On-line Processing of Passives in L1 and L2 Children

Theodoros Marinis
University of Reading

1. Introduction

Research on first language (L1) acquisition has shown that typically developing children acquire a large part of morpho-syntax by the age of 4 (Guasti, 2002). Similarly, studies investigating how children process morpho-syntactic information have revealed that by the same age, their processing routines do not differ from those used by adults (Clahsen & Felser, 2006). However, there is one structure that seems to be problematic for L1 children even at a later age. Until the age of 6, L1 children make errors in the comprehension and production of passives.

In contrast to the substantial literature on L1 acquisition, relatively few studies have investigated the acquisition of morpho-syntax in children acquiring a second language (L2). These have shown that at an early stage of development, L2 children show evidence of transfer from their L1 to the L2 (Haznedar, 1997; Unsworth, 2005), and their language abilities resemble those of children with Specific Language Impairment (SLI) (Paradis, 2005). Finally, there is a controversy as to whether or not L2 children follow similar patterns of development to L1 children or L2 adults (Schwartz, 2006; Weerman, Bisschop, & Punt, 2003).

The present paper addresses the issues above by investigating the acquisition and processing of passives in monolingual English children and Turkish-English L2 children using a novel on-line methodology. This can reveal not only how successfully children comprehend passives, but also whether or not they are able to make use of morphological cues when they process actives and passives in real-time.

1.1 Acquisition of Passives

Studies on the acquisition of passives have shown that English monolingual children make errors in the comprehension and production of passives until the age of 6 years, and some sentence types seem to be more difficult than others. Maratsos et al. (1985) found that 4-5 year-old children have more difficulties in the comprehension and production of *non-actional passives* (e.g. with the verbs *see, hear*) than with *actional passives* (e.g. with the verbs *comb, touch*), and Horgan (1978) showed that monolingual English children comprehend and produce full passives (passives that include the *by*-phrase, e.g., *The zebra was kissed by the camel*) later than short passives lacking the *by*-phrase (e.g., *The tree is broken*). Interestingly, Horgan's study also showed that early passives (e.g., *The tree is broken*) represent after-the-fact observations about states, i.e. they describe a state and not an event (e.g. *The tree is broken* is interpreted similarly to *The tree is green*).

The difference between adjectival and verbal passives was further explored by Borer and Wexler (1987) who argued that the children's errors are caused by an immature grammatical system. Verbal passives (e.g., *The zebra was kissed by the camel*) involve movement and A-chains, whereas adjectival passives are base generated, and do not involve movement. According to Borer & Wexler, young children cannot comprehend and produce verbal passives because they are unable to form A-chains, and thus, they cannot assign the thematic role to the moved constituent. In contrast, they do not make errors with adjectival passives because these do not involve movement and A-chains. Borer & Wexler suggested that the formation of A-chains is subject to maturation, and the mechanism responsible for the formation of A-chains does not mature until at least the age of 5 to 6 years.

Borer & Wexler's account and the findings from earlier research have been challenged by Pinker, Lebeaux & Frost (1987) who showed that in spontaneous speech 3-year-old English children produce

 Proceedings of the 2nd Conference on Generative Approaches to Language Acquisition North America (GALANA), ed. Alyona Belikova et al., 265-276. Somerville, MA: Cascadilla Proceedings Project.

passive sentences with an eventive interpretation that is usually associated with verbal passives. In addition, using elicitation and act-out tasks, they found that 4-year-old English children were able to produce and comprehend passive sentences involving novel actional and non-actional verbs, but they often failed to produce the *by*-phrase. Children's difficulties to comprehend the *by*-phrase in passives was also shown in a study by Fox & Grodzinsky (1998). However, Fox & Grodzinsky's study revealed that this is not due to the *by*-phrase *per se*, but due to a combination of non-actional passives with a *by*-phrase, showing that children have difficulties with thematic-role transmission. In contrast to Borer & Wexler, Fox & Grodzinsky argued that young children's difficulties in interpreting sentences of this type is not due to the lack of maturation of A-chains, but due to processing limitations. They suggested that thematic role transmission increases the processing load beyond the children's capacity, and causes a break-down in the comprehension of passives.

