The structure of silence: A look at children's comprehension of sluicing*

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1. Introduction

Sluicing –a construction in which all of a constituent question is elided except for the *wh*-phrase – has been the object of much attention in the syntactic literature since Ross's seminal 1969 paper. An example of sluicing is given in (1), where the angled brackets enclose (pre-theoretically) unpronounced material.

(1) Someone came to visit me, guess who <_ came to visit me>.

Despite this vast literature, there remain several competing theoretical analyses. The goal of this paper is to provide empirical evidence from acquisition data regarding the syntactic status of the elided material in sluices. Specifically, we show that children exhibit a subject > object asymmetry, as they show in other (overt) Ā-movement constructions, arguably due to the greater difficulty of establishing a dependency between the moved object and its based-generated position, across the intervening subject.

1.1 Theoretical background

Various theoretical accounts have been proposed for sluicing, and ellipsis more generally. Analyses differ primarily with respect to the issue of how much structure is posited in the ellipsis site and whether there is movement or not. Among the analyses that posit structure, two approaches can be identified. The first, originating with Ross (1969) and pursued more recently by Merchant (2001) analyzes sluicing as involving movement of a *wh*-phrase out of TP, followed by deletion of that node at PF; this derivation is schematized in (2a). The primary support for this analysis comes from the fact that across a wide range of grammatical dependencies the 'remnant' *wh*-element in sluicing shows behavior similar to its counterpart in full non-elliptical structures. These 'connectivity

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effects' include: case-matching, preposition stranding parallelisms, and binding phenomena.

A second approach also posits some level of structure but does not implicate movement. Under these analyses, the *wh*-element either remains in situ (Abe 2015; Kimura, 2010), as in (2b), or is base-generated in Spec-CP and binds an indefinite in the elided TP (Chung, Ladusaw, and McCloskey 1995), as in (2c).

Lastly, under non-structural approaches, there is no structure and hence no movement, as in (2d) (e.g., Culicover and Jackendoff 2005, Ginzburg and Sag 2000, Jäger 2001). The primary motivation for the no-movement approach comes from the fact that, as first noted by Ross (1969), sluicing seems not to respect islands – more specifically, the *wh*-phrase in sluicing can be associated with a variable in a position corresponding to an island-internal position in the antecedent TP.[1]

(2) a. Someone is drawing a flower, but I can't see [$_{CP}$ who$_i$ <[$_{TP}$ t$_i$ is drawing a flower]>].

b. Someone is drawing a flower, but I can't see [$_{CP}$ C$_{[Q]}$ [$_{TP}$ who <is drawing flower >]].

c. Someone is drawing a flower, but I can't see [$_{CP}$ who$_i$ <[$_{TP}$ someone$_i$ is drawing a flower]>].

d. Someone is drawing a flower, but I can't see who.

The competing movement/movement-less analyses of sluicing crucially make different predictions about children's acquisition of these structures, as we discuss in the next section.

1.2 Acquisition background

There is now considerable evidence that before the age of 5 or 6, children perform more poorly on extraction from object position than from subject position in several Ā-movement constructions, including *wh*-questions (Avrutin 2000, de Vincenzi et al. 1999, Friedmann, Belletti, and Rizzi 2009, Seidl, Hollich, and Jusczyk, Yoshinaga 1996), relative clauses (Friedmann and Novogrodsky 2004, McKee, McDaniel, and Snedeker 1998), and topicalizations (Friedman & Lavi 2006).

To explain this asymmetry it has been proposed that children are particularly susceptible to 'intervention effects' (e.g., Friedmann, Belletti, and Rizzi 2009, Mateu 2019, Hyams and Snyder 2005, Snyder and Hyams 2015). One way of characterizing intervention effects is by appealing to Relativized Minimality (RM; Rizzi 1990, 2004).

[1] For example, extraction from an NP-island (otherwise ungrammatical) is perfectly acceptable in the sluiced version: : '*I believe the claim that Ben kissed someone, but they don't know who (*I believe the claim that Ben kissed _).'* To explain the 'island repair' phenomena, some proponents of the movement analysis (Lasnik 2001 and Merchant 2001), following ideas of Ross (1969) and Chomsky (1972), have argued that islands are essentially a PF phenomenon and thus that ellipsis can repair an otherwise ungrammatical structure by deleting the offending *wh*-copy/trace inside the island. In more recent linearization theories (e.g., Fox and Pesetsky 2005) islands are the result of spell-out rule violations so they do not arise when the island is not spelled out.

