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Parsing the Passive: Comparing Children With Specific Language Impairment to Sequential Bilingual Children

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Twenty-five monolingual (L1) children with specific language impairment (SLI), 32 sequential bilingual (L2) children, and 29 L1 controls completed the Test of Active & Passive Sentences-Revised (van der Lely 1996) and the Self-Paced Listening Task with Picture Verification for actives and passives (Marinis 2007). These revealed important between-group differences in both tasks. The children with SLI showed difficulties in both actives and passives when they had to reanalyse thematic roles on-line. Their error pattern provided evidence for working memory limitations. The L2 children showed difficulties only in passives both on-line and off-line. We suggest that these relate to the complex syntactic algorithm in passives and reflect an earlier developmental stage due to reduced exposure to the L2. The results are discussed in relation to theories of SLI and can be best accommodated within accounts proposing that difficulties in the comprehension of passives stem from processing limitations.

1. INTRODUCTION

Child language acquisition research has traditionally focused on comparisons between children along one dimension: for example, within the dimension of typical development (TD), comparing monolingual to bilingual children; or within the dimension of language impairment, comparing children with hearing impairment to children with specific language impairment (SLI). More recently, several studies have compared children across two dimensions, for example, sequential bilingual (L2) children to children with SLI, and have found striking similarities in the pattern of these two groups (Paradis 2010). This is surprising because language difficulties in these two groups have a different etiology: language impairment in children with SLI, and reduced exposure to the second language in the L2 children. This raises several questions: Do the two groups have a similar underlying grammatical system despite the different etiology of their language difficulties? Does the similarity hold across different language tasks? Do the two groups have difficulties in the same production/comprehension processes? The present study addresses these questions by comparing the comprehension of passives in children with SLI to L2 and L1 children using on-line and off-line comprehension tasks. Comparison between L2 children and children with SLI allows us to understand whether passives develop uniformly across learners and also whether

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they are processed similarly across the two groups of children. This can address the mechanisms behind language development and language breakdown. Moreover, comparison between on-line and off-line comprehension tasks allows us to pin down the source of the breakdown because they tap into different processes of the sentence comprehension system.

2. PASSIVES IN TYPICALLY DEVELOPING CHILDREN AND CHILDREN WITH SLI

A picture of an event, as shown in Figure 1, can be described at least in two ways, with a sentence in the active voice (hereafter active), as in (1), or in the passive voice (hereafter passive), as in (2).

(1) The zebra was kissing the camel.
(2) The camel was kissed by the zebra.

The actives and passives in (3) and (4) do not match the picture in Figure 1, but correspond to the reversed event.

(3) The camel was kissing the zebra.
(4) The zebra was kissed by the camel.

The crucial information that indicates that there is a mismatch between the picture and the sentences is provided by morphosyntactic cues, the grammatical morphemes *–ing*/*-ed* and the preposition *by.* Therefore, being able to process these cues is crucial for the accurate comprehension of the sentences.

English has a Subject-Verb-Object word order and actives are more frequent than passives. In actives, there is a canonical relationship between grammatical and thematic roles—the thematic role of the agent is mapped onto the subject and the patient role is mapped onto the object. In passives, this relationship is reversed—the patient role is mapped onto the structural subject and the agent is expressed through the by-phrase. According to derivational analyses, passives

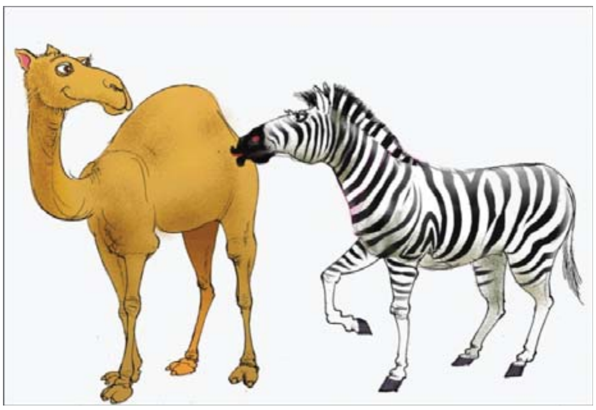

FIGURE 1 Picture of an event (color figure available online).

derive from actives through movement (Chomsky 1981; Borer & Wexler 1987; Baker, Johnson, & Roberts 1989).[1]

