

Putting the Pieces Together: Second Language Learning of Null Subjects, Inversion, and *That-trace**

Larry LaFond

Southern Illinois University Edwardsville

1.0 Introduction

Understanding cross-linguistic variation in the use of null subjects, subject inversion, and *that-trace* has been a long-standing goal within linguistic theorizing. An interesting question for second language acquisition researchers has been why this set of grammatical properties, sometimes subsumed under a ‘pro-drop’ designator, often cluster together and whether a developmental order exists in regard to these properties. Varying generative frameworks have been employed to address this issue, some focusing on parameter-setting (White 1985, Liceras 1989, et al.), others on feature-strength (Speas 1994, Radford 1997), and more recently constraint interactions (Costa 1997, Speas 1997, Grimshaw and Samek-Lodovici 1998, LaFond, Hayes and Bhatt 2001).

This paper reports on a study of the L2 acquisition of Spanish by native speakers of English, and it presents an Optimality-theoretic (OT; Prince and Smolensky 1993, Grimshaw 1997) account of the developmental stages exhibited by these learners. The purpose of such an account is not simply to demonstrate that the known facts regarding certain grammatical properties can be usefully described within the OT framework (that has already been done for each property individually), the goal of this paper is to bring together insights of several lines of research regarding pieces of the pro-drop puzzle from an Optimality-theoretic perspective to consider whether the various proposals offered in these studies may together provide a coherent, unified understanding of pro-drop. Additionally, this paper seeks to test whether a combined analysis would support the notion of recursive stages of constraint demotion, as in the learning algorithm of Tesar and Smolensky (2000), and it seeks to uncover implications such an algorithm may have for the L2 learning of a language.

2.0 Statement of the problem

Languages differ concerning their treatment of overt subjects, their use of subject inversion, and their handling of *that-trace* sequences. For example, the discourse requirements of some languages permit, indeed require, phonologically null subjects when those subjects are the topic of the discourse. The syntactic constraints of other languages prohibit null subjects. One common assumption in syntactic literature for the last twenty years has been that the permissibility of null-subjects is one syntactic property of a single *parameter* that includes a host of additional properties (Chomsky 1981, Jaeggli 1982, Rizzi 1982). For example, in addition to permitting the omission of subject pronouns in tensed clauses, the same parameter has been thought to permit *that-trace* violations and postposing of subjects. Examples (1)-(3) show that L1 English learners of languages such as Spanish or Italian begin from a position where their current grammatical system is in direct conflict with the system they are trying to learn.

* Portions of this research were presented at the 30th Annual Linguistic Symposium on Romance Languages, the 2000 Generative Approaches to Second Language Acquisition, and the 4th Conference on the Acquisition of Spanish and Portuguese as First and Second Languages. I am grateful to numerous people for their comments and assistance on this project: Laura Ahearn, Sean Barnette, Anne Bezuidenhout, Paul Boersma, Rakesh Bhatt, John Grego, Jane Grimshaw, Barbara Hancin-Bhatt, Rachel Hayes, Eric Holt, Ramona Lagos, Juana Liceras, Hyeson Park, Jacqueline Toribio. They are, of course, not responsible for any errors or inaccuracies that remain.

- (1) Null Subjects
 - a. Voy al cine esta noche.
 - b. * 'go to the movies tonight.'

- (2) Inversion
 - a. Vino Juan.
 - b. * 'Came Juan.'

- (3) *That-trace*
 - a. Quién crees que ganará la carrera?
 - b. * 'Who do you think *that* will win the race.'

In parameterized accounts, learning a second language entails parameter resetting; consequently, acquiring the cluster of properties that pertain to a particular setting could be understood as automatization of all the properties that fall under a particular parameter setting. But parameterized accounts of second language learning are susceptible to certain problems: (1) if the acquisitional path of learning a pro-drop language does not involve the *simultaneous* appearance of the cluster of properties associated with pro-drop, that is, if a certain property is not obligatorily present at a particular interlanguage stage, then we have evidence for a process involving something other than the single setting of a parameter, (2) not all the properties of pro-drop appear in some languages that exhibit one or more of the properties, suggesting the need for either a non-parametric or a multi-parametric explanation (White 1986, Liceras 1988), and (3) an understanding of the distribution of null-subjects requires more than just a switch that permits or does not permit these properties, it needs a consideration of semantic and discoursal interfaces with syntax in learner grammars (cf. Liceras 1989, Liceras & Díaz 1999, Pérez-Leroux, et al. 1999), interfaces that may permit us to go beyond the faulty premise that null-subjects are fully optional in languages such as Spanish. This paper supports the view that such 'optionality' evaporates when concerns for information structure are included in the equation.