Abstractly exemplified in (3) – the dependency between the moved element (X) and the gap (Y) is blocked if the intervening element (Z) shares some crucial morphosyntactic feature with X.

(3) X … Z … <Y>

If sluices involve *wh*-movement, as proposed by Merchant (2001) among others, we should find a similar asymmetry when we match X and Z for a particular feature, e.g., animacy, as has been found for relative clauses (e.g., Adani 2012, Arosio, Guasti, and Stucchi 2011; Bentea, Durrleman, and Rizzi 2016). That is, children should perform significantly better with subject-extracted sluices like (4a) than object-extracted sluices like (4b).

(4) a. I can see someone is pushing the boy, can you see who <_ is pushing the boy>?

b. I can see the boy is pushing someone, can you see who <the boy is pushing _>?

On the other hand, if no movement (or structure) is involved, we should find no such asymmetry, all else being equal. Thus, the main goal of this study is to provide evidence from child language relevant to the 'movement/structure - no-movement/no structure' debate.

2. Experimental study

In this study we test children on both subject and object sluices and subject and object relative clauses (RC) in order to establish a potential correlation in performance with another well-known Ā-construction. We additionally manipulate the animacy of the subject and object. In English, animacy is grammaticalized in non-referential *wh*-elements (Alexopoulou and Keller 2014), i.e., the difference between the two *wh*-elements *who* and *what* is the presence or absence of the feature [+/−animate] (in relation to an argumental element). If children perform significantly worse in the object-extracted constructions when both arguments match in animacy features as compared to when they mismatch in such features, this would provide support for an intervention account, and hence movement.

2.1. Participants

Sixty English-speaking children aged 3;0-6;11 (*M* = 5;3) participated in both the sluicing and relative clause experiments, 15 in each year interval. They were tested in Los Angeles, CA. Three additional participants were tested but excluded because they did not pass the control items or failed to finish the task

2.2. Materials and procedure

The tests for RCs and sluices were inspired by those used in De Vincenzi (1996) and Adani (2012) to test *wh*-questions and relative clauses in Italian. They were composed of picture/sentence pairs containing reversible transitive actions that could be performed by or on inanimate entities (*push*, *lift*, and *poke*).[2] The design of the study is given in Table (5).

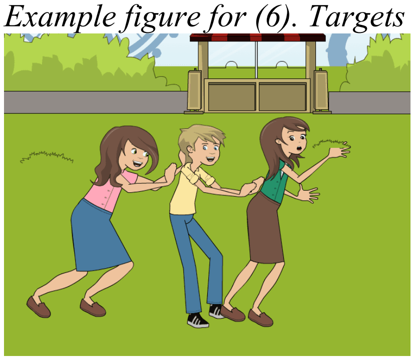
(5) *Design of relative clause and sluicing tasks*.

Subject/Object RC/Sluices		
	Subject	Object
Match	[+animate]	[+animate]
	[−animate]	[−animate]
Mismatch	[+animate]	[−animate]
	[−animate]	[+animate]

The RC task consisted of a 'point-to' person/object-selection task and included sentences such as (6) and a figure such as (7). There were 6 training items, and 24 test items. All items were prerecorded and delivered by an interactive puppet.

(6) a. Point to the girl that _ is pushing the boy.
b. Point to the girl that the boy is pushing _.

(7) *Example figure for (6). Targets are pink girl for (6a) and green girl for (6b).*



The sluicing task was similar except that it involved a '*wh*-question' person/object-selection task. Also, one of the characters/objects on the periphery was always partially hidden in order to make the question felicitous (see Figure 9 below). There were 6 training items, and 24 test items –16 sluices, such as (4), repeated below as (8), which would be paired with a figure such as (9) or (10),[3] and 8 full *wh*-question controls, such as (11). As illustrated in (11), the controls mismatched in terms of who the 'someone' referred to in the first clause and what the response to the *wh*-question was. This was

[2] 'Pushing' scenarios involved boys/girls and/or cars/trains, 'lifting' scenarios involved boys/girls and/or firetrucks/bulldozers, and 'poking' scenarios involved boys/girls and/or statues/trees.

[3] Children often chose to resolve the sluice by pointing to the relevant hidden or visible person, rather than responding with 'yes' or 'no'. We counted their answers as correct if they pointed to the appropriate character on the screen.