How does the noncanonical relationship between grammatical and thematic roles and movement affect how we process passives? Ferreira (2003) provides a very good comparison between the syntactic algorithm used when people process passives compared to actives. In actives, as in (1), when the parser encounters the first NP (*zebra*), it assumes that this is the subject of the sentence and assigns provisionally the thematic role of the agent. By encountering the verb, the progressive morphology (*-ing*) is in line with the first NP being the agent, so the thematic role of the agent is transmitted to the subject. When the second NP (*camel*) is encountered, it is incorporated in the syntactic structure as the object and the parser transmits to it the thematic role of the patient. Parsing of passives, as in (2), is more complex. As in actives, when the first NP (*camel*) is encountered, the parser assumes that this is the subject of the sentence and assigns the thematic role of the agent. When the verb is encountered, the past participle morphology (*-ed*) indicates that this is a passive, and as a result, the parser has to make a reanalysis; the thematic role of the first NP has to be changed from agent to patient. In addition to the reanalysis, a trace has to be inserted and a chain between the trace and the subject has to be established. Upon encountering the *by*-phrase, the thematic role of the agent has to be transmitted to the NP in the *by*-phrase. However, *by* is an ambiguous preposition, as it can also assign a thematic role expressing location (*the camel was kissed by the lake*). Based on the properties of the NP, the parser can give an agentive or locative interpretation to the *by*-phrase. Thus, processing of passives requires processing of morphosyntactic cues of the verb, reanalysis of thematic roles, establishment of chains, and disambiguating the preposition *by.* Therefore, processing of passives is more complex than processing of actives.

A large number of studies have shown that English passives are late acquired[2]; children until the age of 5 or 6 years have difficulties comprehending particular types of passives (Ud Deen 2011). Long passives (passives with a "by-phrase"), as in (2), are acquired later than short passives (passives without a "by-phrase"), as in (5) (Horgan 1978). Verbal passives (passives that have an eventive interpretation), as in (5), are also more difficult than adjectival passives (passives that are ambiguous between an eventive and a stative interpretation), as in (6) (Horgan 1978).

(5) The camel was kissed.
(6) The tree was broken.

These data led Borer & Wexler (1987) to argue that difficulties with passives are caused by an immature grammatical system, with young children being unable to form A(rgument)-chains that result from the movement of the object to the subject position. Therefore, young children interpret passive sentences as actives.[3]

A group of children that shows persistent misinterpretations of passives is children who have language impairment but whose nonverbal abilities are within the norms, that is, children with

[1] For alternative analyses of passives that do not involve movement, see Langacker (1991).

[2] Cf. O'Brien et al. (2006) and Crain et al. (2009).

[3] See Wexler (2004) for a version of this account within the minimalist framework. A slightly different hypothesis was formulated by Fox & Grodzinsky (1998), according to which children have difficulties with passives because they lack the ability to transmit the external theta role to the agent in the by-phrase.

SLI (Leonard 1998). Two groups of theories have been proposed to account for the nature of the children's language deficits. One group argues that SLI is caused by a deficit in linguistic representation (Rice & Wexler 1996; van der Lely 1998), whereas another group argues that SLI is caused by processing limitations, including phonological memory and working memory deficits, that affect the children's verbal and nonverbal abilities (Joanisse & Seidenberg 1998; Leonard 1998; Montgomery 2002).

The Representational Deficit for Dependent Relations (RDDR) hypothesis (van der Lely 1996a) proposes that children with SLI have difficulties comprehending passives because of a deficit in the computational system; as a result, movement operations are optional. van der Lely argues that children with SLI are sensitive to the morphological differences between actives and passives, but they have underspecified syntactic representations and difficulties establishing A-chains. This entails that they may be able to parse the morphosyntactic cues for passives (*-ed, by*) but they may not be able to integrate these cues into the syntactic representation and assign thematic roles. This predicts a high error rate in the comprehension of passives and difficulties with thematic role assignment leading to reversal errors in long passives and adjectival interpretation of short passives. If movement operations are optional, this predicts chance performance. Partial evidence for the RDDR hypothesis was provided by van der Lely (1996a) in a study with 9- to 12-year-old children with SLI and control groups of TD children of similar language abilities. van der Lely used the Test for Active and Passive Sentences (TAPS; van der Lely 1996b), one of the tasks used in the present study. In line with the RDDR, the children with SLI were less accurate in the comprehension of passives than the TD children, showing more reversal errors than the TD children in long passives, and their predominant error type in long and short passives was providing an adjectival interpretation. However, there was no Group by Sentence Type interaction, which implies no qualitative differences between TD children and children with SLI. Moreover, the children with SLI did not perform at chance.

The TAPS was also used by Norbury et al. (2002) with 7- to 10- and 11- to 13-year-old children with SLI along with age and language control groups and a group of children with mild to moderate hearing loss. The younger children with SLI showed a similar pattern to the van der Lely study, but the older children with SLI did not differ from the language controls.[4] In addition, correlations were found between the children's performance on passives and scores on phonological short-term memory. Norbury et al. suggested that the children's difficulties were less severe than those predicted by the RDDR and the error pattern was similar to the pattern of TD children. Therefore, they proposed that the children's difficulties could be better explained due to processing limitations.