3.0 Theoretical Assumptions

The analysis here makes several critical assumptions regarding language theory and second language acquisition. First, the overall theoretical framework is that of OT (Prince and Smolensky 1993, Grimshaw 1997), a theory that views knowledge of a language as the knowledge of a particular set of rankings of universal, violable constraints. In this theory, optimal grammatical output results from an evaluation of possible structural descriptions of input, with the grammatical selection going to the candidate with the least serious constraint violations.

This analysis also assumes that the initial state of L2 acquisition is a full instantiation of the first language (L1) constraint hierarchy (i.e., full transfer) and that subsequent acquisition is guided by UG (i.e., full access). Full transfer/Full access (Schwartz and Sprouse 1996) suggests here that L1 English learners of Spanish will initially process the L2 Spanish using their English constraint rankings, but as learners receive additional input, a UG-guided reranking of this initial hierarchy will occur.

Finally, the analysis here relies upon a specific learning algorithm, the Constraint Demotion Algorithm (CDA) of Tesar & Smolensky (2000). This algorithm claims that UG detects differences between the current grammatical system and the input (i.e., the differences between the constraint rankings) and uses successive applications of a very constrained demotion process until the grammar matches the grammar of the input. Under such an algorithm, each demotion would represent a separate stage of the grammar.

4.0 Hypothesis

Since I am assuming that L2 input feeds the language learning mechanism, and that this in turn prompts the interlanguage grammar to restructure in order to conform to the L2, the restructuring of the internalized system to accommodate L2 input should yield a developmental path that can be

observed in terms of new configurations of constraint rankings. I also propose that this developmental path taken by L2 learners may be characterized as the interaction of discrete discursual and syntactic constraints in keeping with the operation of Tesar and Smolensky's CDA (2000).

5.0 Methodology

Three empirical tests (a translation task, a pilot study, and a grammaticality judgment task) were used to investigate learner competencies regarding null subjects, inversion, and *that-trace*. The translation task involved 124 participants from four proficiency levels (beginning, intermediate, advanced, and native). The pilot consisted of a 36-item grammaticality judgment task administered to 39 intermediate learners of Spanish. The grammaticality judgment task involved 207 participants from five proficiency levels (beginning, intermediate, advanced, near-native, and native). For the translation task, subjects were given dialogues to translate from English into Spanish. There were a total of 370 subjects who were studying Spanish as a second language at the University of South Carolina or the Pennsylvania State University.

For the pilot and final grammaticality judgment task, subjects were asked to read 36 incomplete constructed dialogues between two interlocutors in Spanish. Each dialogue consisted of three exchanges. The first half of the final exchange was a question or statement that learners responded to by selecting the what they believed to be the more native-like of two provided responses. Subjects were given thirty minutes to complete the exercise. For all target items, the semantic content of each of the two choices was identical. Of the two choices, one was appropriate to the information structure and syntax of the dialogue, while the other violated the requirements of information structure or syntax. An example dialogue, one investigating acquisition of *that-trace*, is given in (4):

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>(4) a. <i>Mirando la televisión</i>
 Julio: Iris, ¿a ti te gusta mirar deportes en la tele?

 Iris: No me gusta mucho, pero a veces veo el tenis.
 Julio: ¿De veras? A mí me gusta el tenis también.
 Iris: ¿Has estado mirando el U.S. Open?
 Julio: Sí, me gusta especialmente Todd Martin.
 Iris A: ¿Quién piensas va a ganar el U.S. Open?
 Iris B: ¿Quién piensas que va a ganar el U.S. Open?</p> | <p>a'. <i>Watching television</i>
 Julio: Iris, do you like watching sports on television?

