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Interpreting Object Clitics in Real Time: Eye-Tracking Evidence from 4-Year-Old and Adult Speakers of Spanish

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Object clitics in the Romance languages tend to emerge late in L1 acquisition, follow a protracted course of development, and remain vulnerable in several learner populations, including children with SLI and second language learners (Adiv, 1984; Bedore & Leonard, 2001; Clark, 1985; Jakubowicz et al., 1998; Schaeffer, 2000, *inter alia*). In the case of L1 Spanish, Bedore and Leonard (2001) observed omission rates around 12-15% in an elicited production experiment with typically developing Spanish-speaking children aged between 2;4 and 3;10 years. Using a slightly different elicitation task, Castilla and Pérez-Leroux (2010) reported even higher mean omission rates from a study with Spanish-speaking children in Colombia: 25-35% in their 3-year-old group, and around 13-15% in their 4- and 5-year-old groups. Importantly, these authors also included adult participants, for whom clitic omission was very infrequent (4%), thus confirming that Spanish requires clitics to be overtly realized in specific referential contexts (see section 1 for background on object pronominalization in Spanish).

The potential reasons for the observed optionality in children's production of object clitics have been subject to some debate in the recent literature. Different accounts have been proposed, which we see as falling into two classes: (i) explanations at the representational level, and (ii) explanations at the level of processing. Accounts of the first type hold that the child's early grammar contains the means for syntactically representing a clause with a null referential direct object. Müller and colleagues (1996, 2006), for example, propose that the early grammars of Romance-speaking children sanction referential null objects in the same way as adult Chinese or Japanese grammars. In a related approach, Pérez-Leroux et al. (2008b) have suggested that null cognate objects (null bare nouns) are a universal structure present by default in all grammars. In the course of development, this structure must be restricted to appropriate contexts. Pérez-Leroux and colleagues thus propose that children's overgeneration of referential null objects results from their failure to restrict the default null cognate structure

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to non-referential (generic) contexts. While these accounts lead to the prediction that children at this stage should not only omit objects in production, but also accept referential null objects in a receptive task (a prediction that has received mixed support; see Grüter, 2006; Pérez-Leroux et al., 2008a; Tedeschi, 2009), they do not provide any reason to assume that clitic constructions themselves should be particularly difficult to produce or process. The observed optionality in production is simply the result of the child having two alternative means of encoding a pronominal direct object (i.e., clitic or null).

Accounts of the second type, by contrast, typically appeal to the ‘complexity’ of clitic constructions themselves. Prévost (2006: 276) hypothesizes that clitic omission is due to the fact that “(preverbal) object clitics require computational operations that go beyond the simple projection of the canonical object position,” leading to “heavy processing load,” and consequent omission of the clitic. More recently, Grüter and Crago (2011) have presented an account using tree-adjoining grammar within a psycholinguistic model of language production to operationalize the complexity of clitic constructions. Under their account, clitic omission is due to processing limitations that affect the syntactic encoding process. Thus while they see clitic omission as resulting from processing limitations, these limitations are assumed to be limited to the realm of language production.

Despite the many differences between these various accounts, none of them provide any reason to assume that clitic constructions should be particularly difficult for children to process in real-time comprehension. Yet in spite of the large theoretical and developmental literature on Romance object clitics, little is known about the online processing of clitic constructions, by children or adults. We do not know, therefore, whether children’s consistently observed difficulties with clitics in production might extend to the comprehension of sentences with object clitics during real-time listening, a potentially important piece in the puzzle of why clitic constructions take so long to be mastered during language development. The goal of the present study is to close this gap by examining how Spanish-speaking children as well as adults process preverbal clitic constructions in an online task, using the looking-while-listening paradigm (Fernald et al., 2008). Two specific research questions are guiding this work:

- I. Do child and adult listeners interpret preverbal object clitics incrementally?
- II. Is the ability to *interpret* clitics incrementally related to the ability to *produce* clitics consistently?