Processing limitations have also been put forward as a cause for the children's deficits within the Surface Account (SA; Leonard 1998). The SA proposes that processing capacity limitations affect the acquisition of grammatical morphemes that have brief duration, and as a result low phonetic saliency, due to the children's limitations in speed of processing. Passives involve processing of the auxiliary *be* and the past participle (*-ed*), both of which are brief in duration and have been argued to have low phonetic saliency (Leonard, Wong, Deevy, Stokes & Fletcher 2006); long passives also involve the preposition *by*, which is a weak syllable and is rarely lengthened.

[4]Effects of age were also found in Rice, Wexler & Francois (2001) and suggest that with increasing age comprehension difficulties of passives may resolve.

This predicts that children with SLI may omit these morphemes in their production. This was borne out in Leonard et al. (2003) and Leonard et al. (2006); see also Redmond (2003). In terms of comprehension, the SA predicts that children with SLI will have difficulties processing these grammatical morphemes in real-time. This prediction has not yet been tested, and will be tested in the present study.[5]

Montgomery and colleagues (Montgomery 2002; Montgomery & Evans 2009) have also proposed that the difficulties in the comprehension of passives in children with SLI stem from processing limitations, but instead of attributing the cause of the difficulties to the short duration and low phonetic saliency of grammatical morphemes, they suggested that children with SLI have difficulties in the comprehension of passives because passives are complex structures and require significant working memory resources that exceed the resources available to children with SLI. This hypothesis predicts a correlation between the children's performance on passives and their working memory scores. Montgomery & Evans (2009) provided evidence for this hypothesis in a group of 6- to 12-year-old children with SLI, and age and language controls. However, the correlation was between working memory scores and the children's performance in complex sentences including passives, but also sentences with pronouns and reflexives. The three sentence types were not analyzed separately; therefore, it is unclear whether the correlation was attributed to the passives. This hypothesis is tested in the present study. Finally, Montgomery & Evans's hypothesis predicts that children with SLI will show lower accuracy in long compared to short passives because long passives require assignment of an additional thematic role and include the ambiguous *by* phrase. Therefore, they require more processing resources than short passives. This prediction is also tested in the present study.

The profile of children with SLI shows similarities to the profile of TD sequential bilingual children (hereafter L2 children) who have limited exposure to the L2, for example, in the production of English tense morphology (Marinis & Chondrogianni 2010; Paradis 2010); see also Chondrogianni & Marinis (2012) for the processing of tense morphemes in real-time. Both groups show omission of the tense-marking morphemes *–ed* and third singular *–s*. These similarities are puzzling because language difficulties in these two groups have a different etiology, as mentioned earlier. To date only one study has investigated the comprehension of passives in L2 children (Marinis 2007). Marinis (2007) used the on-line task used in the present study and investigated whether Turkish–English children are capable of using morphosyntactic cues when they process actives and long passives in real-time; a further aim was to identify whether or not they differ from monolingual (L1) age-matched controls in the accuracy of comprehension of passives. L2 children were less accurate than L1 children in the comprehension of long passives, but they were able to make use of morphosyntactic cues in real-time. However, the off-line part of the study by Marinis (2007) consisted of picture verification. Therefore, it was not possible to ascertain how children interpreted passives when they made comprehension errors. In addition, the study did not include children with SLI. Since the task used in Marinis (2007) differs in many ways from the tasks used in previous studies in children with SLI, it is difficult to compare the pattern of performance of L2 children and children with SLI.

The present study compares directly how children with SLI, L2 children and L1 controls perform in passives by using the on-line comprehension task used in Marinis (2007) and the off-line

[5] A similar prediction for the processing of tense morphemes was borne out by Montgomery & Leonard (1998, 2006).

picture selection task used in van der Lely (1996a) and Norbury et al. (2002) in the same groups of children. Off-line picture selection tasks, such as the TAPS, involve a number of different processes. Participants have to process the sentence on-line, store it in working memory, process pictures that usually show similar events, identify their differences, and finally choose which picture matches the sentence. Such tasks measure comprehension after the end of the sentence and involve postinterpretative processes that are associated with the use of extracted meaning to accomplish other tasks (e.g., picture selection; Shapiro, Swinney & Borsky 1998; Caplan & Waters 1999). When participants show low accuracy in such a task, this could result from difficulties in parsing the sentence, working memory limitations, attention deficits that may not allow the participants to process the differences between the pictures, or a combination of some of these factors. On-line sentence processing tasks, on the other hand, measure how participants parse specific types of information in real-time, such as lexical or morphosyntactic information, how they build up the syntactic representation and assign thematic roles; see Shapiro et al. (1998) and Marinis (2010) for a discussion about differences between off-line and on-line tasks. In passives, on-line sentence processing tasks can reveal whether or not participants are capable of parsing morphosyntactic cues (*-ed*, and *by*) and reanalyzing thematic roles before the end of the sentence. Therefore, they are not contaminated by postinterpretative processes.