 Iris: Not too much, but I sometimes watch tennis.
 Julio: Really? I like tennis too.
 Iris: Have you been watching the US Open?
 Julio: Yes, I especially like Todd Martin.
 Iris: Who do you think will win the US Open?
 Iris: *Who do you think that will win the US Open?</p> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

6.0 Results

Evaluation of the translation task was binary, recording whether the translation of an item did or did not use a null subject, inversion, or *that-trace*. Table 1 shows that native speaker response patterns were distinct from all other groups, including the advanced group (although evidence for the difference between advanced and native is marginal). The parameters are listed as log odds ratios.

The difference between native and advanced groups did not achieve significance under this test, largely because the Wald limits ranged from 1.1 to 14.9 times less likely for the advanced speakers to give a preferred response. The performance of the advanced group was, however, distinct from the native group, with $p = 0.0337$, and an odds ratio 4 times less likely than natives to provide the preferred response.

The results of the translation task revealed that the proficiency groups varied in regards to their ability to translate dialogues in a native-like manner with respect to null subjects, inversion, and *that-trace*. It also revealed progressive movement towards native patterns, with the advanced level as a group differing from native speakers in a less than significant way.

Table 1: Analysis of initial parameter estimates for translation task, by group

Parameter	DF	Estimate	Std. Error	Wald 95%	Confidence Limits	Chi-Square	Pr > ChiSq
Beginning	1	-3.5041	0.6376	-4.7535	-2.2544	30.20	<.0001
Intermed.	1	-2.7675	0.6377	-4.0174	-1.5175	18.83	<.0001
Advanced	1	-1.4077	0.6627	-2.7065	-0.1088	4.51	0.0337
Native	0	0.0000	0.0000	0.0000	0.0000	-	-

The pilot project, involving 39 intermediate level participants, was used to refine the design of the main study by assessing the time required to administer the test, check the clarity of the instructions, and uncover difficulties related to vocabulary choice or ambiguities in the discourse context. Subjects in this study appeared to have acquired null subjects, but lacked sensitivity to discourse conditions that regulate their use. They displayed dispreference for inversion, preferring non-inverted orders even for sentences where native speakers prefer inversion, although they did select inversion more often when the inverted item was focused. Intermediates had problems with sentences involving *that-trace* violations, but it was not clear from this study whether this problem was because their grammar prohibited *that-trace* sequences or whether the difficulty was rather one of not recognizing the obligatoriness of *que* in particular contexts.

Results of the grammaticality judgment task are shown in Table 2. Native speaker response patterns were again significantly distinct ($p < .0001$) from beginning and intermediate groups; this test additionally showed significance between the advanced and native groups ($p < .0001$) and a clear, but not significant, difference between the near-native group and the native speakers ($p = 0.0012$). The log odds ratios in the grammaticality judgment task were smaller than in the translation task, but the larger number of respondents and the fact that each subject responded to each item still permitted valid analysis of significances.

Table 2: Analysis of initial parameter estimates for gramm. judg. task, by group

Parameter	DF	Estimate	Std. Error	Wald 95%	Confidence Limits	Chi-Square	Pr > ChiSq
Beginning	1	-0.5142	0.0784	-0.6678	-.03606	43.06	<.0001
Intermed.	1	-0.3428	0.0814	-0.5024	-0.1832	17.72	<.0001
Advanced	1	-0.3649	0.0801	-0.5219	-0.2079	20.75	<.0001
Near-Nat.	1	-0.5030	0.1551	-0.8070	-0.1990	10.52	0.0012
Native	0	0.0000	0.0000	0.0000	0.0000	-	-

Item-by-group differences for the grammaticality judgment task were checked using the Fisher Exact Probability Test, which was able to reveal significant interactions between groups and items. A conservative alpha level was set for this test by inflating the overall experimental wide error to .20 and dividing this number by the total number of comparisons (36). This set the significance level to $\alpha < .006$.

