAT picture-3sg-ACC gave-1sg
      ‘I gave every man his picture’
   b. *Resim-in-i, her adam-a, verdi-m
      picture-3sg-DAT every man-DAT gave-1sg
      *‘I gave every man his picture’

In (3) on the other hand, the theme resim (picture) is the antecedent and the locative goal çerçevesine (in its frame) is the anaphor. In (3a), the theme can bind the goal, but in (3b) it cannot bind the goal. This implies that when the goal is a locative noun, it is placed in a lower position than the theme, and hence the canonical order is [NOM>ACC>DAT]. The locative goal is always an inanimate noun [16].

(3) Locative goal
   a. Resim-i, çerçeve-sin-e, koydu-m
      Picture-ACC frame-3sg-DAT put-1sg
      ‘I put the picture in its frame’
   b. *Çerçevesin-e, resim-i,
      frame-3sg-DAT picture-ACC put-1sg
      *‘I put the picture in its frame’

Öztürk’s analysis shows that there are two types of ditransitive sentences and canonical word orders exist, and moreover, the animacy of the goal (DAT-noun) is also related to formation of these structures in Turkish. However, to the best of our knowledge, no study has reported how these constructions are processed in real time, and how the case markers and animacy are related to online sentence processing in Turkish. Taking previous Japanese studies into consideration, we can make following predictions:

First, if the grammatical information based on the case markers is the most important processing constraint to make incremental predictions and decisions about the sentence structure, irrespective of the animacy of the goal argument, similar processing patterns should be observed in both types of ditransitives (possessor goal and locative goal) [7][8].

On the other hand, if the semantic information, which is based on the animacy of the goal, is also an important constraint to make incremental predictions and decisions about the sentence structure, different processing patterns might be observed in the case of possessor goal and locative goal sentences [9].

1.4. Aim of the present study
Assuming that the canonical word order of ditransitives varies depending on the goal-type (possessor or locative) [15], (i) we first explore whether scrambling has an impact on the processing of two types of ditransitives in Turkish. (ii) Then we will evaluate whether the case markers and the animacy of the goal argument have an impact on the processing of ditransitives (Why Turkish ditransitives are processed in such a way). In doing so, we hope to contribute to cross-linguistic understanding of processing of ditransitive sentences. 3

2. Experiment1: Possessor (animate) goal

2.1. Purpose
The aim of Experiment 1 is twofold. First, we explore how native Turkish speakers process ditransitive sentences and their word order alternations with a possessor (animate) goal. Second, we verify whether a filler-gap dependency, which is driven by case markers, is responsible for the results as in Japanese [7][8]. Since previous studies reported an effect of distance between the filler and the gap [7][8], we manipulated the distance between the DAT-noun and the ACC-noun.

2.2. Materials & Predictions
Experimental materials included 102 sentences in total (20 target sentences, 62 fillers and 20 target sentences for Experiment 2). Target sentences consisted of 4 conditions in which the order of the goal and theme, and the distance between them, were manipulated by inserting an adverbial phrase (two words) between the goal and theme as shown in (4). Moreover, all of the goal arguments were animate nouns, and three-place predicates were so called “show type verbs” [5], in which exhibit same inchoative alternation pattern where the indirect object (DAT-noun) of “Siyasetçi valide ilçeyi tanıttı” (the politician introduced the town to the governor) becomes the subject of “Vali ilçeyi tanıdı” (the governor knew the town).

(4)
   a. Siyasetçi seçimden önce vali-ye ilçeyi
      Politician election before governor-DAT town-ACC
   b. Siyasetçi seçimden önce ilçeyi vali-ye
      Politician election before town-ACC vali-ye
   c. Siyasetçi vali-ye seçimden önce ilçeyi
      Politician.gov.-DAT election before town-ACC
   d. Siyasetçi ilçeyi seçimden önce vali-ye
      Politician town-ACC election before god.-DAT

In (4a) and (4c), the possessor goal (DAT-noun) vali (governor) precedes the theme (ACC-noun) ilçeyi (town), and there is no filler-gap dependency. Conversely, in (4b) and (4d) the theme precedes the goal, and there is a filler-gap dependency. Moreover, the distance between the filler and the gap is greater in (4d). Based on Miyamoto & Takahashi (2004)’s results, following results can be expected in Turkish. Reading time of the DAT-noun immediately before the verb in (4a) and (4c) should be faster than ACC-noun in (4b) and (4d), and due to the greater distance between the filler and the gap, (4d)’s reading time at ACC-noun should be the longest.