3. THE PRESENT STUDY

This is the first study to investigate how children with SLI comprehend passives using a combination of off-line and on-line tasks and providing a direct comparison to L2 TD children and L1 control children. The aim of this study is to uncover the source of difficulties children with SLI and L2 children face when they comprehend passives. Breakdown in the comprehension of passives can result from difficulties in one or more than one of the processes involved in the comprehension of passives: (1) processing of morphosyntactic cues of the verb, (2) reanalysis of the thematic role of the first NP, (3) thematic role transmission to the *by*-phrase, and (4) postinterpretative processes that take place at the end of the sentence. The on-line task will measure how children process sentences in real-time that relate to the first three processes. The off-line task will measure the children's comprehension accuracy at the end of the sentence. The error pattern of the off-line task will provide further information about the way children interpret passives. Finally, comparing the results on passives with the children's performance on tasks measuring nonverbal abilities, comprehension of grammar, vocabulary, and working memory will show how the comprehension of passives relates to the children's verbal and nonverbal abilities.

The results of this study have important implications for SLI theories. The RDDR predicts that children with SLI will be able to process morphosyntactic cues on-line for actives but not for passives; they should also have difficulties with thematic role assignment in passives because of optionality in movement and chain formation. This should lead to chance performance. The predominant error should be reversal of thematic roles and an adjectival interpretation. The SA predicts, similarly to the RDDR, that children with SLI will have difficulties processing morphosyntactic cues for passives on-line, but for different reasons. According to the SA, the cause of this difficulty is the low phonetic saliency of the grammatical morphemes involved in passives and the children's processing limitations. Finally, Montgomery & Evans's (2009) hypothesis predicts that children with SLI will be able to process morphosyntactic cues on-line for both actives and passives, but their working memory limitations should affect postinterpretative processes and lead to low off-line comprehension. In addition, off-line comprehension of passives should correlate with their working memory abilities.

Comparison between children with SLI and L2 children can show whether or not the similarities attested so far reflect difficulties in the same comprehension processes. Since L2 children have had less exposure to English than L1 children of the same age and their language skills in English, as measured by standardised assessments of grammar and vocabulary, are below monolingual norms, their language profile may resemble the profile of younger L1 children. Given that passives are late acquired, this predicts a higher error rate in off-line comprehension than in L1 controls. A lower level of grammar and vocabulary may also lead to difficulties in the processing of passives due to the higher complexity of the syntactic algorithm. The comparison between children with SLI and L2 children can shed light into the children's underlying grammatical system and reveal whether the profile of children with SLI is unique to this group or whether it is shared by typically developing children who have late onset and limited language exposure. At the practical level knowing what differentiates L2 children from children with SLI can aid accurate diagnosis of SLI in bilingual populations.

The L2 children in the present study have Turkish as their L1 and English as their L2. The properties of passives are very similar in the two languages. Passives in Turkish are very infrequent. Turkish is an SOV language and passives involve topicalization of the object which becomes the subject of the sentence. In addition, a passive suffix is used with the verb (Göskel & Kerslake 2005). Thus, in both languages passives are infrequent; they involve movement and noncanonical order of thematic roles. As a result, difficulties in passives in L2 children who have Turkish as their L1 cannot be the result of transferring properties of passives from Turkish to English.[6]

4. METHODOLOGY

4.1. Participants

Eighty-six children completed the off-line and on-line tasks on the comprehension of passives: 25 L1 English-speaking children with SLI (hereafter children with SLI), 32 L2 Turkish-English-speaking children (hereafter L2 children), and 29 L1 TD English-speaking children (hereafter L1 controls).

The L1 control children were recruited from schools in Reading. The L2 children were recruited from the Turkish community in London. All L2 children were growing up in families with Turkish spoken in the home. Systematic exposure to English started at the nursery. A parental and child questionnaire (Chondrogianni & Marinis 2011) showed that the L2 children had a mean age of onset (AoO) of 3 years (*Mean* = 38.78 months, *SD* =5 months, range =29–60 months) and a mean length of exposure to English of 4 years (*Mean* = 52.7 months, *SD* = 16 months, range = 21–80 months). None of the L2 children and L1 controls had a history of speech and/or language delay or impairment based on parental report and information from the schools and the L2 children's parents were not concerned about their language development in Turkish.

