European Journal of Developmental Psychology

ISSN: 1740-5629 (Print) 1740-5610 (Online) Journal homepage: http://www.tandfonline.com/loi/pedp20

Persian speaking children's acquisition of relative clauses

Ramin Rahmany , Hamideh Marefat & Evan Kidd

To cite this article: Ramin Rahmany , Hamideh Marefat & Evan Kidd (2011) Persian speaking children's acquisition of relative clauses, European Journal of Developmental Psychology, 8:3, 367-388, DOI: 10.1080/17405629.2010.509056

To link to this article: http://dx.doi.org/10.1080/17405629.2010.509056

EUROPEAN JOURNAL OF DEVELOPMENTAL PSYCHOLOGY
2011, 8 (3), 367–388

Persian speaking children's acquisition of relative clauses

Ramin Rahmany and Hamideh Marefat
University of Tehran, Tehran, Iran

Evan Kidd
La Trobe University, Melbourne, Australia, and The University of Manchester, Manchester, UK

The current study examined the acquisition of relative clauses (RCs) in Persian-speaking children. Persian is a relatively unique data point in crosslinguistic research in acquisition because it is a head-final language with post-nominal RCs. Children ($N = 51$) aged 2 to 7 years completed a picture-selection task that tested their comprehension of subject-, object-, and genitive-RCs. The results showed that the children experienced greater difficulty processing object and genitive RCs when compared to subject RCs, suggesting that the children have particular difficulty processing sentences with non-canonical word order. The results are discussed with reference to a number of theoretical accounts proposed to account for sentence difficulty.

Keywords: L1 acquisition; Persian; Relative clause; Resumptive clitic.

The acquisition of relative clauses (RCs) has been studied extensively over the past thirty years, but has a more chequered history than most other structures. Early data suggested that children as old as 5 years did not possess the knowledge required to process recursive structures (Sheldon, 1974; Tavakolian, 1981). However, subsequent methodological refinements showed that children as young as 3 years perform above chance on at least some structural variations (Brandt, Kidd, Lieven, & Tomasello, 2009; Correa, 1995; Hamburger & Crain, 1982; Kidd & Bavin, 2002). Now that we have a better understanding of the acquisition of RCs in well-studied European languages such as English and German, attention has been turned

Correspondence should be addressed to Ramin Rahmany, P.O. Box 14155-6553, Faculty of Foreign Languages and Literatures, University of Tehran, Kargar Shomali Street, Tehran, Iran. E-mail: ramin_rahmany@yahoo.com

http://www.psypress.com/edp DOI: 10.1080/17405629.2010.509056

to typologically different languages (e.g., Arnon, 2010; Courtney, 2006; Ozeki & Shirai, 2010), under the assumption that expanding the evidential base will reveal more about the acquisition process. In the current study we add one more language to this list—Persian. We first review the current theoretical and empirical issues concerning the acquisition of RCs, and then provide an overview of RCs in Persian.

A consistent finding in both acquisition and adult sentence processing is that, with some qualification, subject RCs such as (1) are easier to process than object RCs, as in (2), e.g., Arnon (2005); Aydin (2007); Correa (1995); Diessel and Tomasello (2005); Gibson (2000); Izumi (2003); Özcan (1997); Özçelik (2006).

1. The dog that_chased the cat.
2. The cat that the dog chased_.

In (1) and (2) the underscore gap marks the grammatical role occupied by the head noun in the RC. In the case of (1), the head noun (*the dog*) occupies the subject role, and in the case of (2), it (*the cat*) occupies the object role. A number of proposals have been put forward to explain why (1) is generally easier to process than (2). The first is the *structural distance hypothesis* (SDH; O'Grady, Lee, & Choo, 2003), which claims that the structural distance between the head noun and the position it occupies in the RC determines sentence difficulty. The same prediction is made by accounts that attribute the difficulty to the *linear* distance between the head and its position in the RC; that is, the number of intervening words between the head noun and the gap (e.g., Gibson, 1998, 2000; Hawkins, 1989). We call this the *linear distance hypothesis* (LDH). Finally, the difference in complexity has also been attributed to the fact that object RCs have non-canonical word order within the RC (in English, Object–Verb–Subject; e.g., Bever, 1970; Christiansen & MacDonald, 2009; MacDonald & Christiansen, 2002). The suggestion being that, since canonical word order is more frequently encountered, it is easier to parse than non-canonical word order, which is comparatively infrequent and therefore marked. We call this the *word order difference hypothesis* (WDH).

The different hypotheses discussed above often make the same predictions in the one language. As such, we argue that a crosslinguistic approach is needed to help decide between them. Although experimental data from different languages directly bearing on this issue are now available in the adult language-processing literature, there is scant experimental evidence in acquisition. Let us briefly consider the adult literature before returning to acquisition.

The relevant available evidence in the adult processing literature that attempts to explicitly decide between these approaches comes from languages

that, unlike most Indo-European languages, are head-final and have pre-nominal RCs.[1] In these languages, the SDH predicts that subject RCs should be easier to process than object RCs, yet the LDH predicts the opposite. In line with the LDH, Hsiao and Gibson (2003) showed that object RCs were easier to process than subject RCs in speakers of Chinese, and Ishizuka, Nakatani, and Gibson (2006) reported a similar result in Japanese. These results are not without controversy, however, since Chien-Jar and Bever (2006) have argued that there is in fact a subject RC preference in Chinese. Finally, Carreiras, Dunabeitia, Vergara, de la Cruz Pavía, and Laka (2010) reported an object RC preference for Basque, a language characterized by the fact that it is head-final and has pre-nominal RCs, but also by the fact that it is ergative.[2]

In acquisition, our understanding of this issue has been hampered by methodological difficulties. For instance, Hakuta (1982) and Clancy, Lee, and Zoh (1986) reported studies of RC acquisition of Japanese and Korean children, respectively; yet their studies were limited by the fact that they presented their test sentences without a context in which to process the RC as a noun modifier (see Correa, 1995, for a discussion). However, studies of children's spontaneous speech (Japanese; Ozeki & Shirai, 2010) and their elicited production (Quechua; Courtney, 2006) have shown that, for the relevant typological contrast, object RCs are not always more difficult for children. Consistent with this argument, Kidd, Brandt, Lieven, and Tomasello (2007) and Brandt et al. (2009) have shown that English- and German-speaking children do not find object RCs more difficult when they are tested on test sentences that conform to the discourse conditions that lead to object RC formation. Arnon (2010) has reported similar results for Hebrew.