The basic approach was to question whether choice depended on group in a significant way. Using the Fisher test, significant interactions were found for 18 of 36 items. In an additional 13 of the 36 items, there were observable differences between responses that approached, but did not reach, the conservative significance threshold set for this test. Responses to only 5 of the 36 items displayed little or no difference between all levels.

In general, learners in this study accepted null subjects very early, but their judgments regarding the acceptable use of null subjects did not demonstrate sensitivity to discourse conditions (topic/nontopic) until the advanced and near-native stages. Some time prior to learners' correct usage of null subjects, *that-trace* begins to surface (though variably) in learners' grammars. In the discourse context of focus constituents, choices for inversion increase among advanced and near-native groups. But near-native choices do not replicate native judgments regarding inversion as closely as for the null subject and *that-trace* conditions. These findings show that a distinction should be drawn between initial acceptability (resulting from awareness of a particular grammatical property) and correct use (resulting from the proper ranking of discursual constraints in regard to this grammatical property).

7.0 Analysis

If the same universal constraints provided by UG are present in both English and Spanish, these universal constraints must be ranked differently in these two languages. Acquisition is posited to occur when learners detect the differences between the constraint rankings of the L1 and L2 and use input from the target language to recursively restructure their grammars to more closely match the grammar of the input. Since some aspects of the input may be more salient than others, not all differences may be detected simultaneously and acquisition may involve several rerankings.

No new constraints are proposed in the analysis here; the question is whether the separate analyses proposed for null subjects (Grimshaw 1995, Grimshaw and Samek-Lodovici 1995, LaFond, Hayes and Bhatt 2001), inversion (Grimshaw and Samek-Lodovici 1995, Samek-Lodovici 1996), and *that-trace* (Bakovic 1997; Bakovic and Keer 2001) may together form a coherent explanation for the developmental order in which these properties emerge, and whether such an account may be predicted using Tesar and Smolensky's Constraint Demotion Algorithm (2000). A total of six constraints come into play in these accounts, four syntactic constraints SUBJECT (SUBJ), PARSE, FAITH[SUB], and T-LEX-GOV, and two discursal constraints, ALIGNFOCUS-RIGHT (AF-RT) and DROPTOPIC (DROPT).¹

7.1 Null subjects

Previous OT analyses (Grimshaw 1995, Grimshaw and Samek-Lodovici 1995, LaFond, Hayes and Bhatt 2001) suggested that in null subject languages a discourse constraint governing the dropping of topic-connected subjects must rank higher than constraints requiring the parsing of inputs or overt realization of subjects. This requires L1 English speakers who are learning Spanish to rerank constraints.

Under the logic of the Constraint Demotion Algorithm (CDA), the current "winning" constraint ranking (the L1), must be adjusted in the following constrained way: each constraint in the current winning candidate is checked to see if it is dominated by the current "loser" marks. If it is not, the highest winning constraint is demoted to the stratum immediately below that of the loser mark. In Tableau 1, this requires the undominated PARSE to move to the stratum below DROPTOPIC:

Tableau 1: Demotion of PARSE

loser/winner pairs	PARSE	SUBJ	DROPT	AF-RT
Loser: [IP $\acute{e}l_i$ [VP t_i fue a la playa]]			*	
Winner: [IP \emptyset [VP \emptyset fue a la playa]]	*!	*		

The resulting ranking is an interlanguage stage unreflective of either English or Spanish. The requirement to parse inputs has been demoted, but the requirement for overt subjects remains. The learner has moved closer to the Spanish hierarchy, but has still not obtained it. This requires a second demotion, once again with the highest ranking constraint in the current winner (SUBJ) demoted to the stratum below that of the current loser's mark (Tableau 2):

¹ These constraints are defined as follows:

- SUBJECT (SUBJ):** The highest A-specifier in an extended projection must be filled. Failed when a clause lacks a subject in the canonical position. (Grimshaw 1995)
- PARSE:** Parse input constituents. Failed when input elements are not overtly parsed in the output.
- FAITH[SUB]:** The output value of [SUB] (for 'subordination') must be the same as the input value. (Bakovic 1997; Bakovic and Keer 2001)
- T-LEX-GOV:** A trace is lexically governed. (Grimshaw 1997)
- ALIGNFOCUS-RIGHT (AF-RT):** Align the left edge of focus constituents with the right edge of a maximal projection. Failed by non-aligned foci. (Grimshaw and Samek-Lodovici 1995)
- DROPTOPIC (DROPT):** Leave arguments coreferent with the topic structurally unrealized. Failed by overt constituents which are coreferential with the topic. (Grimshaw and Samek-Lodovici 1995)