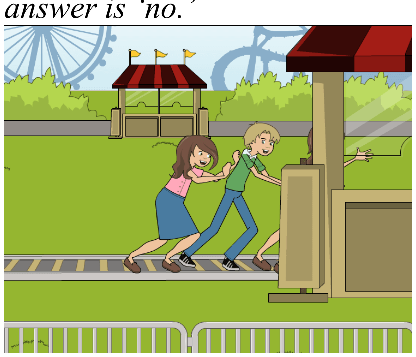
done to ensure children were paying attention to the full sentence and not simply resolving the 'someone' in the first clause. If a child responded or pointed before the puppet had finished talking, we played the question again. Children had to get at least 6/8 correct answers in the control condition in order to be included in the study. The example control sentences in (11) would also be paired with a figure such as (10).

(8) a. I can see someone is pushing the boy, can you see who <_ is pushing the boy>?

b. I can see the boy is pushing someone, can you see who <the boy is pushing _>?

(9) *Example figure for (8a): target answer is 'no', and (8b): target answer is 'yes, the green girl.'*

(10) *Example figure for (8a): target answer is 'yes, the pink girl', and (8b): target answer is 'no.'*



(11) a. I can see someone is pushing the hidden girl, can you see who _ is pushing the boy?

b. I can see the girl in pink is pushing someone, can you see who the boy is pushing _>?

Additional examples from the sluicing experiment are provided below for the other match condition, i.e., [–animate] subject [–animate] object in (12), and the mismatch conditions, [+animate] subject [–animate] object in (13) and [–animate] subject [+animate] object in (14).

(12) a. I can see something is pushing the car, can you see what <_ is pushing the car>?

b. I can see the car is pushing something, can you see what <the car is pushing _>?

(13) a. I can see someone is pushing the car, can you see who <_ is pushing the car>?

b. I can see the boy is pushing something, can you see what <the boy is pushing _>?

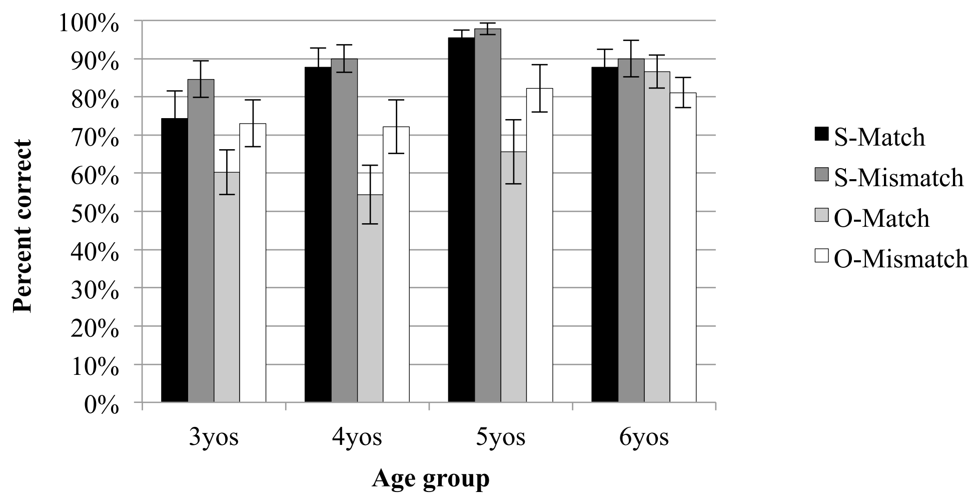
(14) a. I can see something is pushing the boy, can you see what <_ is pushing the boy>?

b. I can see the car is pushing someone, can you see who <the car is pushing _>?

2.3. Results and discussion

We first discuss the results from the relative clauses task. As expected, and as shown in Figure (15), children perform significantly better with subject (S) than with object (O) relative clauses until they reach age 6. Moreover, children do better with object relative clauses when the features of the subject and object mismatch in animacy features until that same age. Crucially, this difference occurs only in the object RCs and not in the subject RCs.