These results from the adult-processing and child language-acquisition literatures suggest that the SDH hypothesis has trouble explaining the range of crosslinguistic results, which can in turn be accommodated by the LDH (with some qualification, see Warren & Gibson, 2002). However, rather crucially, the LDH hypothesis does not account for the fact that children are not adept at processing genitive RCs (e.g., *the woman whose cat licked the bowl*; Diessel & Tomasello, 2005), suggesting that difficulty is not totally captured by simple distance metrics. The WDH can also potentially account for the range of results, although in languages with free word order it is difficult to predict the role of canonicity in the absence of reliable estimates of word order use

[1]Languages with clearly defined verb–object (i.e., head-initial) word order (e.g., English) overwhelmingly have post-nominal RCs, whereas languages with clearly defined object–verb (i.e., head-final) word order are fairly evenly split between a preference for post-nominal and pre-nominal RCs (see Dryer, 1992a, 1992b). This makes the latter category crucial in deciding between different theories of linguistic complexity.

[2]An ergative language maintains syntactic or morphological equivalence between the object of a transitive clause (i.e., *the dog* in *the cat chased the dog*) and the subject in an intransitive clause (*the dog jumped*), while treating the subject of transitives differently. See Dixon (1994).

(i.e., reliable frequency counts). In the current study we add one extra data point to this debate by presenting data from a language in which the acquisition of RCs has not been studied experimentally—Persian. We provide a brief description of Persian RCs below.

Persian relative clauses

Like the East-Asian languages Japanese, Korean, and Chinese,[3] Persian is a null-subject head-final language with Subject–Object–Verb (SOV) word order (Karimi, 2005). However, unlike the East-Asian languages, Persian RCs are post-nominal. Therefore Persian is potentially an interesting language in which to study the acquisition of RCs, because typologically it falls in between the European and East-Asian languages that have been at the centre of debate about RC acquisition and processing.

Persian RCs are introduced by a relative marker *-i* (RM, henceforth) attached to the head noun in Persian restrictive RCs, as in (3).

3.

ketab- i	*ke*	*mæn*	*xær id æm*
book RM	that	I	buy PAST 1SG
The book that I bought.			

A further feature of Persian is that there is no relative pronoun in Persian RCs: the RC is always introduced by the complementizer *ke*. Thus the complementizer is invariant; it does not agree with the function of the noun phrase it follows and takes the same form regardless of the animacy, gender, function, or number of the noun phrase it follows. Persian allows pronominal copies to occur in gap sites in some RCs; that is, a personal pronoun is used where a gap might be expected. For instance, example (4) represents a Persian RC in which the pronoun *u*, "he", is used resumptively, and example (5) shows a clitic pronoun, *æš* "him", used resumptively.

4.

mærd-i	[*ke*	*u*	*ra*	*molaqat kærdid*]	*aqaye*	Bayat	*bud*
man RM	[that	him	OM	meet-PAST-2SG]	mister	Bayat	be-PAST-3SG
The man whom you met him was Mr Bayat.							

[3]Chinese has characteristics that lead to it being characterized as both SOV and SVO.

5.

mærd-i	[*ke*	*molaqatæš kærdid*]	*aqaye*	Bayat	*bud*
man RM	[that	meet him CLITIC PAST-2SG]	mister	Bayat	be-PAST-3SG
*The man whom you met him was Mr Bayat.					

Finally, two more relevant points to note about the Persian language are that (i) verbs are inflected for number and person, and (ii) specific objects are marked by ''râ'', ''ro'' or ''o'' (OM, object marker, henceforth).

Resumption

The role of resumptive pronouns in Persian RCs is an important one that requires further discussion. In Persian, a subject RC requires a gap, an object RC optionally permits a gap (thus allowing a resumptive pronoun in place of a gap), and a genitive RC never permits a gap (i.e., it always requires a resumptive pronoun). Table 1 shows the pattern of distribution of gaps and resumptive pronouns in RCs (Taghvaipour, 2004).

As illustrated in Table 1, if the relativized element is subject, a resumptive pronoun cannot appear. This is illustrated in (6).

6.

(a)	*mærd-i*	*ke*___		*pirahæn*	*o*	*pušid*
	man RM	that___		shirt	OM	wore 3sg
	The man who wore a shirt.					
(b)	**mærd-i*	*ke*	***u***	*pirahæn*	*o*	*pušid*
	man RM	that	**he**	shirt	OM	wore 3sg
	*The man who he wore a shirt.					

Example (7) shows alternative expressions of a Persian object RC representing *the woman that the man is looking at*. They illustrate how

TABLE 1
Gaps and resumptive clitics in Persian RCs

	Subject	*Object*	*Genitive*
Gap allowed?	Yes	Yes	No
Resumptive pronoun allowed?	No	Yes	Yes

Persian allows gaps and resumptive pronouns alternatively if the relativized element is the object.

7.

(a)	*zæn-i*	*[ke*	*[mærd*	*Negāh__*	*mikone]]*
	woman RM	[that	[man	look at__	do.PRES 3SG]]
	The woman that the man is looking at.				
(b)	*zæn-i*	*[ke*	*[mærd*	*negā(hæ)š*	*mikone]]*
	woman RM	[that	[man	look at him CLITIC	do.PRES 3SG]]
	*The woman that the man is looking at him.				