1. Object pronominalization in Spanish

When an argument denotes a discourse-salient referent, it is typically expressed as a pronoun. In Spanish, object pronominalization is normally realized through a clitic construction, involving a clitic marked for gender and number of the corresponding noun phrase. This clitic either precedes the finite

verb (1a,b) or follows a non-finite infinitive or gerund (1c). While preverbal clitics are generally allowed in all finite declarative constructions, postverbal clitics are limited to those involving a non-finite verb. (1d), with a clitic following a finite verb, is not a grammatical declarative clause (although it is grammatical as an imperative). Importantly, object clitics must be overtly realized when a specific referent is denoted, that is, object/clitic omission (1e,f) is generally considered ungrammatical in these contexts.

- (1) ¿Qué hace la niña con su plato?
 ‘What is the girl doing with her plate?’
- a. **Lo** está lavando.
 pro it-MASC-SG is washing
- b. **Lo** lava.
 pro it-MASC-SG wash-3-SG
- c. Está lavando**lo**.
 pro is washing it-MASC-SG
- d. * Lá**valo**.
 pro wash-3-SG it-MASC-SG
- e. * Lavando.
 * Lava.
- f. * Lava.
 ‘(She) is washing it.’

2. The study

2.1 Participants

Participants were 12 native Spanish-speaking adults, and 24 predominantly Spanish-speaking 4-year-olds (mean age = 4;0, range = 3;10-4;2) living in Northern California. Most parents of the 4-yr-old participants were recent immigrants from Mexico with low English proficiency. All families reported Spanish as the main language spoken at home, with children’s exposure to Spanish ranging from 51 to 100% ($M = 83.9$, $SD = 13.7$). As a group, the 4-yr-old participants were right on par with monolingual language norms for Spanish according to the CELF Preschool-2 Spanish, a standardized Spanish language assessment tool (Wiig et al., 2009). Mean scores were 107.1 ($SD = 13.6$), and 104.4 ($SD = 12.6$) on the expressive and receptive scales, respectively. Although all socioeconomic groups were represented, on average, children came from primarily low SES families. Estimates of family SES based on the Hollingshead Four Factor Index of Social Status (Hollingshead, 1975), ranged from 12 to 61 ($M = 22.4$, $SD = 13.9$), with 79% of the families in the lowest two social strata. The majority of parents (68%) had less than a high-school education, although education levels ranged from less than elementary school to advanced degrees. Income levels also spanned a broad range.

2.2 Stimuli and procedure

Child participants were tested in two separate, approximately 1-hour visits to our community laboratory. All communication and testing was conducted in Spanish, by fully bilingual/bicultural researchers. During the first visit, children completed the elicited production task (2.2.1) and one of two looking-while-listening tasks (2.2.2). Parents took part in an interview with a research assistant to complete a questionnaire about the child's language background, designed to determine the proportion of time the child was exposed to Spanish versus English. During the second visit, children completed the second looking-while-listening task, as well as the CELF Preschool-2 Spanish. Adult participants only completed the two looking-while-listening tasks.

2.2.1 Elicited production

The elicited production task consisted of a picture story which the experimenter shared with the child, following a fixed script containing questions to the child. Of these questions, 12 were designed specifically to elicit a response with a pronominalized direct object. (1) above constitutes an example from the elicitation task.¹ Responses were recorded in writing by the experimenter, and the task was audiotaped. A second Spanish speaker independently transcribed the child's responses from the audio record. Responses where the presence or absence of a clitic could not be determined unambiguously were excluded from the analysis.

2.2.2 Looking-while-listening

The goal of this task was to investigate participants' interpretation of sentences containing an object clitic when hearing them in real time. To this end, we employed the looking-while-listening procedure (Fernald et al., 2008), where participants view pairs of pictures projected onto a screen while listening to sentences naming one of them. Participants' eye movements are videotaped, and this record stamped with a digital time-code time-locked to the auditory stimuli. Using custom software, eye movements are then coded offline, frame by frame, with 33-ms resolution, allowing for a precise time-course analysis of participants' looking patterns as the speech signal unfolds. Two separate tasks were constructed, one containing preverbal, the other postverbal clitic constructions. Only the preverbal clitic task will be described and discussed here.