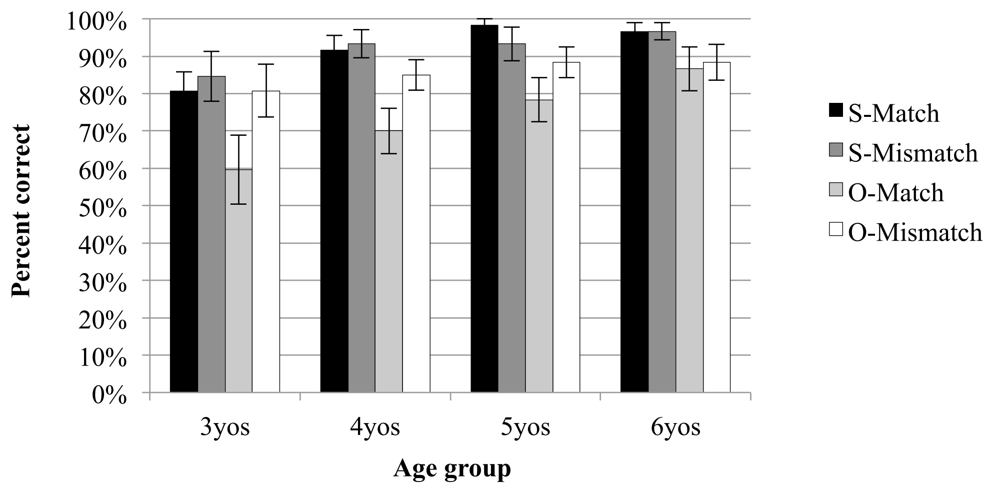
(15) *Results from the relative clause 'point-to' task by age and condition.*



Our observations were confirmed using a mixed-effects logistic regression model with score as a binary dependent variable (correct, incorrect), Age (3, 4, 5, 6), ExtractionSite (Subject, Object), and ExtractionSite by ArgumentMatch (Match, Mismatch) as fixed effects, and Subject and Verb as random intercepts. We found a significant effect of Age, $\chi(3) = 11.4$, $p = .01$, a significant effect of ExtractionSite, $\chi(3) = 95.2$, $p < .001$, and a significant interaction between ExtractionSite and ArgumentMatch, $\chi(2) = 12.596$, $p = .002$. In other words, whether the subject and object match in animacy features or not is only relevant in the object RC condition, not the subject RC condition.

Turning to the sluicing experiment, we also found a significant subject advantage until age 6, and as predicted, the same interaction with feature matching – children perform better with object sluices when the subject and object mismatch in animacy features, but no such difference is observed in the subject sluices. The results are illustrated in Figure (16).

(16) *Results from the sluicing '*wh-*question' task by age and condition.*



The results were confirmed using a mixed-effects logistic regression model with score as a binary dependent variable (correct, incorrect), Age (3, 4, 5, 6), ExtractionSite (Subject, Object), and ExtractionSite by ArgumentMatch (Match, Mismatch) as fixed effects, and Subject and Verb as random intercepts. We found a significant effect of Age, $\chi(3) = 12.79$, $p = .005$, a significant effect of ExtractionSite, $\chi(3) = 46.72$, $p < .001$, and a significant interaction between ExtractionSite and ArgumentMatch $\chi(2) = 9.77$, $p = .007$, such that children do particularly poorly with object sluices when there is a match in animacy features between the object and the subject.

Furthermore we find a strong correlation between performance on object RCs and object sluices, $r_S(58) = .501$, $p < .001$, suggesting that whatever machinery children use to derive object sluices they also use to derive object RCs, viz. Ā-movement. With respect to the competing analyses of sluicing, our results overall are more consistent with approaches that posit structure and movement at the ellipsis site (e.g., Merchant, 2001): Object movement past a subject that shares at least one crucial morphosyntactic feature triggers an intervention effect or an RM violation. Young children do not have the grammatical wherewithal to circumvent such intervening arguments, and consequently, they fail at interpreting the sentence in an adult-like manner.[4]

[4] Snyder and Hyams (2015) and Mateu (2019) propose that children lack smuggling, a mechanism that allows adults to by-pass the intervener in passives and raising past an experiencer (Collins 2005a, 2005b).

However, a closer look at the data reveals some wrinkles that should be addressed. Given what we have been assuming regarding feature mismatches, whether the subject is [+animate] and the object is [–animate] or the reverse should not affect children's performance. All mismatches should help in cases of object extraction. However, this is not the case, as can be observed in Tables (17) and (18) for relative clauses and sluices, respectively. Notice the low performance on the [–animate] subject [+animate] object subcondition of the object relative clauses task (63.9%) and the sluice task (77.5%) (right-most column). The intervention hypothesis alone cannot account for this unexpected depressed performance in a mismatched condition –something else must be at play.