Table 1 also shows that if the element which is relativized is the possessor NP, a resumptive pronoun must be present. This is contrasted in (8a) and (8b).

8.

(a)	*mærd-i*	*ke*	*pirahæn-æš*	*zærd*	*æst*
	man RM	that	shirt his CLITIC	yellow	is
	The man whose shirt is yellow.				
(b)	**mærd-i*	*ke*	*pirahæn __*	*zærd*	*æst*
	man RM	that	shirt __	yellow	is
	The man whose shirt is yellow.				

Resumptive elements have been shown to play an interesting role in RC acquisition. For instance, across a number of languages children have been reported to use them in syntactic contexts where they are not permitted or needed (e.g., Arnon, 2005, 2010; Goodluck & Stojanovic, 1996; Labelle, 1990). McKee and McDaniel (2001) suggested that this reflects capacity constraints on children's processing mechanisms, whereby the resumptive element acts as a prop to reactivate the head referent, which may not be otherwise recoverable from working memory. In the current study we exploited the fact that Persian allows resumptive pronouns in object- and genitive-RCs in order to explore whether this in fact eases comprehension.

The current study

The present study aimed to explore the difficulty Persian-speaking children experience in the acquisition of three Persian RC types (subject, object, and genitive). In doing so, we tested the predictions of each

complexity metric outlined above: SDH, LDH, and the WDH. We outline the specific predictions of each account with reference to sentences (9a–c).

9. (a) Subject RC

xanum-i	$_{CP}$[ke $_{IP}$[___	$_{VP}$*[mærd*	*-o*	*negah mikone]]]*
woman RM	that___	the man	OM	looks at do.PRES-3SG
The woman that looks at the man.				

In the subject RC (9a) the linear distance between the head noun and the gap is 1 word, i.e., *ke*, but the structural distance between them is 2 nodes, i.e., CP and IP.[4] The word order within the RC is the canonical word order of Persian—SOV (for the tree structures of Persian subject, object, and genitive RCs, see the Appendix).

9. (b) Object RC

pærændeh-i	$_{CP}$[ke	$_{IP}$[sæg	$_{VP}$*[negah-eš mikone]]]*
bird RM	that	dog	looks at it CLITIC do.PRES-3SG
The bird that the dog looks at.			

In the object RC (9b) the linear distance between the head noun and the clitic is 3 words, i.e., *ke* and *sæg* and *negah*. The structural distance is 3 nodes, i.e., CP, IP, and VP. The word order is not canonical, i.e., OSV.

9. (c) Genitive RC

xanum-i	$_{CP}$[ke	$_{IP}$*[gorbe-æš*	$_{VP}$*[fekr mikone]]]*
woman RM	that	cat her CLITIC	thinks
The woman whose cat thinks.			

In the genitive RC in (9c), there is no gap but a resumptive clitic pronoun –*æš*, which shows the original location of the head noun in the RC. Thus, the linear distance between the head and the clitic is 2 words, i.e., *ke* and *gorbe*.

[4]The label IP refers to ''Inflectional Phrase'', which denotes a sentence that contains a finite verb, and CP refers to the ''Complimentizer Phrase'', which denotes a subordinate clause (e.g., a relative clause).

The structural distance is 2 nodes, i.e., CP, and IP. The word order is non-canonical.

The contrasting predictions of each account are summarized in Table 2.

In this study, all the test items for object and genitive RCs contained a resumptive clitic. This was because the possibility that children use resumptive pronouns as a local processing prop in RCs suggests that their performance might be better on sentences where the grammar allows their use. If this were the case, and if this manipulation resulted in no subject–object asymmetry in the Persian-speaking children's comprehension (because the object RC contained a resumptive pronoun), then the theoretical accounts of sentence complexity need revision. Additionally, the inclusion of genitive RCs is novel in comparison to other studies that have only investigated subject and object RCs. Diessel and Tomasello (2005) showed that English- and German-speaking children performed very badly on genitive RCs in an elicited imitation task, and attributed the difficulty to both syntactic and semantic properties of the genitive. Note from Table 2 that although every theoretical approach predicts that subject RCs will be easier than object RCs, they all differ on how they predict the genitive to be processed. Therefore the inclusion of genitive RCs was a crucial inclusion in the study. No study has yet tested children's comprehension of genitive RCs, and since Persian genitive RCs obligatorily contain resumptive pronouns, there is a possibility that they will be easier to understand than Diessel and Tomasello (2005) observed in their imitation task.

METHOD

Participants

Fifty-one ($N = 51$) monolingual Persian-speaking children, between 30 and 77 months of age, were recruited for the present study from three

TABLE 2
Linear and structural distance between the head and the gap/clitic and the word order in the three RC types

Hypothesis	*Subject RCs*	*Genitive RCs*	*Object RC*	*Prediction*
LDH	1	2	3	Sub > Gen > Obj
SDH	2	2	3	Sub = Gen > Obj
WDH	Canonical	Non-canonical	Non-canonical	Sub > Gen = Obj

Note: ">" means easier than.

nursery schools in Tehran. The sample was divided into four age groups. The 2- to 3-year-old age group (2;6–3;1, Mean age = 2;8) consisted of 13 participants, the 3- to 4-year-old age group (3;6–4;1, Mean age = 3;10) consisted of 15 participants, the 5- to 6-year-old age group (4;8–5;5, Mean age = 5;1) consisted of 14 participants, the 6- to 7-year-old age group (6;0–7;5, Mean age = 6;3) consisted of 9 participants. All participants were normally developing children with no noted language impairments, hearing deficits, neurological difficulties, and social, emotional, or behavioural problems.