The preverbal clitic task consisted of 36 experimental trials comprising four different conditions. In the NOUN-ONLY condition (k=18), the visual stimuli consisted of two objects depicting nouns of different grammatical gender (e.g.,

¹ The task used here is a Spanish translation of the French production task described in more detail in Grüter (2005).

la mariposa ‘butterfly (fem.)’ and *el pájaro* ‘bird (masc.)’; see Figure 1A), while the auditory stimuli consisted of a request to find one of the two objects (*Enseñame la mariposa* ‘Show me the butterfly’). Each NOUN-ONLY trial was followed directly by a trial in one of the three remaining conditions (k=6 each), all of which contained visual stimuli of the same type (Figure 1B), namely two pictures, both showing the same agent and action (e.g., Diego looking) but a different object. In all cases, the two objects were the same as the objects shown in the immediately preceding NOUN-ONLY trial. In the NOUN-OLD condition, this display was accompanied by an auditory stimulus consisting of a sentence with the *previously named* object as a postverbal lexical object (*Diego está buscando la mariposa* ‘Diego is looking for the butterfly’). In the NOUN-NEW condition, the sentence contained the *previously unnamed* object as a postverbal lexical object (*Diego está buscando el pájaro* ‘Diego is looking for the bird’). In the CLITIC condition, the sentence contained a preverbal clitic construction, with the clitic matching only the previously named object for gender (*Diego la está buscando* ‘Diego is looking for it-FEM’). In this condition, participants were expected to look at the picture showing the previously named object based on two linguistic cues both encoded by the clitic: gender marking and pronominality.

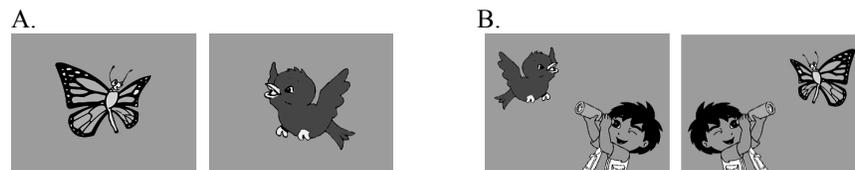


Figure 1. Example of visual stimuli in the NOUN-ONLY condition (A) and the NOUN-OLD, NOUN-NEW and CLITIC conditions (B).

Of critical interest in this task was whether participants would shift their eye-gaze toward the target picture *earlier* in the clitic condition compared to the NOUN-OLD/NEW conditions. If listeners make incremental use of the disambiguating cues encoded by the clitic (gender marking, pronominality), we expect them to start orienting toward the target picture shortly after the onset of the clitic. The auditory stimuli, recorded by a native speaker of Spanish, were edited using Praat (Boersma & Weenink, 2010) such that the acoustic onset of the clitic occurred between 433 and 467ms after the onset of the sentence. In the NOUN-OLD/NEW conditions, by contrast, the first disambiguating cue consisted of the (gender-marked) determiner in the postverbal noun phrase, the onset of which did not occur until between 1400 and 1432ms after sentence onset. If information encoded by the clitic is interpreted incrementally, we thus expect a gap of approximately one second between looks converging on the target in the clitic compared to the noun conditions.

2.3 Results

2.3.1 Elicited production

Responses were coded according to the type of direct object they contained: (i) preverbal clitic (1a,b), (ii) postverbal clitic (1c), (iii) omission, i.e., no direct object in the presence of a transitive verb requiring one (1e,f), (iv) a postverbal lexical noun phrase, and (v) other. Responses of type (v) accounted for 16.7% of the data, and were excluded from further analysis. Two children did not complete the production task due to shyness.