More recently, Stromswold (2004) investigated how preschool (3;1-4;8) and school-aged (4;9-7;4) children and adults process actives and passives in real-time using eye-tracking in a sentence-picture matching task. Participants saw two pictures next to each other on a computer screen and heard an active or passive sentence. In each picture there was a boy and a girl or a man and a woman performing an action. The sentence matched to one of the two pictures. Results showed that all participants were more accurate in the picture-matching task in actives as opposed to passives, and in all groups reaction times (RTs) for correct trials were longer for passives compared to actives. Analyses of the eye-movements revealed that in passives, adults decided which picture matched the sentence at the past participle. In contrast, children looked at the matching picture only after the end of the sentence. Stromswold concluded that children and adults process passives in different ways: adults make use of acoustic, morphological, and semantic cues and decide that a sentence is passive on-line, i.e. at the past participle. On the other hand, children do not seem to make use of these cues, but assume that the first NP is the agent and decide that a sentence is passive off-line, i.e. after the end of the sentence. However, the delay observed in children's decision could be due to the task used in this study. In a sentence-picture matching task with two pictures, participants have to scan the pictures and identify how they differ from each other. In this particular sentence-picture matching task, the two pictures were very similar to each other. This may have impacted the time needed to scan the pictures and observe differences between them. In addition, the sentences used in this experiment were presented in normal speed, were relatively short, and the final phrase in actives was the object and in passives the *by*-phrase. Given that children process sentences at a slower rate than adults and speed increases with age (Felser, Marinis, & Clahsen, 2003; Marinis & van der Lely, in press), it is possible that the children in this study did not process the participle until the end of the sentence because they were over the board slower and not because they were not able to use acoustic, morphological, and semantic cues. To avoid these confounding factors, children in the present study encountered only one picture, and sentences were presented in a self-paced listening task. This reduces the processing load, and allows us to study how children process a sentence phrase-by-phrase.

1.2 On-line Processing of Passives

Studies in the comprehension of passives by adults using off-line and on-line tasks have revealed that in normal adults and adults with Broca's aphasia, actives are easier to comprehend than passives (Caramazza & Zurif, 1976; Townsend & Bever, 2001). Recently, Ferreira (2003) compared the processing of actives and passives using biased reversible (*The dog bit the man*), non-reversible (*The mouse ate the cheese*) and reversible-symmetrical (*The woman visited the man*) sentences, and also manipulated plausibility (*The dog bit the man* vs. *The man bit the dog*). Participants had to listen to the sentences and after the end of the sentence they had to identify as fast as possible the thematic roles of the sentence (e.g., who is the do-er?). This study showed that adults misinterpreted passives frequently

and systematically, especially when they expressed implausible ideas. For the present study, the most relevant results are the ones from the reversible-symmetrical sentences, as this is the type of sentences used. In this condition, participants in Ferreira's study were more accurate in actives (93%) than passives (82%). In addition, RTs to actives were significantly shorter - 1899 ms - than to passives - 2156 milliseconds, reflecting that passives have greater processing load than actives.

However, a study by Rohde & Gibson (2003) investigating how adults process actives and passives involving relative clauses using a word-by-word self-paced reading task showed that it is not the case that all types of sentences involving passives are more difficult to process than actives. RTs in passives involving subject-extraction (*The reporter that was attacked by the senator ignored the president*) were shorter than in active sentences of the same type (*The reporter that attacked the senator ignored the president*), suggesting that actives are not across the board easier to process than passives.

1.3 Processing in Second Language Acquisition Research

To date, the majority of L2 research has focused on how adult L2 learners acquire grammar using off-line tasks. This has given rise to theoretical debates about the nature of L2 grammars, as to whether L2 grammars follow the same developmental stages as L1 grammars, and ultimately as to whether L2 learners have access to Universal Grammar. The bulk of this research has used off-line grammaticality judgments, elicitation and comprehension tasks, and has shown that the grammar of adult L2 learners differs from that of native speakers in systematic ways, even when adult L2 learners have near-native proficiency in their L2 (Hawkins, 2001; White, 2003). However, it is not clear whether this is because of lack of grammatical knowledge or due to the strategies adult L2 learners use to process sentences.