[6]In fact, if the L2 children have acquired passives in Turkish, this could facilitate their performance in English. Given that we did not test the L2 children in Turkish, this issue remains open for future research.

The children with SLI were recruited from speech and language therapy resources in mainstream schools. All children were clinically diagnosed with language impairment and were receiving remediation at the time of testing. Their status was confirmed using a battery of baseline tasks that assessed the children's nonverbal and verbal abilities.[7] Raven's colored matrices (Raven, Court & Raven 2008) were used to measure the children's nonverbal abilities. The language tasks included the Test of Reception of Grammar 2 (Bishop 2003), the British Picture Vocabulary Scales II (Dunn, Dunn, Whetton & Burley 1997), Sentence Recall from the Clinical Evaluation of Language Fundamentals 3 (Semel, Wiig & Secord 1995), the Rice/Wexler Test of Early Grammatical Impairment (Rice & Wexler 2001), the Children's Test of Non-Word Repetition (Gathercole & Baddeley 1996), and Listening Recall that tests the children's working memory (WM; Pickering & Gathercole 2001).

Exclusion criteria for all groups were performance below one standard deviation on the Raven's colored matrices and a history in hearing impairment, frank neurological impairment, psycho-emotional disturbance, and diagnosis of autism. One L1 control child and one child with SLI scored below one standard deviation on the Raven's colored matrices and were, therefore, excluded from the study. Inclusion criteria for the children with SLI consisted of a clinical diagnosis of language impairment and performance of at least one standard deviation below the mean in one or more language assessments. One child who was clinically diagnosed with SLI performed within the norms in all language assessments. This could indicate that the language impairment has been resolved. Therefore, the data of this child were not included in the analyses. The remaining 83 children were matched on chronological age between the three groups. Each group had a mean chronological age of 7 years (L2 children: *Mean* = 91.5 months, *SD* = 14 months, range= 57–116; L1 controls: *Mean* = 88.7 months, *SD* = 10 months, range = 72–107; children with SLI: *Mean* = 84.3 months, *SD* = 10 months, range = 69–103; $F(2, 82) = 2.55$, $p > 0.05$; $\eta^2 = 0.06$).[8]

4.2. Experimental Tasks

The experimental tasks comprised the revised TAPS-R (van der Lely 1996b) and the Self-Paced Listening and Picture Verification task for actives and passives (SPL-AP; Marinis 2007).

The TAPS-R is an off-line picture selection task assessing the comprehension of reversible actives and passives. It consists of four sentence types (12 per condition): (1) actives (*the man is eating the fish*), (2) long passives (*the fish is eaten by the man*), (3) short progressive passives (*the fish is being eaten*), and (4) short ambiguous passives that are compatible with a verbal or an adjectival interpretation (*the fish is eaten*). Each sentence is presented together with four pictures, each representing a possible interpretation: (1) transitive interpretation (man eating fish), (2) reversal (fish eating man), (3) adjectival (stative) interpretation (a fish bone on a plate), and (4) semantic distracter (skeleton of a man). For actives, long passives, and short progressive passives, the correct picture is the one with the transitive interpretation. For short ambiguous passives, both the transitive and adjectival interpretations are correct. The sentences are presented in a randomized order. The verbs used in TAPS-R are the same as in TAPS, but most pictures and

[7] These were administered to all children.

[8] η^2 (eta-squared) estimates the effect size in the sample. According to Cohen (1992), 0.1 is a small effect, 0.25 is a medium effect, and 0.4 is a large effect.

TABLE 1
Experimental Conditions

Condition	*Segment 1*	*Segment 2*	*Segment 3*	*Segment 4*	*Segment 5*	*Segment 6*	*Segment 7*
Active-match	I think	that	the zebra	was kissing	the camel	at the zoo	last Monday
Active-mismatch	I think	that	the camel	was kissing	the zebra	at the zoo	last Monday
Passive-match	I think	that	the camel	was kissed	by the zebra	at the zoo	last Monday
Passive-mismatch	I think	that	the zebra	was kissed	by the camel	at the zoo	last Monday

characters are new. Therefore, results on the TAPS-R may differ slightly from results on the TAPS.