Materials

The participants in the study performed a picture selection task that consisted of 20 items: 5 subject-, object- and genitive-RCs, and five fillers (see the Appendix). On each page of the test booklet there were three pictures, presented vertically, from which the participants had to choose the picture that matched the sentence read to them by the experimenter. All the verbs used in the RCs were in the present tense. All the noun phrases were animate to control for possible animacy effects, which has been shown to affect children's comprehension (e.g., Brandt et al., 2009; Correa, 1995; Goodluck & Tavakolian, 1982). Testing children only on animate NPs was therefore necessary to test the differing predictions of the structural processing theories outlined above.

Since Persian verbs agree in person and number with the subject in each clause, the two NPs had the same person and number to factor out possible cues from verb agreement. Figure 1 shows an example of the test materials.

Procedure

The children were tested individually. At the beginning of the session, the children were shown the test booklet. They were told that they would hear the experimenter read out a sentence that matched only one of the pictures, and that their task was to choose the picture that the experimenter had described. The children were then given three practice items to ensure that they understood the procedure. On these trials the children were provided with feedback if they provided incorrect answers, during which the experimenter showed them the correct picture and how that picture differed from the others. No feedback was provided during the remainder of the testing session. A test sentence was repeated only if the child requested this specifically, and was only repeated once. All children were tested in a single testing session. The entire session lasted approximately 18 minutes for each child.

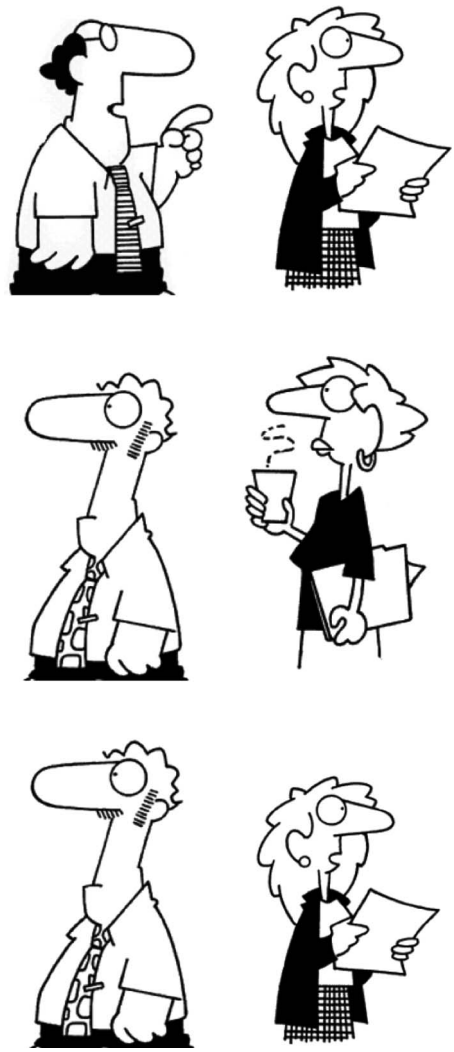


Figure 1. Sample pictures used for the item *the man that the woman is looking at*, an object RC.

RESULTS

Items were initially scored as either correct (score = l), if they pointed to the correct picture, or incorrect (score = 0). An error analysis was also conducted based on the incorrect decisions the children made.

The children's correct performance is presented first. Table 3 shows the means and standard deviations (*SD*s) for each age group's performance on each sentence type.

Table 3 shows that the children's performance improved with age across the three RC types. Overall the children performed best on subject RCs, followed by object RCs, followed finally by genitive RCs.

The data were analysed using a 3 (RC Type: subject-, object-, genitive) × 4 (Age Group) repeated-measures analysis of variance (ANOVA). There was a main effect for RC Type, $F(2, 47) = 14.521$, $p < .01$, a main effect for Age Group, $F(3, 47) = 8.377$, $p < .001$, but no Age by RC Type interaction, $F(6, 47) = 1.543$, $p = .216$. The effect size, calculated using eta-squared, was 34.8% for age group and 23.6% for RC, indicating that most of the variability in the children's performance was accounted for by the two independent variables.

Post hoc comparisons were conducted in order to identify the source of the main effects. Concerning the variable of RC type, LSD post hoc comparisons revealed that, overall, subject RCs (Mean = 3.59) were comprehended better than both object RCs (Mean = 2.88) and genitive RCs (Mean = 2.47). Object RCs (Mean = 2.88) were comprehended significantly better than genitive RCs (Mean = 2.47), i.e., subject RCs > object RCs > genitive RCs.

The post hoc analyses that compared across age groups showed that the 6- to 7-year-old age group performed significantly better than the 2- to 3- and the 3- to 4-year-old age groups, but did not differ from the 5- to 6-year-old group. The 5- to 6-year-old group performed significantly better than the 2- to 3-year-old group but did not differ from the 3- to 4- and the 6- to 7-year-old groups. Finally, the 3- to 4-year-old age group performed significantly better than the 2- to 3-year-old group. These results are represented in Table 4.

Although the interaction between age and RC type was not significant, we analysed the performance of each group separately in order to identify any developmental trends. A series of one-way ANOVAs with LSD post hoc

TABLE 3
Descriptive statistics for performance of different age groups on the three RC types

Age group (years)	*Age group (months)*		*Subject RC*	*Object RC*	*Genitive RC*
2–3	30 to 36 months	Mean	2.62	2.15	2.23
	($N = 13$)	*SD*	0.767	1.143	1.166
3–4	42 to 49 months	Mean	3.60	2.80	2.47
	($N = 15$)	*SD*	0.828	1.207	0.743
5–6	58 to 65 months	Mean	4.00	3.21	2.57
	($N = 14$)	*SD*	0.960	0.892	1.554
6–7	72 to 77 months	Mean	4.33	3.556	2.66
	($N = 9$)	*SD*	0.500	1.014	1.500
	Total	Mean	3.59	2.88	2.47
	($N = 51$)	*SD*	1.00	1.16	1.22

Note: The mean scores reported are out of 5.

tests were conducted to compare each group's performance on each RC type. The results, summarized in Table 5, showed that, with the exception of the youngest age group, the children performed significantly better on the subject RCs than on both the object and genitive RCs, but that the differences between performance on the object and genitive RCs did not differ.