Recent studies of sentence processing by L2 adults using on-line methodologies (Marinis, 2003) have revealed systematic quantitative and qualitative differences between L2 adults, L1 adults, and L1 children. First, adult L2 learners process sentences more slowly than native speakers (Hahne, 2001; Hahne & Friederici, 2001; Marinis, Roberts, Felser, & Clahsen, 2005). Second, adult L2 learners seem not to be using all types of information available to L1 learners. Although they seem to be able to use lexical-semantic cues when they process sentences on-line, several studies have revealed qualitative differences compared to both L1 adults and L1 children in the processing of syntactic information (Clahsen & Felser, 2006; Felser, Roberts, Gross, & Marinis, 2003; Juffs, 1998; Marinis, Roberts, Felser, & Clahsen, 2005; Papadopoulou & Clahsen, 2003). These differences could result from shallow processing (Clahsen & Felser, 2006) and/or the use of simple processing heuristics (Ferreira, 2003) reflecting difficulties accessing syntactic information in the L2, which is argued to be subject to a critical period (Hawkins & Chen, 1997; Meisel, 1997; Tsimpli, 1997). A way to address the source of these differences is by investigating language acquisition and processing in L2 children.

1.4 Child Second Language Acquisition

In contrast to the substantial literature on adult L2 acquisition, relatively few studies have investigated how children acquire a second language. These have shown that at an early stage of development, L2 children similarly to L2 adults show transfer effects from their L1 to the L2 (Gavruseva, 1998; Haznedar, 1997; Unsworth, 2005; Whong-Barr & Schwartz, 2002). However, despite their difficulties with inflectional morphology, L2 children seem to acquire the syntactic apparatus of their L2 (Haznedar, 2001, 2003a, 2003b). Finally, there is a debate as to whether L2 children follow similar patterns of development to L1 children or L2 adults (Gavruseva, 2002; Haznedar & Schwartz, 1997; Schwartz, 2006; Unsworth, 2005; Weerman, Bisschop, & Punt, 2003). According to Weerman, Bisschop, & Punt (2003) L2 children show a similar pattern of development to

L1 children. However, Schwartz (2006) argues that this may hold only for morphology, but not for syntax.

A further set of studies has compared the language abilities of L2 children with those of children with SLI. Two studies by Paradis & Crago (2000; , 2003) showed that English children acquiring French as L2 exhibit similar types of errors in marking finiteness and tense, in subject-verb agreement and in the use of clitics to those of French children with SLI. In addition, studies comparing children acquiring Swedish as L2 to Swedish children with SLI revealed similar error types in word-order (Hakansson & Nettelbladt, 1993, 1996). Finally, in a recent study of child L2 learners of English, Paradis (2005) reported that L2 children show similar error patterns and accuracy rates to English children with SLI in the production of a wide range of grammatical morphemes.

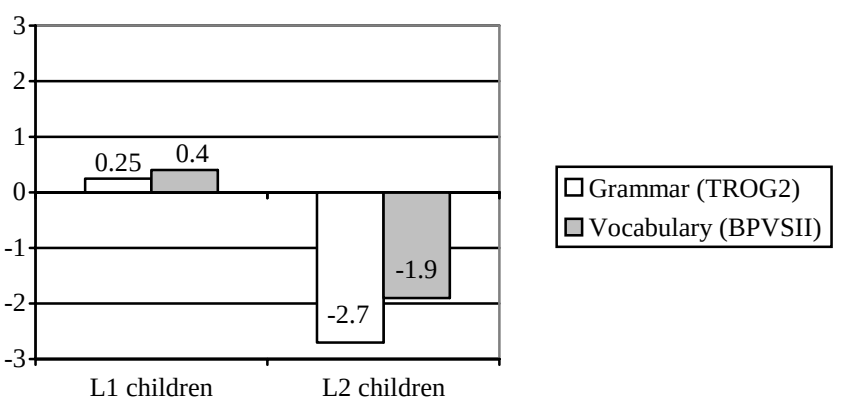
All previous studies on child L2 have either used naturalistic data or off-line tasks. To date there are no studies on how L2 children process sentences in real-time. This paper aims to fill this gap by investigating how L2 children process actives and passives in real-time.