Tableau 2: Demotion of SUBJECT

loser/winner pairs	SUBJ	DROPT	PARSE	AF-RT
Loser: [IP <i>él</i> _i [VP <i>t_i</i> <i>fue a la playa</i>]]		*		
Winner: [IP \emptyset [VP \emptyset <i>fue a la playa</i>]]	*!		*	

The second demotion results in a grammar where subjects, when topic-connected, must be dropped. In those cases where the subject is not a topic of the discourse, DROPTOPIC does not come into play. In such cases, in Spanish (as in English), overt subjects are required.

7.2 Inversion

Previous OT accounts of inversion (Grimshaw and Samek-Lodovici 1995, Samek-Lodovici 1996) suggested one difference between English and Italian is that, in English, the high-ranking SUBJECT constraint blocks ordering sentence information in a way that consistently places focused constituents on the right edge of a maximal projection. In contrast, Italian requires a focused alignment of constituents, even when this violates the SUBJECT constraint.

Spanish reveals a third possibility, namely, a language where the constraints concerning alignment of focus and the realization of subjects are unranked with respect to each other, placed on the same stratum. Such a possibility arises if we consider the intermediate grammar of L2 learners of Spanish (i.e., one where PARSE has been demoted below DROPTOPIC, but SUBJECT still has not):

Tableau 3: Intermediate grammar (inversion)

loser/winner pairs [+focus]	SUBJ	DROPT	PARSE	AF-RT
☞ a. [IP <i>Rosa</i> _i [VP <i>t_i</i> <i>va a estar allí</i>]]				*
b. [IP \emptyset [VP <i>t_i</i> <i>va a estar allí</i> <i>Rosa</i>]]	*!			
c. [IP \emptyset [VP <i>t_i</i> <i>va a estar allí</i>]]	*!		*	*

Tableau 3 shows that, since intermediate learners of Spanish operate with a grammar that ranks SUBJECT on a stratum above ALIGN-FOCUS RIGHT, the possibility of producing inverted subjects does not arise. The SUBJECT constraint prohibits it. But once SUBJECT has been demoted to the same stratum as ALIGN-FOCUS RIGHT, inversion becomes possible, though still not mandatory (Tableau 4):

Tableau 4: Advanced grammar (inversion)


loser/winner pairs [+focus]	DROPT	PARSE	AF-RT	SUBJ
☞ a. [IP <i>Rosa</i> _i [VP <i>t_i</i> <i>va a estar allí</i>]]			*	
☞ b. [IP \emptyset [VP <i>t_i</i> <i>va a estar allí</i> <i>Rosa</i>]]				*
c. [IP \emptyset [VP <i>t_i</i> <i>va a estar allí</i>]]		*	*(!)	*

Tableaus 3 and 4 also suggest both why we often see null subjects and inversion patterning together in a language and why these two properties are not acquired simultaneously. The movement of the SUBJECT constraint that results in learners' advanced use of null subjects is also the movement that makes inversion possible.

7.3 That-trace

Previous OT accounts of *that-trace* introduced constraints regarding the government of traces (Grimshaw 1997) or suggested that some functional features, such as a value of \pm for subordination, are a part of the input (Bakovic 1997, Bakovic and Keer 2001). Combining these two types of analyses, we posit that the acquisition of the Spanish grammar here involves a two-step learning process, a first step of gaining awareness that all Spanish embedded clauses have a CP status (i.e., they include the value [+sub]), and a second step involving the standard operation of the Constraint Demotion Algorithm, as in Tableau 5.

Tableau 5: Demotion of T-LEX-GOV

loser/winner pairs [+sub]	T-LEX-GOV	FAITH[SUB]
Loser: ¿Quién _i crees [_{CP} t _i llamó]? 		*
Winner: ¿Quién _i crees [_{CP} que t _i llamó]?	*!	