The SPL-AP is a phrase-by-phrase self-paced listening task that addresses on-line and off-line comprehension of actives and passives. It consists of 10 practice sentences, 40 experimental sentences and 20 filler sentences. All experimental sentences are reversible. All verbs are monosyllabic and have a regular past participle form. Each sentence is presented together with a picture that either matches the event of the sentence or it shows 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 Table 1.[9]

All four conditions were presented with the same picture, in this example the picture in Figure 1. The sentences were recorded by three female native speakers of English at a normal speaking rate in a sound-isolating booth and were analyzed using Adobe Audition. Four different lists 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 and saw each picture only once.

The sentences were ambiguous as to whether they match/mismatch the picture until the progressive/past participle (*kissing*/*kissed*), which was the first critical segment and provided the morphological cue (*-ing*/*-ed*) for match/mismatch with the picture. This was always the fourth segment of the sentence. The second critical segment for the passives was the *by*-phrase because it provided an additional cue for the passives; this was always the fifth segment.

To ensure that the participants made an active effort to comprehend the sentences, at the end of each sentence children judged whether the sentence matched the picture. This was recorded by the tester on a scoring form, and gave an off-line accuracy measure of comprehension. Children did not receive feedback for accuracy. For half of the sentences, the picture matched the sentence and for the other half it did not match. The position of the pictures was counterbalanced.

4.3. Rationale of the SPL-AP and Predictions

The rationale underlying the SPL-AP task is that children will develop some expectations about the sentence when they see the picture. When the sentence does not match the picture, this should lead to reanalysis of the initial expectation at the time window when they process the cues for reanalysis. The cue for reanalysis in actives is provided by the *-ing* morpheme; in passives, the

[9]The full materials for this task are available through the IRIS digital depository (http://www.iris-database.org) and the website of the University of Reading (http://www.personal.reading.ac.uk/~lls05tm/).

cues are provided by the *-ed* morpheme and the preposition *by*. Reanalysis is costly and should cause elevated RTs when participants process these cues. Therefore, elevated RTs at the offset of these morphemes in the mismatch conditions (Segments 4 and 5) will provide evidence that participants processed these grammatical morphemes and started the reanalysis process. Difficulties processing these cues should lead to lack of elevated RTs in the mismatch condition. Completion of the reanalysis should lead to similar RTs in the matching and mismatch condition in Segment 6. If the RTs in the mismatch conditions continue to be elevated in Segment 6, this will indicate that the reanalysis has not been completed.

The RDDR predicts that children with SLI will be able parse the cues for actives and passives, but they will have difficulties integrating them into the syntactic representation and assign thematic roles in passives. This predicts elevated RTs in Segments 4 and 5 in the mismatch conditions only for actives. Moreover, optionality should lead to chance level performance in the accuracy of passives, but accuracy in actives should be intact. The SA makes the same predictions, that is, elevated RTs in Segments 4 and 5 in the mismatch conditions for actives, but not for passives, but for different reasons. Lack of elevated RTs in passives should be caused by their inability to parse the morphosyntactic cues for passives because they have low phonetic saliency. Finally, Montgomery & Evans's (2009) hypothesis predicts that children with SLI will be able to parse cues for actives and passives and show elevated RTs in the mismatch conditions. However, reanalysis may extend to Segment 6 in both actives and passives because of slower speed of processing and limited working memory resources. Limited working memory resources should also lead to low accuracy in both actives and passives because working memory affects post-interpretative processes.

4.4. Procedure and Scoring

The children completed the two tasks in two separate sessions in a quiet room in the school. TAPS-R was always presented after the SPL+PV-AP because being an off-line comprehension task it may involve using meta-linguistic abilities and could contaminate the SPL-AP.

Administration of TAPS-R followed the test manual. The pictures were presented on a laptop in order to follow a similar presentation with the SPL-AP. Scoring of actives, long passives, and short progressive passives followed the manual. Ambiguous passives were scored as accurate with both a transitive and adjectival interpretation. This differs from the manual and scoring sheet that calculates only the transitive interpretation.

In the SPL-AP task, children sat in front of a laptop and an E-prime button box and listened to the sentences via headphones. A fixed set of instructions was given first orally and then through headphones. In each trial, children first saw a picture on the computer screen for 2500ms and then listened to a sentence segment-by-segment by pressing a button on the button box while the picture remained on the computer screen. Children were told that they have to press the button as quickly as possible to hear the whole sentence. The end of each sentence was indicated by a beep sound. Children were taught how to press the button and were given 10 practice sentences to familiarize 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 Reaction Times (RTs) from the onset of each segment until the button press. Residual RTs were calculated by subtracting the length of each segment from the raw RTs.

5. RESULTS

5.1. Baseline Tasks

Figure 2 illustrates the children's performance on their nonverbal abilities (Raven's), grammatical abilities (TROG-2), vocabulary abilities (BPVS-II), and WM (Listening Recall).