2. Method

2.1 Participants

30 6;9 to 8;9 year old monolingual English children and 28 6;10 to 8;8 year-old Turkish children with English as an Additional Language participated in this study. Monolingual English children were randomly selected from schools in London and Sussex, and Turkish-English children were selected from mainstream schools in London. L2 children spoke Turkish at home, and started having systematic exposure to English when they went to nursery/school (at 3-to-4 years). L1 and L2 children had no history in speech and/or language impairment. The Test of Reception of Grammar 2 (TROG2) (Bishop, 2003) and the British Picture Vocabulary Scale (BPVS II) (Dunn, Dunn, Whetton, & Burley, 1997) were administered in both groups of children as baseline tests in order to ensure that the monolingual children had language abilities within the normal range, and also to assess the comprehension of grammar and single-word vocabulary of the L2 children. Figure 1 shows z-scores for these tasks for the two groups.

Figure 1: Comprehension of Grammar and Vocabulary in L1 and L2 children



Monolingual children performed within the normal range in both tasks. In contrast, L2 children scored more than 2 standard deviations (SD) below the mean in TROG2 and almost 2 SD below the

mean in BPVSII. This pattern resembles the pattern of children with SLI, and is in line with previous research comparing language abilities of L2 children and children with SLI (Paradis, 2005).

2.2 Design and material

This study used a novel task that combines *picture-verification* and *self-paced listening* (Ferreira et al., 1996), and is a modified version of the task used in Marinis & van der Lely (2005). Children sat in front of a laptop and a fixed set of instructions was given, first by the experimenter, and then through the headphones. The children first saw a picture on the computer screen for 2500ms. Then they listened to a sentence in a segment-by-segment fashion by pressing a button while the picture remained on the computer screen.

Children were told that they have to press the button as quickly as possible in order to listen to the next segment. The end of each sentence was indicated by a beep sound. Children were taught how to press the button to hear the sentences and were given 10 practice sentences to familiarise themselves with the task. The practice sentences could be repeated for a second time if the children or the experimenter felt that more practice was needed. E-prime was used to present the stimuli and to record RTs from the onset of each segment until the button press.

The material for this task comprised 10 practice sentences, 40 experimental, and 20 filler sentences. The sentences were recorded by three female native speakers of English at a normal speaking rate in the sound booth of our department, and were subsequently analysed using Adobe Audition. Four different experimental sets were created, each containing one version of the experimental sentences. Each participant encountered 10 sentences of each condition and was presented with only one of the four conditions of each item.

The experimental sentences were reversible active and full passives, in which both the agent and the patient/theme were animals. 10 monosyllabic verbs with a regular participle form were used, and each verb was used four times throughout the experiment. The pictures either matched the event of the sentence or they showed the event with the agent and patient reversed. This makes a total of four experimental conditions (active-match, active-mismatch, passive-match, passive-mismatch), as shown in (1) to (4) below.

(1) I think / that / the zebra / was kissing / the camel / at the zoo / last Monday.(matching picture)

(2) I think / that / the camel / was kissing / the zebra / at the zoo / last Monday.(non-matching picture)

(3) I think / that / the camel / was kissed / by the zebra / at the zoo / last Monday.(matching picture)

(4) I think / that / the zebra / was kissed / by the camel / at the zoo / last Monday.(non-matching picture)

The rationale underlying this task is that increased RTs to a particular segment indicate a processing difficulty at this point in the sentence. Mismatch between the picture and the sentence should cause increased RTs, indicating a processing difficulty. The sentences were ambiguous as to whether they match/mismatch the picture until the participle (kissing/kissed), which was always in the fourth segment - the first critical segment in this task. To successfully comprehend actives/passives, children had to process the morphological cue (-ing/-ed), and (re)assign thematic roles. The fifth segment provided an additional cue for passives - the preposition *by*. Therefore, this is the second critical segment in this experiment.