Error analysis

An error analysis was performed to investigate whether the children's errors could reveal anything more about the processing strategies they use in acquisition. A preliminary inspection of the children's error patterns on the subject RCs revealed no systematic patterns; the children in general performed well on this sentence type, and when they did not interpret them correctly they chose pictures at random. We therefore only report on the children's errors for the object and genitive RCs.

Table 6 shows the distribution of the main error types for the children's performance on the object RCs. Overall, the children chose the correct picture on 59% of occasions. On 25.6% of occasions, they interpreted an object RC as a subject RC, imposing Persian canonical word order onto the RC in the test sentence. For example, the children interpreted items like *zæni ke mærd negaš mikone* (the woman that the man is looking at) as *zæni ke mærdo negah mikone* (the woman that is looking at the man). This suggests that children tended to prioritize canonicity of word order over the presence

TABLE 4
The difference among the age groups

Age group	*2–3*	*3–4*	*5–6*	*6–7*
6–7	$p < .001$***	$p = .032$*	$p = .325$	–
5–6	$p < .001$***	$p = .199$	–	
3–4	$p = .009$**	–		
2–3	–			

Note: *$p < .05$; **$p < .01$; ***$p < .001$.

TABLE 5
The difference among the three RC types

Age group	*Subject RC vs. Object RC*	*Object RC vs. Genitive RC*	*Subject RC vs. Genitive RC*
2–3	$p = .273$	$p = .874$	$p = .374$
3–4	$p = .009$**	$p = .238$	$p = .008$**
5–6	$p = .040$*	$p = .133$	$p = .009$**
6–7	$p = .043$*	$p = .212$	$p = .010$*

Note: *$p < .05$; **$p < .01$; ***$p < .001$.

of Persian resumptive clitic *š*, an unambiguous local cue to grammatical role assignment. Finally, 15.4% of the time the children appeared to choose at random; however, unlike the error where they interpreted the RC as having canonical word order, the prevalence of this error type diminished across development, from 30% in the youngest group to zero in the eldest group.

Table 7 shows that the children correctly interpreted the genitive RCs on 57% of occasions. For this structure there were two main error types. First, on 26.2% of occasions the children ignored the subject of the matrix clause, i.e., the possessor, interpreting *the boy whose cat is reading* as *the cat is reading*. Second, on 19.3% of occasions children ignored the second noun phrase in the sentence, the possessum, interpreting *the boy whose cat is reading* as *the boy is reading*. The children made these two error types in approximately equal proportions, and there were no discernible developmental trends.

These error patterns for the genitive RCs suggest that the children have difficulty in processing the dependent relationship between the possessor and the possessum. Instead the children revert to analysing the sentence by either using a linear recency strategy, thereby ignoring the subject, or by associating the topicalized NP (i.e., the head noun) with the verb. Both errors suggest that instead of attending to the resumptive clitic, once again an unambiguous cue to interpretation, the children instead largely opted for a word order strategy when analysing the sentences.

TABLE 6
The percentage of participants' errors on object RCs

Age group (years)	*Age group (months)*	*Correct*	*Incorrect (imposing canonical word order)*	*Incorrect (others)*
2–3	30 to 36 months ($N = 13$)	45%	25%	30%
3–4	42 to 49 months ($N = 15$)	55%	20%	25%
5–6	58 to 65 months ($N = 14$)	65%	28.33%	6.66%
6–7	72 to 77 months ($N = 9$)	71.11%	28.88%	0%
	Total ($N = 51$)	59.02%	25.55%	15.41%

TABLE 7
The percentage of participants' errors on genitive RCs

Age group (years)	*Age group (months)*	*Correct*	*Incorrect (ignoring possessor)*	*Incorrect (ignoring possessum)*
2–3	30 to 36 months ($N = 13$)	55%	26.66%	18.33%
3–4	42 to 49 months ($N = 15$)	56.25%	28.75%	25%
5–6	58 to 65 months ($N = 14$)	50%	31.66%	18.33%
6–7	72 to 77 months ($N = 9$)	66.66%	17.77%	15.55%
	Total ($N = 51$)	56.97%	26.21%	19.30%

DISCUSSION

The current study investigated the acquisition of relative clauses in Persian-speaking children aged 2–7 years. Persian has typological features that make it an interesting data point in the context of debates about RC complexity. Like European languages such as English and German, it has post nominal RCs; however, like East-Asian languages such as Japanese and Korean, it is a pro-drop language and is head final. These two broad language categories have been argued to differ in experiments investigating RC complexity, making Persian a potentially interesting middle ground. We specifically tested the predictions of three theoretical approaches to sentence complexity, which we evaluate with reference to our data below.

The first major finding was that, with the exception of the youngest age group, the children found subject RCs easiest to interpret. This finding is consistent with all of the theoretical approaches to structural complexity, which for Persian differ only in their predictions about the complexity of subject RCs relative to object and genitive RCs. Second, the children did not differ in their performance on object and genitive RCs. This is inconsistent with the predictions of both the SDH and the LDH, which both predict that the genitive RCs should have been easier to process than the children's performance indicated. In fact, the children performed at consistently low levels on the genitive RCs, but did not differ in their performance on the genitive and object RCs. This result is consistent with the WDH hypothesis, which argues that difficulty is not associated with distance between the head noun and the gap, but instead with the fact that both object and genitive RCs contain non-canonical word order.

There are some broad theoretical issues that are raised by these results. The first concerns the question as to why non-canonical word order causes difficulty for the children despite the presence of resumptive pronouns that should aid Persian-speaking children's interpretation of object and genitive RCs. Numerous studies of language acquisition have shown that children experience difficulty with non-canonical structures (e.g., Bates & MacWhinney, 1982, 1989; Bever, 1970; Slobin & Bever, 1982). Such results clearly show that children's processing systems, like those of adults, are attuned to the frequency distributions of their input language (Townsend & Bever, 2001). That is, upon segmenting a series of nouns and verbs in the speech stream, children prefer to assign grammatical roles according to how they are most frequently assigned given their history of speaking and listening to the language.