(17) *Results from the relative clause 'point-to' task by age and subcondition. Left squared brackets represent the subject animacy feature value. Right squared brackets represent the object animacy feature value.*

	RELATIVE CLAUSES							
	Subject				**Object**			
	Matched		**Mismatched**		**Matched**		**Mismatched**	
	[+] [+]	[−] [−]	[+] [−]	[−] [+]	[+] [+]	[−] [−]	[+] [−]	[−] [+]
3yo	79.5%	74.4%	89.7%	76.9%	64.4%	51.1%	88.9%	48.9%
4yo	89.7%	89.7%	97.4%	84.6%	53.3%	55.6%	82.2%	62.2%
5yo	97.8%	93.3%	95.6%	100.0%	71.1%	60.0%	91.1%	73.3%
6yo	84.4%	91.1%	95.6%	84.4%	84.4%	88.9%	91.1%	71.1%
AVG	**87.9%**	**87.1%**	**94.6%**	**86.5%**	**68.3%**	**63.9%**	**88.3%**	**63.9%**
	87.5%		**90.5%**		**66.1%**		**76.1%**	
	89.0%				**71.1%**			

(18) *Results from the sluicing '*wh*-question' task by age and subcondition. Left squared brackets represent the subject animacy feature value. Right squared brackets represent the object animacy feature value.*

	SLUICES							
	Subject				**Object**			
	Matched		**Mismatched**		**Matched**		**Mismatched**	
	[+] [+]	[−] [−]	[+] [−]	[−] [+]	[+] [+]	[−] [−]	[+] [−]	[−] [+]
3yo	90.0%	73.3%	80.0%	86.7%	60.0%	60.0%	86.7%	70.0%
4yo	100.0%	83.3%	96.7%	90.0%	66.7%	73.3%	93.3%	76.7%
5yo	100.0%	96.7%	90.0%	96.7%	80.0%	76.7%	93.3%	83.3%
6yo	100.0%	93.3%	93.3%	100.0%	90.0%	83.3%	96.7%	80.0%
AVG	**97.5%**	**86.7%**	**90.0%**	**93.3%**	**74.1%**	**73.3%**	**92.5%**	**77.5%**
	92.1%		**91.7%**		**73.8%**		**85.0%**	
	91.9%				**79.4%**			

However, a smuggling analysis is not required. Children lack whatever operation adults use to avoid intervention in these cases.

It is a well-known cross-linguistic generalization that subject NPs tend to be animate and animate NPs tend to be subjects. This generalization is captured by Silverstein's (1976) Animacy Hierarchy (AH), which essentially claims that a subject must be higher in animacy than an object. Indeed, various corpus and experimental studies show that both children and adults are overwhelmingly more likely to produce sentences that conform to the unmarked 'animate subject-inanimate object' pattern (*Swedish*, Dahl 2000; *Norwegian*, Øvrelid 2004; *English* child directed speech, Scott & Fisher 2009). Similar results hold for relative clauses specifically (*English*, Diessel 2004, 2007, 2009, Fox and Thompson 1990; *English/German*, Kidd et al. 2007; Brandt et al. 2009; *Dutch/German*, Mak, Vonk, and Schriefers 2002; *Italian*, Belletti and Chesi 2011), and sluices (Mateu, Hyams, and Winans, 2018), as shown in Table (19).

(19) *Results from CHILDES corpus (MacWhinney 2000) study on sluices contained in child directed speech (from Mateu, Hyams, and Winans 2018).*

	[+ animate] subject			[–animate] subject		
	[+ani] object	[–ani] object	No object	[+ani] object	[–ani] object	No object
Subject	1	9	6	0	0	2
Object	5	26	N/A	0	1	N/A

It is thus unsurprising that naturalness/frequency effects might also show up in our experimental findings. The depressed result on the [–animate +animate] subcondition might be explained as an AH violation. Interestingly, however, we do not see a similar effect in subject RCs (86.5%) and subject sluices (93.3%). A possible explanation for this asymmetry is that there is a cumulative complexity of movement across an intervener and non-canonical distribution of animacy features. In other words, the mitigating effects of mismatched features in the intervention structures is offset to large degree by the violation of the AH, which is perhaps stricter for children than adults. This suggests that *both* Relativized Minimality (RM; Rizzi 1990, 2004) and the Animacy Hierarchy (Silverstein 1976) are necessary to explain children's performance on relative clauses and sluices in our tasks.

Another result that deserves our attention is the difference in performance between the relative clauses and the sluices. As can be seen in Figures (15) and (16) children performed better in the object sluices than in the object relative clauses. This is not surprising if we assume the featural configurations in (20) and (21). In object relative clauses, the relation between the subject and the moved object is that of *inclusion* (if matched animacy) or *intersection* (if mismatched animacy). In object sluices, the relation between the subject and the moved object is that of *intersection* (if matched animacy) or *disjunction* (if mismatched animacy).

