Language-Specific Properties Influence Children's Acquisition of Argument Structure

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1. Introduction

Children's acquisition of verb argument structure (VAS) involves learning the number and placement of the required and optional arguments associated with each verb, as well as, in some languages, the grammatical morphemes that mark each argument's role. In this paper, we investigate whether some language-specific properties of Turkish and Mandarin lead to different developmental patterns in the acquisition of VAS as compared to English.

Previous research, primarily with English learners, has suggested that the acquisition of VAS is promoted by lexical factors such as word frequency and the principles of Uniqueness and Entrenchment (e.g., Brooks & Tomasello, 1999; Clark, 1987; Naigles, Fowler & Helm, 1992). Research with children learning other languages, though, has reported differences in the patterns and/or instigating factors of VAS acquisition. In particular, grammatical factors pertaining to prepositional phrases, word order, and verb morphology seem relevant for specific languages (e.g., French, K'iche Maya and Sesotho; see Demuth, Machobane & Moloi, 2003; Naigles & Lehrer, 2002; Pye, 1994 for discussion).

None of this research, though, has compared children's acquisition of VAS *across ages and across languages, using the same task,* to investigate language-specific and language-general effects on children's *patterns* of development. One of the objectives of the current study is to investigate 2- to 5-year-old children's acquisition of VAS in English, Mandarin Chinese, and Turkish using a task that has already been shown to be appropriate for (a) cross-linguistic comparison (Lidz, Gleitman & Gleitman, 2003; Naigles & Lehrer, 2002) and (b) revealing developmental changes (Naigles et al., 1992). In this task, children are asked to enact familiar verbs placed in sentences with too many overt arguments (2-NP) such as *"The zebra goes the lion"* or too few overt arguments (1-NP) such as *"The zebra brings."* Here, verb and frame information are at odds and enactors must choose which to follow.

Using this task, Naigles and colleagues (Naigles, Gleitman, & Gleitman,1993; Naigles, et al., 1992) have described English learners' VAS

acquisition between the ages of 2 and 12 years. They found a developmental pattern in which the youngest children relied more heavily on the frame information (Frame Compliance) while the oldest children (and adults) relied most heavily on the verb information (Verb Compliance). In particular, when the 2-year-old English learners heard ungrammatical 2-NP sentences, they enacted them causatively; for example, *the zebra goes the lion* was enacted as the zebra making the lion go. Moreover ungrammatical 1-NP sentences were enacted noncausatively, with *the zebra brings* enacted as the zebra coming alone. Thus, the youngest children followed the canonical transitive-causative and intransitive-noncausative mappings between form and meaning (Bowerman, 1982; Jackendoff, 1990; Levin, 1993; see Lidz et al., 2003 and Naigles & Lehrer, 2002, for similar findings from Kannada and French learners). By 12 years of age, though, children enacted the sentences, as did adults, following the specific semantic and syntactic requirements of each verb. Thus, 2-NP sentences with intransitive verbs were enacted noncausatively (the zebra goes TO the lion) and 1-NP sentences were enacted causatively (the zebra brings SOMETHING*)*. Developmentally, then, children between 2 and 12 years of age shifted from Frame Compliance to Verb Compliance.

Interestingly, the developmental shift toward verb compliance differed as a function of syntactic frame, reaching "ceiling" levels at different ages. For example, the 1-NP frame elicited robust Verb Compliance only from 5-year-olds and older children whereas the 2-NP frame elicited robust Verb Compliance only from 7-year-olds and older children (Naigles et al., 1993; Naigles et al., 1992) (Other sentence frames, not studied here, elicited robust Verb Compliance only from 12-year-olds and adults.)

This task is thus well-suited for a cross-linguistic investigation of children's understanding of VAS with children from a wide range of ages. By placing familiar verbs in novel frames, we can test the extent to which children at different ages rely on the properties of the frame (*e.g.*, number and arrangement of NPs) as opposed to properties of the verb (*e.g.,* transitive vs. intransitive) in their conceptions of VAS. In addition, by eliciting enactments from the children, the task reveals what they think the sentences mean, and not just whether they recognize the sentences to be unconventional or anomalous.

In this study, we examined how Mandarin and Turkish native speakers of different ages compared with English native speakers when acting out similar sentences. These three languages offer an innovative comparison because of two significant properties that have the potential to affect the acquisition of VAS and vary across the three languages.