What the results of the current study also suggest, however, is that children prefer this strategy over attending to local cues to interpretation (i.e., resumptive pronouns). This is inconsistent with arguments in the literature that suggest that local cues are privileged in acquisition

(e.g., Bowerman, 1985; Slobin, 1982), but consistent with results reported by Dittmar, Abbot-Smith, Lieven, and Tomasello (2008), who showed that German-speaking children prefer to use word order to interpret sentences over and above case marking until the age of 7 years. Since nouns in German are marked for case on determiners, the cue is local and, in general, fairly reliable. Despite this fact, children do not use it as a cue until they are school-age. Why might this be the case? It so happens that although case marking is a reliable cue to interpretation, the case system is rather difficult for children to acquire because it is fairly complex, owing to the fact that there are three noun genders and different case paradigms for each. Therefore, although reliable, the cue of case marking is not as readily available to children as is word order. As such, since word order is both reliable and available to children, they appear to rely on the cue that will provide them with the best chance at pursuing correct interpretation, or, in other words, they pursue the strategy that has been most successful for them in the past. Coming back to the Persian data, it is likely that the strength of canonical word order as a cue to interpretation, and potentially the low perceivability (due to their status as clitics) or availability of resumptive pronouns (due to the fact that object and genitive RCs are in general rarer than subject RCs), result in young children choosing word order as their preferred comprehension strategy.

The second issue that these data raise concerns the manner in which linguistic complexity is calculated. All of the complexity metrics that we tested in the present study either explicitly or implicitly determine complexity on the basis of syntactic measures alone. For instance, the SDH calculates complexity on the basis of distance measurements across formal syntactic structure, the LDH calculates complexity on the basis of the number of words between the head and hypothesized gap, and the WDH hypothesis calculates complexity based on deviation from the canonical configurational pattern of the language. The problem here is that complexity in language comprehension and use cannot solely be captured by appeals to syntactic features, formal or otherwise. The children's performance on the object and genitive RCs directly bear on this issue. Although when the age groups were analysed separately there was no difference between these two sentence types, the children consistently performed numerically worse on the genitive RCs, and when age was collapsed the children's performance on the object RCs was significantly better than on the genitive RCs. This result is not predicted by any of the complexity metrics we have discussed. What, then, might contribute to the complexity of genitive RCs over and above the fact that they contain non-canonical word order?

First and foremost, genitive RCs are likely to be low in frequency, suggesting that children have very little experience processing them. Upon hearing the first part of the sentence, that is, the head noun plus the

complementizer, the children are likely to assume that this is either a subject or object RC (most likely a subject RC, given our results). This expectation is likely to make genitive (and object) RCs difficult, since the children will have to reanalyse these sentences if they are to correctly process them. In the object RCs they must reassign thematic roles, but because this is a direct reversal of their first likely interpretation and because object RCs are not unattested in their input, they can cope with the processing load more easily. However, there is an additional source of difficulty with the processing of the genitive construction that is associated with establishing the possessive relationship. That is, the children must establish a possessor–possessum relationship that is actually peripheral to the activity described by the verb. More specifically, in a genitive RC like *the woman whose cat thinks*, they must compute something like *the woman owns the cat* and *the cat is thinking*. Compare this to an object RC like *the dog that sees the bird*, where the children must compute either *the dog sees the bird* or *the bird sees the dog*. The suggestion is that the genitive RC adds an additional layer of complexity that is not only syntactic, but also semantic. This highlights the fact that the child's role is not simply to induce a grammar of a language, but is instead to identify the syntactic–semantic (or form–function) correspondences as they parse the speech stream. Any measure of linguistic complexity needs to accommodate such results.

The results from the present study suggest that Persian patterns like other Indo-European languages in that subject RCs were found to be easier to process than object RCs, despite Persian being typologically different from more typical family members in some crucial respects. Recent findings in English and German have shown that object RCs are not always more difficult than subject RCs. In particular, Brandt et al. (2009) and Kidd et al. (2007) have shown that the subject–object asymmetry disappears when children are tested on object RCs that conform to the discourse conditions that generally lead to object RC use: when they contain (i) an inanimate head noun, and (ii) a pronominal RC subject, as in *This is the pen that I used yesterday* (cf. *This is the boy the girl chased yesterday*). Since we only tested animate NPs in this study, a similar effect is yet to be established in Persian. Furthermore, it is unclear at what age Persian-speaking children become sensitive to the role of the resumptive pronoun in both object and genitive RCs. This would be valuable information to know, because resumptive pronouns can potentially alleviate the complexity associated with non-canonical word order in these two structures. These issues await further research.

Manuscript received 11 February 2009
Revised manuscript accepted 15 June 2010
First published online 27 September 2010

REFERENCES

Arnon, I. (2005). Relative clause acquisition in Hebrew: Toward a processing-oriented account. In A. Brugos, M. R. Clark-Cotton & S. Ha (Eds.), *Proceedings of the twenty-ninth Boston University Conference on Language Development*. Somerville, MA: Cascadilla Press.

Arnon, I. (2010). Rethinking child difficulty: The effect of NP type on children's processing of relative clauses in Hebrew. *Journal of Child Language*, *37*, 27–57.

Aydin, Ö. (2007). The comprehension of Turkish relative clauses in second language acquisition and agrammatism. *Applied Psycholinguistics*, *28*, 295–315.

Bates, E., & MacWhinney, B. (1982). Functionalist approaches to grammar. In E. Wanner & L. Gleitman (Eds.), *Child language: The state of the art* (pp. 173–218). New York: Cambridge University Pres.