The three groups did not differ from each other on their nonverbal abilities ($F(2, 82) = 1.48$, $p > 0.1$), but they differed on grammar ($F(2, 82) = 21.51$, $p < 0.001$), vocabulary ($F(2, 80) = 57.39$, $p < 0.001$), and WM ($F(2, 76) = 14.14$, $p < 0.001$). On both grammar and vocabulary, L2 children and children with SLI were less accurate than L1 controls (L2 children vs. L1 controls: grammar, $p < 0.01$, vocabulary, $p < 0.001$; children with SLI vs. L1 controls: grammar and vocabulary, $p < 0.001$). Children with SLI were less accurate than L2 children on grammar ($p = 0.001$), but the opposite pattern was attested for vocabulary ($p < 0.001$). On the WM task, children with SLI were less accurate than both L2 children ($p < 0.01$) and L1 controls ($p < 0.001$) who did not differ from each other.

5.2. TAPS-R

Figure 3 shows the raw scores of the children's performance on the TAPS-R. To identify differences between the three groups and the four conditions, a mixed repeated-measures analysis of variance (ANOVA) was used with the factors Group (children with SLI, L2 children, L1 controls)

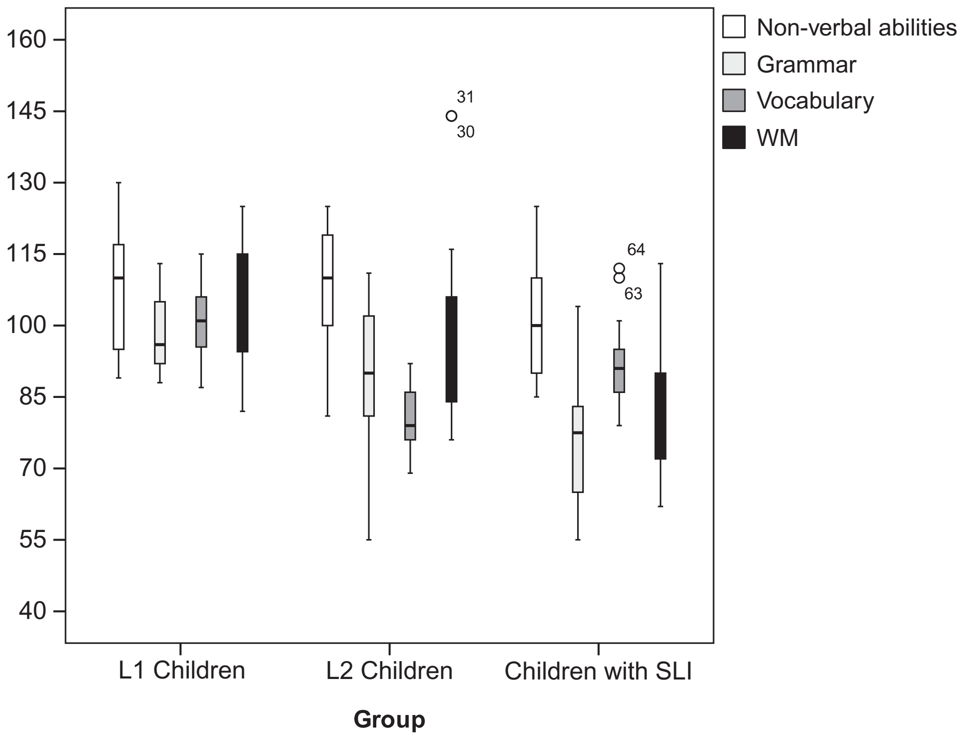

FIGURE 2 Accuracy in the baseline tasks (standard scores).