The first property is ellipsis (*i.e*., the allowance of omitted subjects and/or direct objects). In English, the acquisition of VAS involves learning that transitive verbs (e.g., *bring, push)* require both an overt agent and an overt patient. For example, for the verb *push*, children need to hear both subject and direct object to grasp the meaning of *push*. Although the acquisition of VAS in Turkish and Mandarin Chinese also involves learning that transitive verbs require two arguments, these arguments need not be expressed overtly as in

English. Examples (1) in Turkish and (2) in Mandarin are widely used and grammatically accepted when discourse conditions are appropriate, though both are missing an argument (Küntay & Slobin, 2002; Lee & Naigles, 2005).

(1) Koyun getiriyor
    Sheep is bringing (something)

(2) Xiao3yang2 dai4
    Sheep brings (something)

This difference across the three languages allows us to investigate the extent to which the presence of ellipsis in one's language influences a child's developing knowledge that transitive verbs involve two arguments. That is, does hearing many transitive verbs in single-NP sentences (such as (1) and (2) above) make it harder or easier to learn that transitive verbs always *involve* two arguments?

The second property involves word order flexibility. English requires strict SVO word order, so most direct objects are post-verbal, and oblique or indirect objects are signaled by prepositions. In contrast, both Mandarin and Turkish allow more flexible word orders. The most common word order in Turkish is SOV, but all other orders are possible or attested (Aksu-Koc & Slobin, 1985; Küntay & Slobin, 1996). For example,

(3a) Zebra kedi getirsin
    Zebra cat brings

and

(3b) Zebra getirsin kedi
    Zebra brings cat

can both be used. Moreover, though Mandarin is canonically an SVO language, post-verbal NPs without prepositions are common and may represent oblique objects as well as direct objects (Lee & Naigles, 2005). For example, in

(4a) Wo3men2 qu4 shang1dian4
    We *go* (to the) store')

the postverbal noun is oblique as it refers to a location while in

(4b) Wo3men2 dai4 xiao3mao1
    We bring (the) cat

the postverbal noun is a direct object (the patient).

The following question emerges from these different properties of word order: To what extent does flexibility (or not) of word order influence the child's developing knowledge that intransitive verbs involve one argument? That is, does hearing intransitive verbs in a variety of orders (e.g., VS, SV, SV + oblique object) render this knowledge *easier* or *harder* to acquire?

Thus, in the present study we investigate the effects of language specific properties, particularly ellipsis and word order flexibility, on the developmental patterns of the acquisition of VAS across three languages. In particular, we are interested in whether there are language differences in the degree of Frame Compliance at any of the ages tested, and whether there are language differences in the pattern of decrease in Frame Compliance across age.

2. Method
2.1. Participants

A total of 212 children was tested in daycare centers and kindergartens in Eastern U.S. (English; already reported in Naigles et al., 1993, Naigles et al., 1992), Singapore (Mandarin) or Istanbul (Turkish). They were all monolingual speakers and were between the ages of 2 and 5 years. Children were separated into 4 age groups in each language: 20 2-year-olds, 24 3-year-olds, 18 4-year-olds, and 12 5-year-olds in the English-speaking group; 18 2-year-olds, 23 3-year-olds, 25 4-year-olds, and 16 5-year-olds in the Mandarin-speaking group; and 14 2-year-olds, 15 3-year-olds, 16 4-year-olds, and 15 5-year-olds in the Turkish-speaking group. Table 1 presents the means and standard deviations for each age group in each language.

Table 1. Means and standard deviations for each age group in each language.

	2-year-olds		3-year-olds		4-year-olds		5-year-olds	
	mean	SD	mean	SD	mean	SD	mean	SD
English	2;9	-	3;7	-	4;4	-	5;6	6.4
Turkish	2;7	3.3	3;4	2.5	4;5	2.5	5;3	2.4
Mandarin	2;8	3.3	3;8	3.6	4;7	3.6	5;6	3.7

2.2. Materials

Children were asked to enact between 40 and 52 sentences, including a total of 4 frames and up to 12 verbs, in each language. However, in this paper, only those sentences and verbs comparable across the three languages are considered. For example, some Turkish sentences included accusative casemarking on one of the NPs and some English and Mandarin sentences included prepositional phrases. The test sentences considered in this paper included those with 3 intransitive verbs (*come, go, fall*) and 4 transitive verbs (*bring, take, push,* and *put*) each placed in 2 frames: a 2-NP, either NVN (English, Mandarin) or NNV

(Turkish) and a 1-NP frame, NV. Table 2 presents examples of each frame with a verb in all three languages.

Table 2. Example sentences for each frame in each language.