Bates, E., & MacWhinney, B. (1989). Functionalism and the competition model. In B. MacWhinney & E. Bates (Eds.), *The crosslinguistic study of sentence processing* (pp. 3–73). New York: Cambridge University Press.

Bever, T. G. (1970). The cognitive basis for linguistic structures. In J. R. Hayes (Ed.), *Cognition and the development of language*. New York: Wiley.

Bowerman, M. (1985). What shapes children's grammars? In D. Slobin (Ed.), *The crosslinguistic study of language acquisition. Vol. 2: Theoretical issues*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Brandt, S., Kidd, E., Lieven, E., & Tomasello, M. (2009). The discourse bases of relativization: An investigation of young German and English-speaking children's comprehension of relative clauses. *Cognitive Linguistics*, *20*, 539–570.

Carreiras, M., Dunabeitia, J. A., Vergara, M., de la Cruz Pavía, I., & Laka, I. (2010). Subject relative clauses are not universally easier to process: Evidence from Basque. *Cognition*, *115*, 79–92.

Chien-Jar, C. L., & Bever, T. (2006). Subject preference in the processing of relative clauses in Chinese. In D. Baumer, D. Montero, & M. Scanlon (Eds.), *Proceedings of the 25th West Coast Conference on Formal Linguistics* (pp. 254–260). Somerville, MA: Cascadilla Press.

Christiansen, M. H., & MacDonald, M. C. (2009). A usage-based approach to recursion in sentence processing. *Language Learning*, *59*, 126–161.

Clancy, P., Lee, H., & Zoh, M. (1986). Processing strategies in the acquisition of relative clauses: Universal principles and language-specific realizations. *Cognition*, *24*, 225–262.

Correa, L. M. (1995). An alternative assessment of children's comprehension of relative clauses. *Journal of Psycholinguistic Research*, *24*, 183–203.

Courtney, E. H. (2006). Adult and child production of Quechua relative clauses. *First Language*, *26*, 317–338.

Diessel, H., & Tomasello, M. (2005). A new look at the acquisition of relative clauses. *Language*, *81*, 1–25.

Dittmar, M., Abbot-Smith, K., Lieven, E., & Tomasello, M. (2008). German children's comprehension of word order and case marking in causative sentences. *Child Development*, *79*, 1152–1167.

Dixon, R. (1994). *Ergativity*. Cambridge, UK: Cambridge University Press.

Dryer, M. (1992a). The Greenbergian word order correlations. *Language*, *68*, 81–138.

Dryer, M. (1992b). Adverbial subordinators and word order asymmetries. In J. A. Hawkins & A. Siewierska (Eds.), *Performance principles of word order* (pp. 50–67). Strasbourg, France: EUROTYP Working Papers, European Science Foundation.

Gibson, E. (1998). Linguistic complexity: Locality of syntactic dependencies. *Cognition*, *68*, 1–76.

Gibson, E. (2000). The dependency locality theory: A distance-based theory of linguistic complexity. In Y. Miyashita, A. Marantz, & W. O'Neil (Eds.), *Image, language, brain* (pp. 95–126). Cambridge, MA: MIT Press.

Goodluck, H., & Stojanovic, D. (1996). The structure and acquisition of relative clauses in Serbo-Croatian. *Language Acquisition*, *5*, 285–315.

Goodluck, H., & Tavakolian, S. (1982). Competence and processing in children's grammar of relative clauses. *Cognition*, *11*, 1–27.

Hakuta, K. (1982). Interaction between particles and word order in the comprehension and production of simple sentences in Japanese children. *Developmental Psychology*, *18*, 62–76.

Hamburger, H., & Crain, S. (1982). Relative acquisition. In S. Kuczaj (Ed.), *Language development*. *Vol. 1: Syntax and semantics*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Hawkins, R. (1989). Do second language learners acquire restrictive relative clauses on the basis of relational or configurational information? The acquisition of French subject, direct object, and genitive restrictive clauses by language learners. *Second Language Research*, *5*, 156–188.

Hsiao, F., & Gibson, E. (2003). Processing relative clauses in Chinese. *Cognition*, *90*, 3–27.

Ishizuka, T., Nakatani, K., & Gibson, E. (2006). *Processing Japanese relative clauses in context*. Paper presented at the 19th Annual CUNY Conference on Human Sentence processing, CUNY, New York.

Izumi, S. (2003). Processing difficulty in comprehension and production of relative clauses by learners of English as a second language. *Language Learning*, *53*, 285–323.

Karimi, S. (2005). *A minimalist approach to scrambling: Evidence from Persian*. Berlin, Germany: Mouton de Gruyter.

Kidd, E., & Bavin, L. B. (2002). English-speaking children's comprehension of relative clauses: Evidence for general-cognitive and language-specific constraints on development. *Journal of Psycholinguistic Research*, *31*, 599–617.

Kidd, E., Brandt, S., Lieven, E., & Tomasello, M. (2007). Object relatives made easy: A crosslinguistic comparison of the constraints influencing young children's processing of relative clauses. *Language and Cognitive Processes*, *22*, 860–897.

Labelle, M. (1990). Predication, WH-movement, and the development of relative clauses. *Language Acquisition*, *1*, 95–119.

MacDonald, M. C., & Christiansen, M. (2002). Reassessing working memory: Comment on Just and Carpenter (1992) and Waters and Caplan (1999). *Psychological Review*, *109*, 35–54.

McKee, C., & McDaniel, D. (2001). Resumptive pronouns in English relative clauses. *Language Acquisition*, *9*, 113–156.

O'Grady, W., Lee, M., & Choo, M. (2003). A subject–object asymmetry in the acquisition of relative clauses in Korean as a second language. *Studies in Second Language Acquisition*, *25*, 433–448.

Özcan, H. (1997). Comprehension of relative clauses in the acquisition of Turkish. In K. Imer & N. E. Uzun (Eds.), *Proceedings of the VIIIth International Conference on Turkish Linguistics* (pp. 149–155). Ankara, Turkey: Ankara Üniversitesi Basımevi.