Analysis of the mean proportion of response types (i)-(iv) in the data from the remaining 22 children showed the following distribution: 43% preverbal clitics, 30% postverbal clitics, 23% omissions, and 4% lexical NPs. All but one child produced at least one clitic in this task; 18 (out of 22) produced at least one *preverbal* clitic, and 16 produced at least one *postverbal* clitic, with many children (n=13) producing both pre- and postverbal clitics throughout the task. These findings demonstrate that both pre- and postverbal clitic constructions are regularly produced by the children in this study. Yet they were not produced consistently by all children, as illustrated by the 23% omissions overall. Importantly, the proportion of omissions varied widely between children (0-86%), with 11 children omitting one or no clitic out of all scorable responses ($\leq 10\%$), while the other 11 omitted two or more (18-86%). Proportion omissions also correlated significantly with children's performance on the CELF, in terms of both expressive ($r = -.46, p < .05$) and receptive ($r = -.44, p < .05$) standard scores, suggesting that consistency of clitic production may be a useful indicator of overall language development in Spanish.

In order to further explore potential links between consistency of clitic *production*, and efficiency of clitic *interpretation* during real-time listening, participants were divided into subgroups based on their proportion of omissions in the production task: those who omitted at most one clitic ($\leq 10\%$ omissions, n=11) comprise the 'non-omitter' group, while those who omitted them more frequently (18-86%, n=11) constitute the 'omitter' group. We will refer to these subgroups in the analysis of the results from the looking-while-listening task.

2.3.2 Looking-while-listening

In order to illustrate some basic differences and similarities in performance on the looking-while-listening task between child and adult participants on the one hand, and 'omitters' and 'non-omitters' on the other, Figure 2 presents the time course of looking-patterns in the simple NOUN-ONLY condition. This graph shows that adults' looks begin to be directed toward the target only a couple of hundred milliseconds after the onset of the determiner, and converge on the target at a proportion above 90% approximately one second later. An overall similar pattern emerges in the 4-year-old group, although looks to the target begin to increase somewhat later, and reach asymptote at a somewhat lower level, i.e., at around 80% proportional looking to the target. These general

observations on adult versus child looking patterns are consistent with previous findings from related experiments (e.g., Lew-Williams & Fernald, 2007). Importantly, when the child data are plotted separately for the ‘omitter’ vs. ‘non-omitter’ groups, no between-group differences are apparent, suggesting that there are no obvious differences between children in these two subgroups with regard to the real-time processing of lexical nouns.²

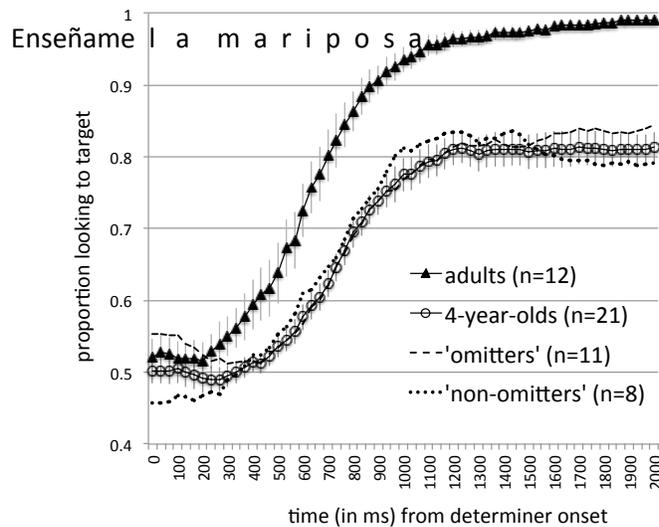


Figure 2. Time course of children’s and adults’ looking to the target image in the NOUN-ONLY condition. Error bars indicate standard errors of the means.

Turning now to participants’ performance on the three remaining trial types, we begin by presenting the adult data, illustrated in Figure 3. We note, in all three conditions, a baseline bias around 70% for looking at the previously mentioned object. This results in baseline bias in favor of the target in the CLITIC and the NOUN-OLD condition, and bias against the target in the NOUN-NEW condition. Of critical interest, however, is the time point at which these relatively stable baseline biases begin to change. In the NOUN-OLD/NEW conditions, no change is apparent until after the onset of the determiner in the postverbal noun phrase. In the CLITIC condition, by contrast, looks to the target increase sharply after the clitic, and proportion looking to the target approaches 90% by the offset of the verb. This impressionistic contrast is confirmed when proportion looking to the target is compared in two distinct temporal windows,