To ensure that the participants made an active effort to comprehend the stimulus sentences, at the end of the sentence children judged whether the sentence matched the picture. This was recorded by the

tester on a separate form, and gave an additional off-line accuracy measure of comprehension. Children did not receive feedback as to whether or not they answered the comprehension question accurately. For half of the experimental sentences and fillers, the picture matched to the sentence and for the other half it did not. The experiment was carried out in the children's school and lasted approximately 30 minutes.

3. Results

3.1 Analyses of Accuracy

Prior to the analysis of the reaction times, the data were analysed for the accuracy in the off-line comprehension question. Table 1 shows the accuracy of the two groups in the 4 conditions.

Table 1. Off-line accuracy data in percentage (standard deviation).

Conditions	L1 children	L2 children
Active-match	94.6 (4.2)	93.9 (7.4)
Active-mismatch	85.6 (15)	77.5 (16.9)
Passive-match	92.7 (7.7)	87.9 (14.2)
Passive mismatch	82.8 (12.7)	62.5 (30)

A repeated measures ANOVA with the factors Group (L1, L2), Sentence Type (active, passive) and Matching (match, mismatch) showed a main effect of Group ($F(1, 56) = 13.010$, $p = .001$) reflecting better accuracy in L1 compared to L2 children. There was a main effect of Sentence Type ($F(1, 56) = 22.109$, $p < .001$) reflecting better accuracy in actives compared to passives, and a main effect of Matching ($F(1, 56) = 33.170$, $p < .001$) reflecting better performance in matched compared to mismatched sentences. An interaction was found between Group x Sentence Type ($F(1, 56) = 8.660$, $p < .01$). Independent samples t-tests revealed that this was due to a highly significant difference between the two groups in passives ($t(56) = 3.984$, $p < .001$) in contrast to actives, in which the difference was only approaching significance ($t(56) = 1.989$, $p = .05$). In addition, there was a significant interaction between Group x Matching ($F(1, 56) = 4.736$, $p < .05$). Independent samples t-tests revealed that this was due to a significant difference between the two groups in the mismatch conditions ($t(56) = 3.064$, $p < .01$) in contrast to the matching condition, in which there was no significant difference between the two groups ($p > .1$). Inaccurate responses were eliminated prior to the analyses of RTs.

3.2 Analyses of Reaction Times

Each segment was analysed separately in a repeated measures ANOVA with the factors Group (L1, L2), Sentence Type (active, passive) and Matching (match, mismatch). This paper will focus on Segments 4 and 5, the two critical segments of this experiment.

Figure 1 shows the mean RTs per group for the accurate responses of the Segment 4 that included the participle (*was kissing/was kissed*). The repeated measures ANOVA showed a main effect of Group ($F(1, 55) = 7.699$, $p < .01$) reflecting longer RTs in the L2 group compared to the L1 group. There was also a main effect of Matching ($F(1, 55) = 4.684$, $p < .001$) reflecting longer RTs in the Mismatch compared to the Match condition. The analysis showed no other significant main effects or interactions.

Figure 1. On-line RTs data in milliseconds – Segment 4 (*was kissing/was kissed*)