Özçelik, O. (2006). *Processing relative clauses in Turkish as a second language*. Unpublished master's thesis. University of Pittsburgh.

Ozeki, H., & Shirai, Y. (2010). Semantic bias in the acquisition of relative clauses in Japanese. *Journal of Child Language*, *37*, 197–215.

Sheldon, A. (1974). The role of parallel function in the acquisition of relative clauses in English. *Journal of Verbal Learning and Verbal Behavior*, *13*, 272–281.

Slobin, D. I. (1982). Universal and particular in the acquisition of language. In E. Wanner & L. R. Gleitman (Eds.), *Language acquisition: The state of the art* (pp. 128–172). Cambridge, UK: Cambridge University Press.

Slobin, D. I., & Bever, T. G. (1982). Children use canonical sentence schemas: A crosslinguistic study of word order and inflections. *Cognition*, *12*, 229–265.

Taghvaipour, M. A. (2004). An HPSG analysis of Persian relative clauses. In S. Müller (Ed.), *Proceedings of the HPSG04 Conference* (pp. 274–293). Leuven, Belgium: Center for Computational Linguistics, Katholieke Universiteit Leuven, CLSI Publications.

Tavakolian, S. (1981). The conjoined-clause analysis of relative clauses. In S. Tavakolian (Ed.), *Language acquisition and linguistic theory* (pp. 167–187). Cambridge, MA: MIT Press.

Townsend, D. J., & Bever, T. G. (2001). *Sentence comprehension: The integration of habits and rules*. Cambridge, MA: MIT Press.

Warren, T., & Gibson, E. (2002). The influence of referential processing on sentence complexity. *Cognition*, *85*, 79–112.

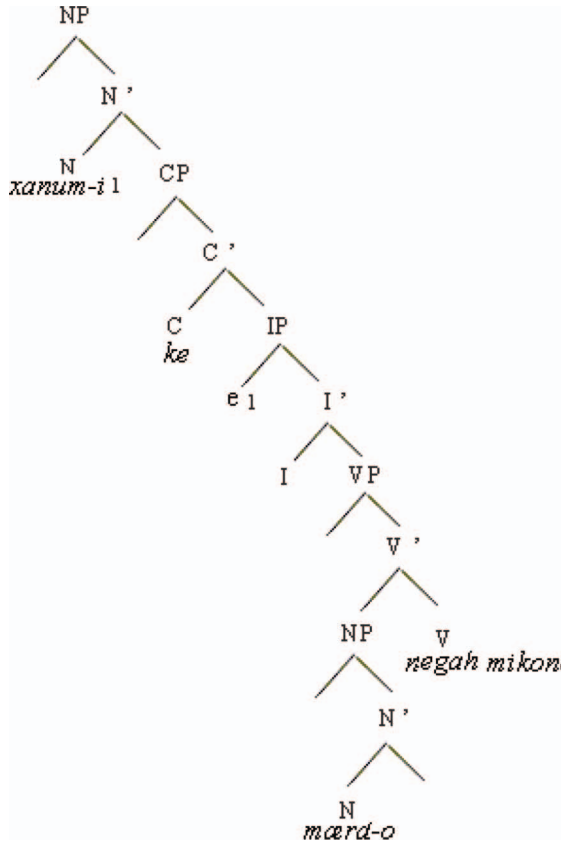
APPENDIX

Test sentences

The girl who thinks
The woman that the man looks at
The woman whose cat thinks
The woman that looks at the man
The bird that the dog looks at
The boy whose horse thinks
The man that follows the man
The horse that the man thinks about
The boy whose rabbit reads
The dog that loves the penguin
The woman that the bear hits
The man whose rabbit paints
The cow that carries the lion
The boy that the man paints
The woman whose dog writes

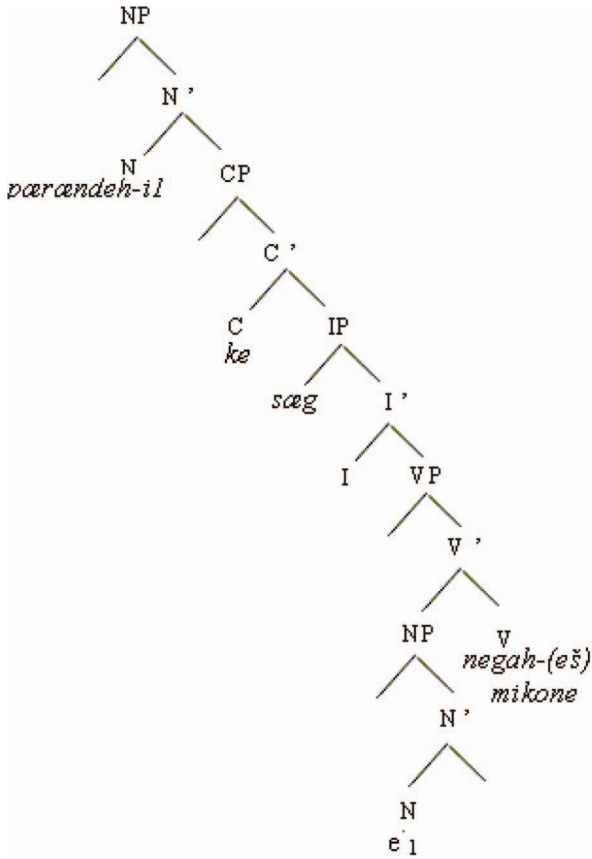
Post nominal subject RC, head-final

xanum-i ke mærd-o negah mikone
the woman that looks at the man



Post nominal object RC, head-final

pærændeh-i ke sæg negah-eš mikone
the bird that the dog looks at



Post nominal genitive RC, head-final

xanum-i ke gorbe-æš fekr mikone
the woman whose cat thinks