2.3. Participants & Procedure
Fifty-two undergraduate or graduate students at Çanakkale Onsekiz Mart University in Turkey participated in the experiment (Average ages: 21; ranging from 18 to 33). All were native speakers of Turkish.

Experimental sentences were presented on a computer monitor using Linger 2.94 (developed by Dough Rohde) in a word-by-word, non-cumulative reading task. After

3 Present study does not aim to verify the validity of Öztürk (2004)’s claim, or distinguish between the competing theories (views) of Turkish linguistics.
reading a sentence, the participants answered a yes-no comprehension question. Before the experiment, the participants were given a practice set of 6 sentences.

2.4. Results

Statistical analyses for the reading times were conducted only on sentences wherein the participants correctly answered the comprehension question. Overall accuracy rate was 96% and there was no statistical difference among four conditions ($F$s < 1). Before comparing reading times, we discarded the data whose reading times were shorter than 250ms or longer than 2500ms (2.75 SD). This affected 3.1% of the data. Average reading times of each word in four conditions are as shown in Fig. 1. Main region (word) of interest is just before the embedded verb (region 5) and verb (region 6).

![Fig. 1 Reading times of possessive (animate) goal sentences](image)

Since we used different words for the goal and the theme objects at region 5, ANOVAs were conducted on residual reading times that allow us to see how long a participant spent per-letter. The results revealed that the main effect of word order was significant at region5 [$F_1$ (1, 51) = 14.47, $p < .01$; $F_2$ (1, 19) = 5.61, $p < .05$]. However, the main effect of distance between the goal and theme, and the interaction between the word order and distance was not significant (reading times (RTs) by condition: a: 710 ms; b: 785 ms; c: 696; d: 753 ms). Similarly, the main effect of word order was significant also at verb (region6) [$F_1$ (1, 51) = 4.08, $p < .05$; $F_2$ (1, 19) = 6.04, $p < .05$], but there was no significant main effect of distance, or interaction (RTs by condition: a: 769 ms; b: 821 ms; c: 761; d: 820 ms). The results show that irrespective of the distance between the goal (DAT-noun) and theme (ACC-noun), the [NOM>DAT>ACC] order was read faster than the [NOM>ACC>DAT] at region 5 and 6.

2.5. Discussion

The results of Experiment 1 show that when the goal argument has a possessor interpretation (DAT-noun is animate), irrespective of the distance between the goal and the theme (the filler and the gap) [7][8][10], the sentences where the goal preceded the theme were read faster than the sentences where the goal preceded the theme, immediately before and at the verb. Therefore we can conclude that the [NOM>DAT>ACC] order was easier to process than the [NOM>ACC>DAT] order in Turkish. This result is consistent with Öztürk (2004)’s claim [15], and previous studies in Japanese [6][7][8].

Although, there was no significant effect of the distance between the filler and the gap [10], the results of Experiment 1 can be explained by the formation difficulty of filler-gap dependencies [7][8]. Since the parser had to establish a filler-gap dependency between the ACC-noun and its original position at DAT-noun position in (4b) and (4d), their processing load would have been greater immediately before the verb (DAT-noun) and at the verb, compared to (4a) and (4c) (ACC-noun) where there was no filler-gap dependency. As argued by Miyamoto and Takahashi, the parser might have rapidly utilized the information from case markers while establishing a filler gap dependency between the ACC-noun and its original position at the DAT-noun position [7][8].

However, if the case markers are the only important information source for the incremental processing of ditransitives in Turkish, similar processing pattern should be observed even when the goal argument is a locative (inanimate) noun. On the other hand, if the Turkish parser also immediately utilizes the semantic information which can be obtained from the animacy to comprehend ditransitives and their word order alternations, when the DAT-noun is an inanimate noun, the processing pattern (time course) may differ from the Experiment 1. In the Experiment2 we tested this possibility.

3. Experiment2: Locative (inanimate) goal

3.1. Purpose

First, we explore how native Turkish speakers process ditransitive sentences and their word order alternations with locative (inanimate) goals, then we evaluate whether the grammatical information obtained from the case markers is responsible for the processing of ditransitives, or if the semantic information obtained from animacy also has an impact on the processing of ditransitives in Turkish. The distance between the ACC-noun and the DAT-noun was also manipulated in Experiment 2.