(20)

X	Z	< Y >	
[+R, +NP, +ani]	[+NP, +ani]		(matched, inclusion)
[+R, +NP, +ani]	[+NP, –ani]		(mismatched, intersection)

(21)	X	Z	< Y >	
	[+Q, +ani]	[+NP, +ani]		(matched, intersection)
	[+Q, +ani]	[+NP, –ani]		(mismatched, disjunction)

According to Belletti et al. (2012) and Friedmann, Belletti, and Rizzi (2009), among others, adult grammars only rule out configurations that involve complete *identity* of relevant morphosyntactic features between target X and intervener Z. Children, on the other hand, have a more constrained grammar; their grammars do not license configurations that involve an *inclusion* relationship, e.g., object relative clauses where the two arguments [+animate] NPs, but in which the headed NP also has the R feature, as well as those that involve an *intersection* relationship, e.g., object relative clauses where the two arguments are NPs, but the headed NP also has the R feature and [+animate] feature while the intervener has a distinctive [–animate] feature. Immature grammatical systems can only compute more distinct sets, such as *disjunction*, which would correspond to our mismatched object sluices. Crucially, the fact that matched object sluices obtained significantly worse performance rates than mismatched object sluices provides support for the inclusion of [animacy] into the computation of RM. However, this is not uncontroversial.

For example, Friedmann, Belletti, and Rizzi (2009) propose that only features that trigger movement matter for RM and propose that the feature 'lexical NP restriction', which they represent as [+NP], is such a feature. Belletti et al. (2012) claim that in order to count for intervention in a specific language features must be represented in the T system and overtly marked on the verb. More precisely, they suggest that Gender plays a role in the computation in Hebrew, a language in which verbs are marked for Gender, but not in Italian where verbs are not so marked, while in Italian Number is marked on the verb and so this feature counts in that language. In English, animacy is neither a trigger for verb movement nor is it marked on the verb, so we must assume that these are not necessary conditions for a particular feature to count for intervention.

An alternative suggestion is that it is sufficient that [+/− animacy] is "active" somewhere in the target grammar, but not necessarily in the TP domain. One might suggest that animacy is active in the DP domain in English in the genitive, and in the dative constructions. For many speakers the genitive *of* construction is preferred with inanimate possessors and the genitive *'s* is preferred with animate possessors (22) (Rosenbach 2012). Similarly, according to Bresnan, Cueni and Nikitina (2004) among others, in the dative PP construction an inanimate recipient is over twelve times more likely to be expressed than an animate (23).

(22) a. The man's hands.
b. ??The hands of the man.
c. ??The clock's hands.
d. The hands of the clock

(23) a. Give John a book.
b. ??Give a book to John.
c. ??Give the library a book.
d. Give a book to the library.

However, these are admittedly weak effects and one would be hard-pressed to argue that young children are sensitive to them. On the other hand, there are languages in which animacy is arguably part of the T system. For example, in Ancient Greek, Persian, Turkish, and Georgian the verb agrees with plural NPs only when animate; the verb is unmarked for plurality with plural inanimate NPs. In Blackfoot and other Algonquian languages the animacy of the subject and object are morphologically encoded in the verb (Ritter and Rosen 2010). In structural terms this means that animacy must be represented in the T system of these languages. Similarly, in Romance languages the Person Case Constraint may be triggered by the presence of animacy in object agreement (e.g., Bianchi 2006; Ormazabal and Romero 1998).

Our results lead us to conclude that children's sensitivity to animacy (as a feature for intervention) does not require animacy to be an "active" feature in their language, but only that it is available in UG as a potential "attractor" for movement realized in (some) adult grammar.

3. Summary and conclusion

In this study we found a subject > object asymmetry in both relative clauses and sluices, providing support for theoretical analyses that posit syntactic structure and movement in sluicing (e.g., Merchant, 2001). Moreover, we found that children have greater difficulty with object RCs and sluices when the subject and object are matched in animacy features. While the Animacy Hierarchy or frequency may play a role in children's (and adults') comprehension of complex constructions, our results cannot be fully accounted for without appeal to structural intervention. Thus, we argue that animacy features must be part of the computation of intervention in child language. Finally, the results from this study also lead us to propose that even when an intervening argument is not overtly expressed (as in sluices), it may nevertheless induce an intervention effect if it is syntactically projected (see also Mateu, 2019).

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