Frame	Transitive verb	Intransitive verb
2-NP		
English:	The zebra brings the cat	The zebra comes the cat
Turkish:	Zebra kedi getirsin	Zebra kedi gelsin
Mandarin:	Ban1ma3 dai4 xiao3mao1	Ban1ma3 lai2 xiao3mao1
1-NP		
English:	The zebra brings	The zebra goes
Turkish:	Zebra getirsin	Zebra gelsin
Mandarin:	Ban1ma3 dai4	Ban1ma3 qu4

At this point, we introduce new terminology to refer to our stimulus sentences. Naigles et al. (1993) called transitive verbs placed in intransitive frames, and intransitive verbs placed in transitive frames, 'ungrammatical'. However, such terminology is not quite appropriate for Mandarin Chinese or Turkish, as described earlier: Sentences (1) and (2) are simply infelicitous in a discourse context where no 'bringee' has been previously mentioned. Moreover, (3a) and (4a) are merely unusual, because Mandarin postverbal NPs with intransitive verbs are usually recognizable sources or goals rather than patients, and conjoined nouns in Turkish usually include the connection word *'ile' (with)*. Following Sanford & Sturt (2002) and extending Lahiri & Marslen-Wilson (1991), we term such sentences, which yield less-than complete representations in the current discourse context, *underspecified*, and their counterparts with the appropriate number of arguments *fully specified*.

As shown in Table 1, the children heard transitive verbs in 2-NP frames and intransitive verbs in 1-NP frames; these are fully specified in English, Mandarin, and Turkish. They also heard intransitive verbs in 2-NP frames and transitive verbs in 1-NP frames; these are ungrammatical in English and underspecified in Mandarin and Turkish. Approximately half of the sentences were thus fully specified and half were ungrammatical and/or underspecified. Children were asked to enact the sentences on a wooden stage using small toy animals as props.

2.3. Procedure

Each child was tested individually in a quiet room by native speaker experimenters. Before the testing began, the children were asked to name each of the animals that are involved in the sentences. If they gave an incorrect name for a certain animal, the experimenter corrected it. Then, they were asked to

enact the sentences on a stage using whichever animals(s) they needed. After each sentence was enacted, the animals were placed off the stage back to their initial place, making sure that children had easy access to all of the toys. All enactments were routinely praised. All the sessions were videotaped for later coding.

2.4. Coding

Enactments of the fully specified sentences (transitive verbs in 2-NP frames and intransitive verbs in 1-NP frames) were coded for correctness. Only those children who enacted at least 80% of these sentences correctly are included in the final analyses.

Enactments of the ungrammatical or underspecified sentences were coded as Frame Compliant, Verb Compliant, or Other. For intransitive verbs in 2-NP frames, enactments were coded as Frame Compliant (FC) if they were *causative.* In this case, the first NP acted as the agent of the second NP's action/motion. Enactments were coded as Verb Compliant (VC) if they were *noncausative,* where the first NP and the second NP acted or moved independently. For Transitive verbs in 1-NP frames, enactments were coded as Frame Compliant if they were *noncausative.* In these enactments, the mentioned NP moved by itself. On the other hand, they were coded as Verb Compliant if the enactment was *causative,* in which the mentioned NP acted as the agent of the introduced second NP.

Enactments were coded as *other* for the wrong movement, animals, wrong agent-patient relation, or no movement at all. These "Other" enactments comprised fewer than 10% of the total.

3. Results
3.1 Intransitive verbs in 2-NP frames

The children's enactments of the intransitive verbs in 2-NP frames are presented in Figure 1. As the Figure shows, not only did English learners perform more Frame Compliantly overall but they also showed the latest shift to Verb Compliance. On the other hand, Turkish learners performed much less Frame Compliantly overall, showing increases in Verb Compliance enactments beginning at age 3. Mandarin learners enacted less Frame Compliantly than the English learners but more Frame Compliantly than the Turkish learners. As seen in Figure 1, Mandarin learners displayed the least change in their enactment types across the 2 to 5 year age range

The children's percentages of Frame Compliant enactments were compared via a 2-way ANOVA (Age X Language). The results found main effects of Language [$F(2, 204) = 67.36$, $p < .001$] and Age [$F(3, 204) = 4.20$, $p < .01$]. A marginally significant Language by Age interaction was also obtained [$F(6, 204) = 2.00$, $p = .067$]. As the Figure shows, the English learners were clearly

the most Frame Compliant and the Turkish learners the least; moreover, the younger children were more Frame Compliant than the older children.