3.2. Materials & Predictions

Experiment 2 was conducted together with Experiment 1, and all of the goal arguments of target sentences were inanimate nouns. Moreover, all of the three-place predicates were so called “pass type verbs” [5], and exhibit same inchoative alternation pattern in which the direct object (ACC-noun) of “Kurye paketi uçaga ulaştırdı” (The courier delivered the package to the plane) becomes the subject of “paket uçaga ulaştı” (the package reached plane).

![Diagram](image)

In (5a) and (5c), the theme (ACC-noun) paket (package) precedes the locative goal (DAT-noun) uçaga (plane), and since all arguments stay in-situ, there is no filler-gap dependency. On the other hand, in (5b) and (5d), the locative goal precedes the theme, and there is a filler-gap dependency between the DAT-noun and its canonical position. If the Turkish parser ignores the animacy and only uses the information from case markers to process these sentences, (5b) and (5d) should be read faster than (5a) and (5c) as in the Experiment 1. On the other hand, if the Turkish parser also rapidly utilizes the semantic information from animacy to process the sentences, the results may differ from Experiment 1.
3.3. Participants & Procedure
Participants and procedure were identical to Experiment 1.

3.4. Results
The overall accuracy rate was 97% and there was no statistical difference among four conditions ($F$s < 1). Before comparing reading times, we discarded the data whose reading times were shorter than 250 ms or longer than 2500 ms (2.75 SD). This affected 3% of the data. Average reading times of each word in the four conditions are as shown in Fig. 2. Main region (word) of interest is just before the embedded verb (region 5) and embedded verb (region 6).

ANOVA's were conducted on residual reading times at region 5 and 6. The results revealed that the main effect of word order was significant at region 5 ($F_1 (1, 51) = 9.36, p < .01; F_2 (1, 19) = 13.96, p < .01$). However, the main effect of distance between the goal and theme, and interaction was not significant (reading times by main effect of distance between the goal and theme, and interaction was not significant (RTs by condition: a: 677; b: 777; c: 706; d: 793)). Similarly, the main effect of word order was significant also at verb condition (ms): a: 677; b: 777; c: 706; d: 793). The results reveal that irrespective of the distance, or interaction (RTs by condition: a: 727; b: 756; c: 735; d: 846). The results reveal that irrespective of the distance between the goal (DAT-noun) and theme (ACC-noun), [NOM>ACC>DAT] order was read faster than [NOM>DAT>ACC] order where there was a filler gap dependency between the ACC-noun and its canonical position. As argued in Japanese sentence processing, the Turkish parser, based on the grammatical information from the case markers, might have also immediately postulated a gap position for the ACC-noun as soon as the DAT-noun was encountered [7][8]. Thus, this gap postulation process might have increased the processing load. Although, this possibility seems quite reasonable, the Turkish parser might have also utilized the semantic information from the animacy of the nouns to facilitate the sentence processing. However, from only the results of Experiment 1 we cannot fully test this possibility. Thus we conducted the Experiment 2 with inanimate goal.

The results of Experiment 2 revealed that the [NOM>DAT>ACC] order where there was no filler-gap dependency was easier to process than the [NOM>ACC>DAT] order where there was a filler gap dependency between the ACC-noun and its canonical position. As argued in Japanese sentence processing, the Turkish parser, based on the grammatical information from the case markers, might have also immediately postulated a gap position for the ACC-noun as soon as the DAT-noun was encountered [7][8]. Thus, this gap postulation process might have increased the processing load. Although, this possibility seems quite reasonable, the Turkish parser might have also utilized the semantic information from the animacy of the nouns to facilitate the sentence processing. However, from only the results of Experiment 1 we cannot fully test this possibility. Thus we conducted the Experiment 2 with inanimate goal.

Below, we would like to propose three future studies

4. General Discussion and Future Directions
The aim of the present study was twofold. The first aim was to explore how Turkish native speakers process two types of canonical and scrambled ditransitives with possessor (animate) and locative (inanimate) goals in Turkish. The second aim was to evaluate whether case markers and animacy affect sentence processing.