² Data from three children, all from the ‘non-omitter’ group, were excluded from the analysis, as they did not contain enough valid trials in all conditions.

where window 1 extends from sentence onset to the frame before the one containing the onset of the clitic in the CLITIC condition (0-432ms), and window 2 extends from 200ms after the onset of the clitic in the clitic condition to 200ms after the onset of the determiner in the NOUN-OLD/NEW conditions (633-1632ms). Window 1 thus constitutes a time period where no disambiguating information was available in any condition. Window 2, by contrast, precedes the disambiguating information in the NOUN-OLD/NEW conditions, but follows it in the CLITIC condition. We thus expect a change in proportional looking to the target in the CLITIC but not the NOUN-OLD/NEW conditions. Pairwise comparisons between proportional looking in the two windows confirm this prediction: no significant changes in the NOUN-OLD ($t(11) = 1.1, p = .29$) and NOUN-NEW ($t(11) = .2, p = .81$) conditions, yet a significant increase in the CLITIC condition ($t(11) = 2.3, p = .04$), from 63% in window 1 to 73% in window 2.

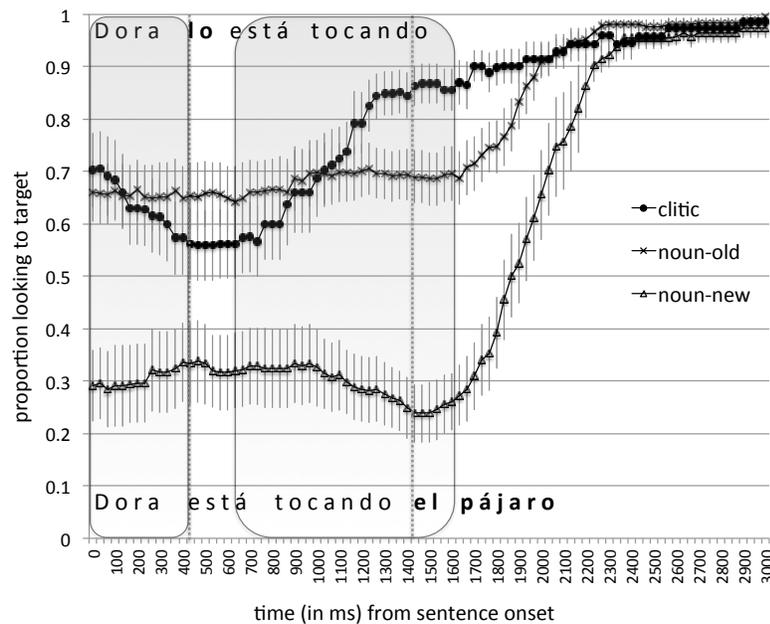


Figure 3. Time course of adults' (n=12) proportional looking to the target. Error bars indicate standard errors of the means.

This finding presents the first evidence that adult native speakers of Spanish interpret information encoded by preverbal object clitics incrementally and begin to identify the referent of the clitic well before the acoustic offset of the verb phrase. In light of the overwhelming evidence from the psycholinguistics literature showing incremental linguistic processing in adults (e.g., Tanenhaus et al., 1995), this finding is not surprising. Nevertheless, it constitutes an important

point of reference for analysing children's processing of the same construction, a construction known to be prone to protracted development in language acquisition.

Figures 4 and 5 present the looking patterns in the two child groups, the 'non-omitter' and 'omitter' group respectively. It is noteworthy that the baseline bias for the previously named object observed in the adult group is absent from both child groups. Regardless of the presence or absence of any baseline biases, however, what is of interest here is whether children's looking patterns would differ in the CLITIC compared to the NOUN-OLD/NEW conditions. In the 'non-omitter' group, i.e., for those children who omitted at most one clitic in the elicitation task, looking patterns indeed appear similar to those observed in the adult group. Specifically, no changes are observed between windows 1 and 2 in either of the noun conditions, yet importantly, looks to the target increase in the CLITIC condition, from 55% in window 1 to 67% in window 2. The magnitude of this increase in terms of percentage points is comparable to that observed in the adult group, yet fails to reach statistical significance ($t(7) = 1.4, p = .20$), quite possibly due to insufficient power as a result of the small sample size ($n=8$).