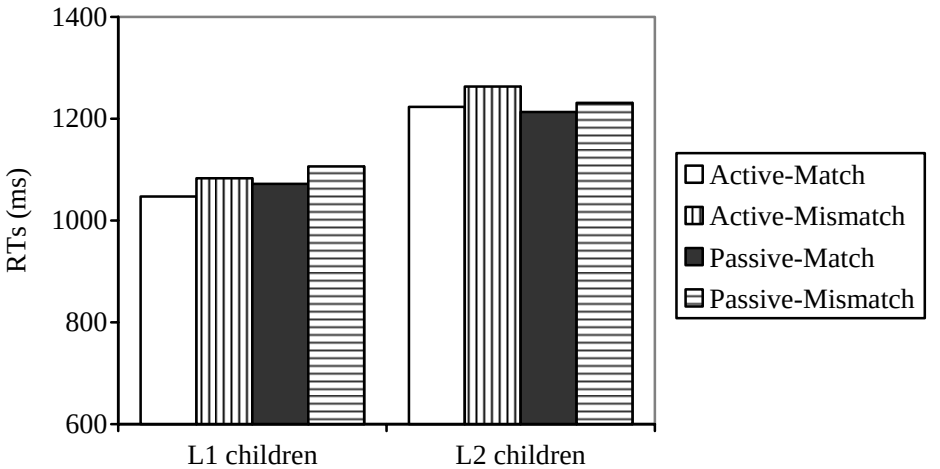
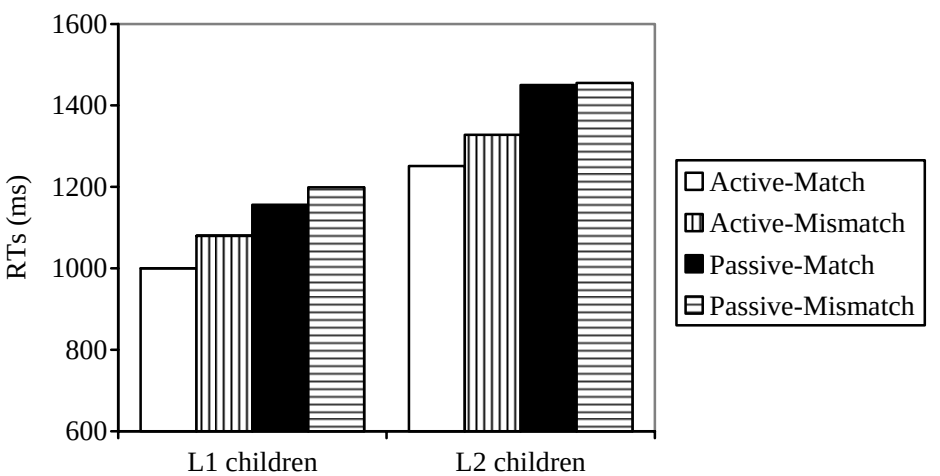


Figure 2 shows the mean RTs per group for the accurate responses of the second critical segment involving the *by*-phrase (*the camel/by the camel*).

Figure 2. On-line RTs data in milliseconds – Segment 2 (*the camel/by the camel*)



The repeated measures ANOVA showed a main effect of Group ($F(1, 55) = 17.855$, $p < .001$) reflecting longer RTs in the L2 group compared to the L1 group. There was a main effect of Sentence Type ($F(1, 55) = 53.994$, $p < .001$) reflecting longer RTs in passives that included an additional word (*by the camel*) compared to actives (*the camel*), and a marginally significant main effect of Matching ($F(1, 55) = 3.893$, $p = .054$) reflecting longer RTs for the Mismatch compared to Match condition. The analysis showed no significant interactions.

4. Discussion

This study investigated comprehension of grammar and vocabulary in L1 and L2 children and how they process actives and passives in real-time. In the comprehension of grammar and vocabulary, L1 children were within the normal range; in contrast, L2 children were almost two standard deviations below the mean in the comprehension of vocabulary, and more than 2.5 standard deviations in the comprehension of grammar, a pattern that resembles the pattern attested in children with SLI.

Results from the on-line task showed that L1 children were more accurate in the comprehension of passives than L2 children, which is not surprising given that they scored more than 2.5 standard deviations below the mean in the standardised assessment for the comprehension of grammar. Accuracy in actives was overall better than in passives, and accuracy in sentences that matched the picture was better than in the mismatch conditions. However, in terms of off-line accuracy the two groups did not follow exactly the same pattern. In actives, L1 children performed only numerically better than L2 children, but in passives L1 children had a highly significant advantage compared to L2 children. In addition, the two groups did not differ when the sentence matched the picture, but L2 children performed significantly worse than L1 children in the mismatch conditions.

RTs data in the critical segments showed only quantitative, but no qualitative differences between L1 and L2 children. Overall L2 children had longer RTs than L1 children, but both groups showed the same pattern. At the segment including the participle (*was kissing/was kissed*), which provides a morphological cue (*-ing*/*-ed*) for an active or passive structure, RTs in the mismatch condition were longer than in the matching condition. This was independent from sentence type, i.e. the effect appeared in both actives and passives. This shows that both groups of children were capable of using morphological cues (*–ing*/*-ed*) to process actives and passives and to assign thematic roles.