The English ranking (Tableau 5) is one in which *that-trace* sequences are disallowed because trace must be lexically governed. In contrast, faithfulness to the subordination feature is more important in Spanish than the lexical governance of traces; hence, the Constraint Demotion Algorithm moves T-LEX-GOV to the stratum below FAITH[SUB], resulting in the ranking shown in Tableau 6.

Tableau 6: Ranking after the demotion of T-LEX-GOV

[+sub]	FAITH[SUB]	T-LEX-GOV
¿Quién _i crees [_{CP} t _i llamó]?	*!	
☞ ¿Quién _i crees [_{CP} que t _i llamó]?		*

Following the demotion of T-LEX-GOV, the cumulative effect of this set of constraint demotions is a grammar that now processes null subjects (under appropriate discursal conditions), permits the inversion of overt subjects (under appropriate discursal conditions), and overcomes the grammaticality constraint of the L1 English that would prohibit *that-trace* sequences. The learner grammar now reflects the target grammar, so the learning algorithm halts.

8.0 Conclusion

In this paper, I have attempted to synthesize several strands of research related to the grammatical properties once assumed to be part of a *pro-drop* parameter. I have claimed that these separate findings gain even greater coherence when viewed in the light of an acquisitional process involving recursive constraint demotion. The developmental path taken by L2 learners is here characterized in terms of the interaction between syntactic and discursal constraints via a set of three demotions summarized in Figure 1.

The results of the study inform the hypothesis presented in Section 4.0. A clear developmental path was revealed, one for which there was evidence of an interaction between syntax and discourse for L2 learners. Each stage of grammar in Figure 1 is represented by a total ranking of six constraints. Each stage is followed by one demotion, and each demotion yields a new grammar that is used by learners to progressively move towards the target language. The developmental path that learners take offers some support for the Constraint Demotion Algorithm of Tesar and Smolensky (2000), and also lends support for its application to issues of second language development.

Figure 1: Developmental Stages and Constraint Demotion

<i>Beginners (English):</i> PARSE » SUBJ » DROPT » {AF-Rt, T-LEX-GOV} » FAITH[SUB]
Demote PARSE below DROPTOPIC
<i>Intermediates:</i> SUBJ » DROPT » {PARSE, AF-Rt, T-LEX-GOV} » FAITH[SUB]
Demote SUBJECT below DROPTOPIC
<i>Advanced:</i> DROPT » {SUBJ, PARSE, AF-Rt, T-LEX-GOV} » FAITH[SUB]
Demote T-LEX-GOV below FAITH[SUB]
<i>Near-native (Spanish):</i> DROPT » {SUBJ, PARSE, AF-Rt} » FAITH[SUB] » T-LEX-GOV

The results here provide support for viewing the variant outputs of interlanguage grammars as the result of movement in the rankings of syntactic and discoursal constraints. Further applications of OT to questions of second language learning may provide further insights into important interfaces between syntax and discourse in L2 acquisition. The account here leaves several questions unanswered, but highlights the need for research that explores how constraint interactions between various levels of grammatical knowledge are used by learners in second language acquisition.

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Proceedings of the 6th Generative Approaches to Second Language Acquisition Conference (GASLA 2002): L2 Links

edited by Juana M. Liceras,
Helmut Zobl, and Helen Goodluck

Cascadilla Proceedings Project Somerville, MA 2003

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LaFond, Larry. 2003. Putting the Pieces Together: Second Language Learning of Null Subjects, Inversion, and *That-trace*. In *Proceedings of the 6th Generative Approaches to Second Language Acquisition Conference (GASLA 2002)*, ed. Juana M. Liceras et al., 168-175. Somerville, MA: Cascadilla Proceedings Project.

or:

LaFond, Larry. 2003. Putting the Pieces Together: Second Language Learning of Null Subjects, Inversion, and *That-trace*. In *Proceedings of the 6th Generative Approaches to Second Language Acquisition Conference (GASLA 2002)*, ed. Juana M. Liceras et al., 168-175. Somerville, MA: Cascadilla Proceedings Project.
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