To explore the differences across the three languages for each age group, one-way ANOVAs were conducted. Our findings revealed that the English 2-year-old learners differed significantly from both the Mandarin and Turkish 2-year-old learners [$F(2, 49) = 8.78, p < .001$]. For the other age groups, all language groups differed significantly from each other (3- year-olds: $F(2, 59) = 30.28, p < .0001$, 4-year-olds: $F(2, 56) = 32.57, p < .0001$, and 5-year-olds: $F(2, 40) = 11.88, p < .0001$).
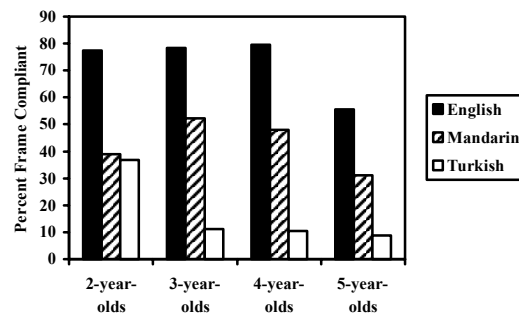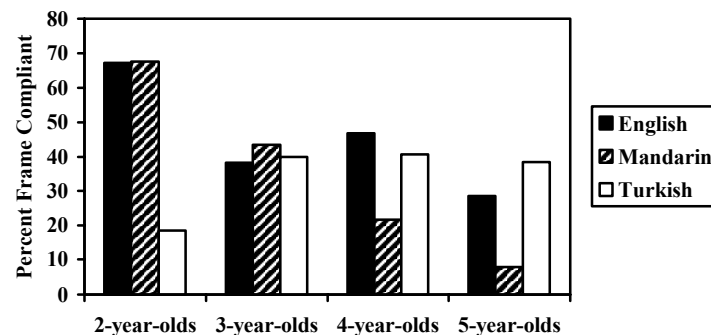

Figure 1. Percent of Frame Compliant enactments of intransitive verbs in 2-NP frames (NVN or NNV) by language (English, Mandarin Chinese, and Turkish) and by age (2- to 5-year-olds).

Finally, a regression analysis was performed to compare the *pattern of change* in Frame Compliant enactments across the 2-5 year span for the three languages. This analysis found significant differences in the intercepts for the three languages [$F (2, 204) = 5.19, p < 0.01$], but no significant difference in the slopes [$F(2, 204) = 0.91$, n.s.]. In other words, initial levels of FC enactments were significantly different across the three languages, while the rate of decrease in FC enactments across the three languages was not significantly different. Hence the pattern of change in FC enactments across the 2-5 year span for the three languages is the same, though each language group starts out at a different level.

3.2. Transitive verbs in 1-NP frames

The children's enactments of the transitive verbs in 1-NP frames are summarized in Figure 2. Their percentages of FC enactments were compared via a 2-way ANOVA (Age X Language). The results found a main effect of Age [$F(3, 203) = 5.32, p < .01$] and a significant Language by Age interaction [$F(6, 203) = 5.72, p < .0001$]. As the Figure shows, the older children were again less Frame Compliant than the younger children; moreover, this effect of age was more pronounced in some languages than in others.

One-way ANOVAs across languages within each age group were again conducted. The results showed that within the 2-year-olds, the Turkish learners differed significantly from both English and Mandarin learners [$F(2, 48)$ = 15.34, p < .0001]. Within both the 4- and 5-year-olds, only the Mandarin learners differed significantly from the English learners [$F(2, 56)$ = 3.18, p = .049] and [$F(2, 40)$ = 3.66, p = .034, respectively]. No significant differences were found for the 3-year-old learners.

Figure 2. Percent of Frame Compliant enactments of transitive verbs in 1-NP frames (NV) by language (English, Mandarin Chinese, and Turkish) and by age (2- to 5-year-olds).

A regression analysis was again performed to compare the pattern of change for the three languages. Once again, we found significant differences in the intercepts for the three languages [$F (2, 203)$ = 12.70, p <0.001]; moreover, a significant difference in the slopes was also obtained [$F(2, 203)$ = 13.45, p <0.0001.]. Hence, initial levels of FC enactments *and* the rate of decrease in FC enactments were significantly different across the three languages. In other words, the pattern of change across 2 -5 age span is different for the three languages.

The findings demonstrate that the Mandarin learners were Frame Compliant at age 2, but their Verb Compliant enactments increased with each age. Although English learners' Verb Compliance also increased with age, their rate of increase was smaller than the Mandarin learners (see Figure 2). Last, Turkish learners performed the most Verb Compliantly overall, showing little change in enactment pattern across the age groups.

4. Discussion

The current study compared children's acquisition of VAS in three different languages, English, Mandarin, and Turkish, investigating language-specific and language-general effects on children's patterns of development. The results

supported our overall hypothesis, that learning VAS is influenced by language-specific properties. Turkish and Mandarin learners displayed earlier Verb Compliance, as well as a faster rate of change to VC, than English learners with the 1-NP frame while only their overall rate of VC was different for the 2-NP frame. In other words, the effect of frame seemed to be less strong in Turkish and Mandarin learners at each age tested than their English-learning counterparts. What are the potential reasons for such earlier Verb Compliance in Turkish and Mandarin compared to English?