Regarding the first aim, the results of two experiments revealed that when the goal argument was an animate noun, the [NOM>DAT>ACC] order was easier to process than the [NOM>ACC>DAT] order, whereas when the goal argument was an inanimate noun, the [NOM>ACC>DAT] order was easier to process than the [NOM>DAT>ACC] order. These results are consistent with Öztürk (2004)'s analysis of canonical and scrambled word orders of Turkish ditransitives. In other words, our performance data is in line with Öztürk's competence data. However, this is not to mention that other researchers are wrong [11][12][13][14], or competence and performance should always be in line. Rather, our study only indicates that canonical ditransitives in Turkish were psychologically easier to comprehend than their scrambled counterparts in performance as well.

Regarding the second aim, it can be said that both case markers and animacy have an impact on the processing of ditransitives and their word order alternations in Turkish. The results of Experiment 1 revealed that when the goal was an animate noun, the [NOM>DAT>ACC] order where there was no filler-gap dependency was easier to process than the [NOM>ACC>DAT] order where there was a filler gap dependency between the ACC-noun and its canonical position. As argued in Japanese sentence processing, the Turkish parser, based on the grammatical information from the case markers, might have also immediately postulated a gap position for the ACC-noun as soon as the DAT-noun was encountered [7][8]. Thus, this gap postulation process might have increased the processing load. Although, this possibility seems quite reasonable, the Turkish parser might have also utilized the semantic information from the animacy of the nouns to facilitate the sentence processing. However, from only the results of Experiment 1 we cannot fully test this possibility. Thus we conducted the Experiment 2 with inanimate goal.

The results of Experiment 2 revealed that the [NOM>DAT>ACC] order where there was no filler-gap dependency was easier to process than the [NOM>ACC>DAT] order where there was a filler gap dependency between the ACC-noun and its canonical position as in the Experiment 1. However, we cannot explain this result through only the grammatical information from the case markers, because if the case markers are the only relevant information source for sentence processing in Turkish, irrespective of the animacy of the goal argument, the [NOM>ACC>DAT] order should have been easier to process than the [NOM>ACC>DAT] order in Experiment 2 as well. However, the results of Experiment 2 are opposite to those of Experiment 1. Thus, the results suggest that the Turkish parser utilizes not only grammatical information from the case markers, but also semantic information from animacy, and makes predictions about the upcoming constituents of the sentence.

Overall, our results suggest that the animacy of the goal argument is not only related to structure formation of ditransitive sentences in Turkish [15], but it also related to real time sentence processing. Thus it is safe to say that the case markers and animacy are not specific to Japanese sentence processing, they are more general processing constraints and govern the processing of the canonical and scrambled ditransitives in Turkish as well.

Below, we would like to propose three future studies
related to present study. First, the results of Experiment 1 and Experiment 2 are both consistent with filler-gap dependencies. However at this point we cannot determine whether animacy directly affects the formation processing of the filler-gap dependencies or if it is an independent processing constraint in Turkish. In a future study, we will attempt answer this question.

Second, Miyamoto and Nakamura (2005) pointed out that the frequency of the canonical and scrambled sentences must be taken into consideration in sentence processing studies [17]. In the present study we could not investigate the distribution of the canonical and scrambled ditransitive sentences in Turkish corpus. In a future study, we will count the number of the two types of ditransitive sentences with their canonical and scrambled order in Turkish, and take the distribution into consideration as a variable (processing constraint).

Third, previous studies in English have already demonstrated that there is a close relationship between the language comprehension and production [e.g.18]. In the present study, we only focused on the comprehension side of sentence processing. In order to deepen our understanding of human sentence processing mechanisms, we will also conduct a production study in line with the comprehension study, and attempt to explore how comprehension and the production are related to each other in head-final languages.

5. Conclusions

In the present study, we investigated how canonical and scrambled ditransitive sentences are processed in Turkish. The results of two self-paced reading experiments revealed that when the dative object was an animinate noun, the [NOM>DAT>ACC] order was easier to process than the [NOM>ACC>DAT] order, whereas when the dative object was an inanimate noun, the [NOM>ACC>DAT] order was easier to process than [NOM>DAT>ACC] order. Based on these results, we can conclude following points.

1. The canonical ditransitive sentences are easier to process than the scrambled ones in Turkish.
2. While processing diransitives and their word order alternations, the Turkish parser utilizes not only the grammatical information from the case markers, but also the semantic information from the animacy of the nouns to make forward predictions. Thus, both factors are general (non-language specific) processing constraints.
3. The animacy factor must actively be taken into consideration in the sentence processing studies of scrambling phenomena.

References


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