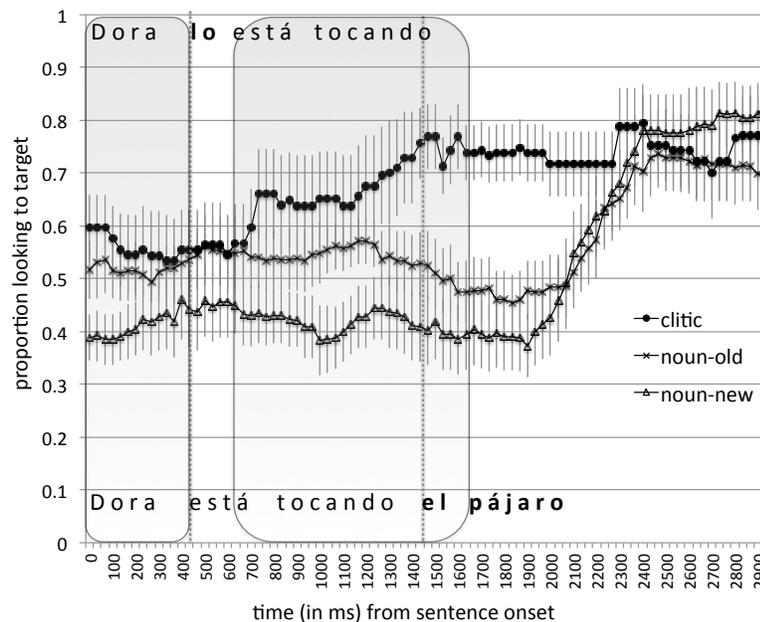


Figure 4. Time course of proportional looking to the target in the 'non-omitter' group (n=8). Error bars indicate standard errors of the means.

In the 'omitter' group, i.e., for those children who did not produce clitics consistently in the elicitation task, by contrast, we observe no changes in looking

behavior between windows 1 and 2 in either of the noun conditions, nor in the CLITIC condition (Figure 5). The absence of such change in the CLITIC condition suggests that children in this group did not use the information encoded by the preverbal clitic incrementally to identify a referent in the visual context. Interestingly, while looks to the target rise to approximately 80% in both noun conditions following the onset of the postverbal noun phrase, proportional looks to the target in the CLITIC condition hardly ever exceed the 60% mark. This raises doubts whether participants in this group used the cues encoded by the clitic *at all* to identify a referent.

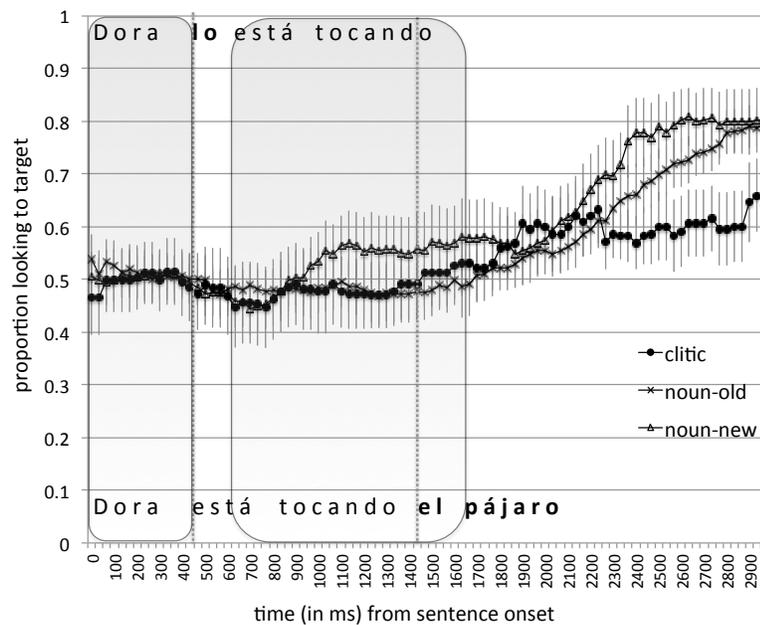


Figure 5. Time course of proportional looking to the target in the ‘omitter’ group (n=11). Error bars indicate standard errors of the means.