At the next segment (*the camel/by the camel*), L2 children had again longer RTs than L1 children, but similarly to the previous segment, both groups showed the same pattern. RTs in passives were longer than in actives, which is not surprising given that passives have an additional word that has to be processed (*by*). RTs in the mismatch conditions were also longer than in matching conditions, and this difference was approaching significance. Given that this effect is weaker than in the previous segment, this could be a spill-over effect from the previous segment.

Summarising, although L2 children had a very poor performance in the standardised tasks measuring the comprehension of grammar and vocabulary, and their accuracy in the comprehension of passives was lower than in L1 children, they did not show qualitative differences in the way they process active and passive structures. RTs showed that both L1 and L2 children were capable of using morphological cues (*–ing*/*-ed*) to process actives and passives and (re)assign thematic roles.

4.1 On-line processing of passives and assignment of thematic roles

This study showed that both L1 and L2 children were able to use morphological cues (*-ing*/*-ed*) to process active and passive structures. This was evident from the elevated RTs when the sentences did not match the pictures. This shows that in a task, in which children see a picture representing an event and then they listen to a sentence describing the event, they make an initial assignment of thematic roles very early in the sentence, after listening to the subject of the sentence, and before encountering the verb. For example, when the picture showed a zebra kissing a camel, and they listened to the sentence *I think / that / the zebra / was kissed / by the camel / at the zoo / last Monday*, the actor in the picture is the first NP in the sentence. We hypothesise that after listening to the segment *the zebra*, children made an initial assignment of the thematic role Agent to the first NP of the sentence, and were expecting an active structure. Then, when they encountered *was kissed*, they had to make a re-analysis, and assign the thematic role Patient/Theme to *the zebra*. This caused elevated RTs at this segment in the mismatch

condition compared to the matching condition. This seemed to hold also in the opposite scenario when they saw the same picture and they listened to the sentence *I think / that / the camel / was kissing / the zebra / at the zoo / last Monday.* Here, the actor in the picture is the object of the sentence. In this condition, we hypothesise that after listening to the first NP *the camel*, children made an initial assignment of the thematic role Patient/Theme to the first NP based on the action in the picture and expected a passive structure. Then, when they encountered the segment *was kissing*, they had to make a re-analysis, and assign the thematic role Agent to that NP. Again, evidence for this is provided by elevated RTs at this segment in the mismatch condition as opposed to the matching condition.

Similar results have been reported in on-line sentence processing studies by adults. For example, Altmann and Kamide (1999) and Kamide, Altmann, & Haywood (2003) showed that adults integrate rapidly syntactic and semantic information, which enables partial processing of the forthcoming words even before these are encountered. The results from the present study show that 6 to 8 year old L1 and L2 school children are capable of rapid integration and very early thematic role assignment even before the verb has been encountered. Thus, when children encountered the verb, and did not match their expectations, and the thematic role assigned to the first NP, they made a reanalysis which was reflected in the longer RTs in the mismatch conditions.

This is a novel result for sentence processing in both L1 and L2 children, and contradicts Stromswold's (2004) findings. How can the findings in these two studies be explained?

Firstly, there is only partial overlap in the age of the school-children participating in the two studies (Stromswold's study: 4;9 to 7;4, present study: 6;9 to 8;9). It is possible that Stromswold's results reflect an earlier developmental stage.

A second possible explanation for this difference could relate to the differences in the two tasks. The present task used only one picture that was presented on the computer screen 2500ms prior to the sentence, and remained on the computer screen during the auditory presentation of the sentence. Children had sufficient time to scan the picture, make a mental representation of the scene, and develop expectations about the sentence. Then they listened to the sentence phrase-by-phrase in a self-paced fashion. This means that they were pressing the button as fast as possible, but at a pace that was suitable for them to comprehend the sentence. In Stromswold's study, participants had to scan two similar pictures on a computer screen in order to identify differences between the two, they listened to the sentences in normal speed and not phrase-by-phrase, and the sentences were shorter than in the present study – the final phrase in actives was the object and in passives the *by*-phrase. The children in Stromswold's study may not have used morphological cues on-line not because they were not capable of using them, but because the task was much more demanding than the task in the present study in terms of processing of both visual and auditory information.