The role of ellipsis

We had hypothesized that the frequent use of ellipsis in Turkish and Mandarin would influence children's pattern of acquisition of VAS, but we were not sure whether the influence would be facilitative or inhibitory. Given that a facilitative effect was found, in that earlier and more robust VC was found for Turkish and Mandarin enactors of the transitive verbs in 1-NP frames, how might frequent ellipsis account for this? . Children learning Turkish and Mandarin hear transitive verbs in a variety of frames, both 1-NP and 2-NP (Küntay & Slobin, 2002; Lee & Naigles, 2005). One possibility is that this actual *variety* of frames -while keeping intentions constant- helps the child learn that the verb, rather than the frame, is the more stable indicator of meaning. For example, hearing both *Anne kediyi getiriyor* 'the mother cat-ACC brings' AND *Anne getiriyor* 'the mother brings' (in Turkish) or *Ma1ma dai4* mao1 'Mother brings cat' AND *Ma1ma dai4* 'Mother brings' (in Mandarin) might help to focus the child's attention on the fact that *bring* always involves an agent acting on a patient, i.e., two arguments. Our findings, then, could be viewed as the first empirical support of Küntay and Slobin's proposal that 'variation sets' with stable verbs and varying argument frames facilitate children's acquisition of language.

Of course, English input also provides child learners with what Naigles and Hoff-Ginsberg (1995, 1998; see also Naigles & Swensen, in press) called 'multiple frames' and Levin (1993) termed 'verb alternation patterns' (see also Gleitman, 1990) That is, English learners hear 'John drops the ball' and 'the ball drops'. Full discussion of why and how English 'multiple frames' and Turkish and Mandarin 'variation sets' might be treated differently by child learners is beyond the scope of this paper; however, we point here to two possibilities. First, quantitative comparison might reveal that the sheer amount of frame variation is greater in languages like Turkish and Mandarin when compared with languages like English. Second, a critical difference between the two notions is that within variation sets, the meanings and intentions of the speaker—and so the utterances—are constant whereas within multiple frames or verb alternation patterns, the meanings change with the frame changes. Further investigations are needed to determine how children realize the constancy vs. change in meaning. What is clear from our study is that this realization is not completely obvious from the beginning of language use,, as our youngest children frequently did treat frame changes as meaning changes (i.e., were Frame Compliant).

The role of word order

We also hypothesized that the different degrees of flexibility of word order across the three languages would influence the shift to VC. Again, though, we did not know if the influence would be facilitative or inhibitory. Flexibility of word order seems to be facilitative, as the children learning Turkish and Mandarin demonstrated significantly earlier and more robust Verb Compliance with the 2-NP frame than the children learning English. However, just how word order flexibility translates into earlier Verb Compliance may differ for the two languages. The canonical word order of Turkish (SOV) seems to provide children with multiple ways to interpret 2-NP sentences, especially when case markers are absent: NNV sentences with transitive verbs (*zebra kedi getirsin* 'zebra cat bring') were enacted causatively (*the zebra moved the cat somewhere*) whereas NNV sentences with intransitive verbs (*zebra kedi gelsin*) were enacted noncausatively *(the zebra and the cat moved somewhere)*. In Turkish, the noncausative interpretation appears reasonable for the NNV frame, because the sentence might simply lack the connection word *ile* 'with'. The SOV order that was used in our study, then, allowed a Turkish-specific interpretation for NNV sentences. Future studies are needed, of course, to compare Turkish learners' interpretations of the NNV vs. NVN 2-NP frames with intransitive verbs.

In contrast, the earlier and more robust Verb Compliance of the Mandarin learners may be attributed to the presence of post-verbal NPs that indicate the action's goal/ground (*Go* store/*qu4* shang1dian4). Thus, our Mandarin 2-NP sentences with intransitive verbs (*Ban1ma3 qu4 xiao3mao1/the zebra goes the cat*) were generally interpreted as *the zebra goes TO the cat.* Following again the notion of variation sets, it is possible that hearing intransitive verbs both with and without such ground NPs thus facilitates Mandarin Chinese children's learning that intransitive verbs only require one argument.

In conclusion, the findings from both frames in three different languages promote the notion that children's acquisition of VAS is facilitated by a *diversity* of grammatical features in the input, rather than by highly frequent presentations of a single grammatical cue.

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