In sum, results from the looking-while-listening experiment indicate that Spanish-speaking adults, as well as 4-year-olds who produce clitics consistently, use information encoded by a preverbal clitic incrementally to identify its referent. Four-year-olds who are able to produce clitics, but do not yet do so consistently, on the other hand, appear to have difficulty processing information encoded by the clitic in real-time comprehension.

3. General discussion

The goal of the present study was two-fold. First, we sought to examine how sentences containing a preverbal clitic construction are processed in real-time, by adults as well as by children. Our second goal was to investigate whether children's well-documented difficulties with clitic constructions in language production – manifested as protracted optional clitic omission – might extend to the realm of language processing in the receptive mode. With regard to the first goal, our study established the (unsurprising) fact that adult native speakers of Spanish take advantage of linguistic information encoded by a preverbal clitic to identify a referent well before the offset of the verb phrase. Consistent with findings from the processing of other linguistic structures, this demonstrates that adult sentence comprehension is an essentially incremental process.

The extent to which children's syntactic processing is similarly incremental is not as well established (see e.g., Trueswell et al., 1999). Yet evidence from the online processing of morphosyntactic cues such as grammatical gender have shown that children as young as 2- to 3-years of age are able to take advantage of such information to identify an immediately following noun (Lew-Williams & Fernald, 2007). The syntactic construction we investigate here, however, adds an additional layer of difficulty, in that the linguistic cues relevant to identifying a direct object are encountered in a sentential position that is different from the canonical object position. In other words, a preverbal object clitic provides information for identifying the theme of an event, an argument that, in Spanish, is canonically and most frequently expressed through a postverbal noun phrase. The incremental processing of a preverbal clitic thus requires the uptake of information at a point earlier than where this information is typically expected.

Yet despite this extra complexity, the 4-year-olds in our study who produced clitics consistently in production (the 'non-omitters') appeared to be able to make incremental use of the cues encoded on preverbal clitics, as indicated by the increase in looks to the target after encountering the clitic in the CLITIC condition of the looking-while-listening task. This increase was numerically comparable to that observed in the adult group. We would like to caution, however, that this observation is presently based on a sample of only eight participants in the 'non-omitter' group, and does not give rise to a statistically significant result. Our current efforts are focused on increasing the sample size in order to provide a basis for more definitive conclusions.

Findings from the subgroup of children who produced clitics less consistently in the elicitation task, by contrast, showed a clear absence of incremental processing related to cues encoded by the preverbal clitic. This lack of an effect is striking in light of the observation that the two subgroups performed comparably in their processing of lexical noun phrases, both in the NOUN-ONLY as well as in the NOUN-OLD/NEW conditions. In other words, the only condition for which there is some evidence of the two groups differing is the CLITIC condition. This observation speaks directly to our research question,

namely whether children's difficulties with clitics in production might extend to online processing. The present findings suggest that the answer is positive: those children who produced clitics inconsistently were also those who showed no evidence of incremental processing of clitics, while those who produced them consistently showed a pattern of eye-movements similar to that observed in adults.

These results are not easily accommodated by any of the current theoretical accounts of clitic omission/optionality in child language. As discussed earlier, accounts seeking an explanation for object (clitic) omission at the representational level do not predict that clitic constructions themselves should cause any difficulties in comprehension, be it on- or offline. Grüter and Crago's (2011) processing account, on the other hand, explicitly confines the realm of difficulty to production, and thus is also unable to capture the weaknesses in online comprehension observed here. Given the present findings, what is called for is an account that can explain what appear to be linked difficulties in production (manifested as optional clitic omission) and online comprehension (manifested as a lack of uptake of information encoded by the clitic). Such an account will likely make reference to the need for rapid integration of a variety of linguistic (and non-linguistic) cues when language is used in real time, whether it be expressively or receptively. The details of such an account, however, remain to be worked out.

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