4.2 Implications for child L2 acquisition and processing

The results from the L1 children cannot address the debate regarding the acquisition of passives in L1 acquisition (Borer & Wexler, 1987; Fox & Grodzinsky, 1998) because the children were older than 5 years old. However, the data from the L2 children can address the debate regarding the development of morpho-syntax in L2 children (Schwartz, 2006; Weerman, Bisschop, & Punt, 2003). Weerman et al.'s account predicts that L2 children should show a similar pattern of development to L1 children, whereas Schwartz's account predicts that L2 children should show a similar development to L1 children in terms of the development of morphology, but their development of syntax should resemble the pattern attested in L2 adults.

The task used in the present study involves the use of morphological cues for the assignment of thematic roles and reanalysis. RT data revealed that L2 children do not differ from L1 children of the same age. Both groups were able to use morphological cues for reanalysis in order to reassign thematic

roles when the sentence did not match to the picture. Given that the present task tested the processing of morphological cues that feed into syntax, the results from this study are compatible with both accounts.

Studies on sentence processing in adult L2 learners have shown quantitative and qualitative differences between L2 adults, L1 adults, and L1 children (Felser & Roberts, 2007; Felser, Roberts, Gross, & Marinis, 2003; Roberts, Marinis, Felser, & Clahsen, in press). This could result from shallow processing (Clahsen & Felser, 2006) and/or the use of simple processing heuristics (Ferreira, 2003) reflecting difficulties accessing syntactic information subject to a critical period (Hawkins & Chen, 1997; Meisel, 1997; Tsimpli, 1997). Results from the present study reveal only quantitative, but no qualitative differences between L1 and L2 children. L2 children showed overall longer RTs compared to L1 children, but the same pattern in terms of RTs. Thus, it seems that their parser is only slower, but does not differ from children acquiring English from birth. However, although their RTs provide evidence for the use of morphological cues, L2 children were less accurate in the off-line comprehension of passives compared to L1 children, and the accuracy rate in the L2 children for the passive-mismatch condition was relatively low (62.5%). How can this error rate in off-line comprehension be explained if L2 children are capable of using morphological cues, reassign thematic roles, and use the same parser with L1 children?

Although it is not possible to give a firm answer to this question based on this study, this result could be explained through Townsend and Bever's (2001) and Ferreira's (2003) model that include both algorithmic computations, and heuristic processing. Given that overall grammatical abilities in L2 children are well below average as measured in a standardised assessment, they may rely more on simple heuristics and world knowledge than L1 children, and this could explain the higher rate of errors in the mismatch condition.

5. Conclusion

This paper investigated comprehension of grammar and vocabulary in L1 and L2 children, and the processing of actives and passives in real-time. Although L2 children performed in the standardised tasks similarly to children with SLI, results from the on-line task showed that they are capable of using morphological cues to process actives and passives, and (re)assign thematic roles. This shows that in terms of morpho-syntax, L2 children develop similarly to L1 children. Finally, the results of this study show that on-line tasks provide a more accurate window into L2 children's knowledge of grammar than off-line measures standardised on monolingual populations.

Acknowledgements

Many thanks to Peter Hudspith for drawing the pictures, Olivia Berry, Jodi Hookins, and Katy Mueller for recording the sentences, Christos Pliatsikas and Emine Topal for the data collection, and the children and schools for their participation. The costs for the pictures, and the data collection were covered by the Research Endowment Trust Fund from the University of Reading (E3097100).

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Proceedings of the 2nd Conference on Generative Approaches to Language Acquisition North America (GALANA)

edited by Alyona Belikova,
Luisa Meroni, and Mari Umeda

Cascadilla Proceedings Project Somerville, MA 2007

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ISBN 978-1-57473-419-5 library binding

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Marinis, Theodoros. 2007. On-line Processing of Passives in L1 and L2 Children. In *Proceedings of the 2nd Conference on Generative Approaches to Language Acquisition North America (GALANA)*, ed. Alyona Belikova, Luisa Meroni, and Mari Umeda, 265-276. Somerville, MA: Cascadilla Proceedings Project. www.lingref.com, document #1567.