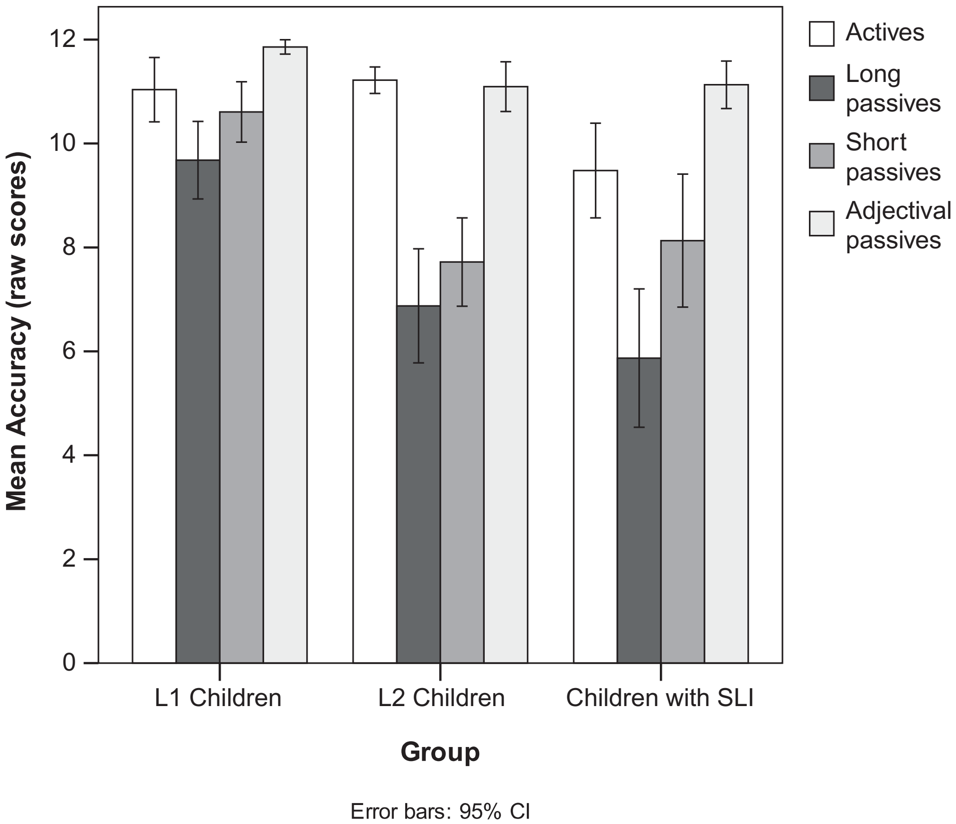

FIGURE 3 Accuracy on the raw scores of the TAPS–R.

and Sentence Type (Active, Long Passives, Short Passives, Ambiguous Passives). Interactions were followed up using pairwise comparisons with Bonferroni adjustment.

The analysis showed a main effect of Group ($F(2, 80) = 17.25$, $p < 0.001$, $\eta^2 = 0.3$), a main effect of Sentence Type ($F(3, 240) = 87.55$, $p < 0.001$, $\eta^2 = 0.52$), and an interaction between Group and Sentence Type ($F(6, 240) = 8.29$, $p < 0.001$, $\eta^2 = 0.17$). L1 controls performed equally well on Actives and Long and Short Passives and were more accurate in Ambiguous Passives compared to Long and Short Passives ($p < 0.001$; $p = 0.001$). L2 children were also more accurate in Ambiguous Passives than in Long and Short Passives (both $p < 0.001$), but they were also more accurate in Actives compared to Long and Short Passives (both $p < 0.001$). The children with SLI also performed better in Ambiguous Passives than in Long and Short Passives (both $p < 0.001$), and in Actives than in Long Passives ($p < 0.001$), but they showed also a lower performance in Long than in Short Passives ($p < 0.01$). Comparison between the groups in each sentence type showed that in Actives children with SLI were less accurate than both groups of TD children (L1 TD: $p = 0.001$; L2 TD: $p < 0.001$). In Long and Short Passives, children with SLI and L2 children were less accurate than L1 controls ($p \leq 0.001$).

One-sample *t*-tests showed that all groups of children provided a transitive response above chance[10] in all four sentence types (Actives-L1: $t(27) = 25.3$, $p < 0.001$; Actives-L2: $t(31) =$

[10] A conservative rate of 33% (4 out of 12) was counted as chance level since this is a four-choice task but one of the pictures was a semantic distracter.

57.81, $p < 0.001$; Actives-SLI: $t(22) = 12.47$, $p < 0.001$; Long Passives-L1: $t(27) = 15.61$, $p < 0.001$; Long Passives-L2: $t(31) = 5.34$, $p < 0.001$; Long Passives-SLI: $t(22) = 2.91$, $p < 0.01$; Short Passives-L1: $t(27) = 23.32$, $p < 0.001$; Short Passives-L2: $t(31) = 8.92$, $p < 0.001$; Short Passives-SLI: $t(22) = 26.7$, $p < 0.001$; Ambiguous Passives-L1: $t(27) = 5.45$, $p < 0.001$; Ambiguous Passives-L2: $t(31) = 3.17$, $p < 0.01$; Ambiguous Passives-SLI: $t(22) = 3$, $p < 0.01$).

To investigate differences in the children's error pattern, the four error types were analysed for each sentence type separately, as shown in Figure 4. Mixed repeated-measures ANOVAs on the children's raw scores were used with the factors Group (children with SLI, L2 children, L1 controls) and Sentence Type (Active, Long Passive, Short Passive, Ambiguous Passive) for

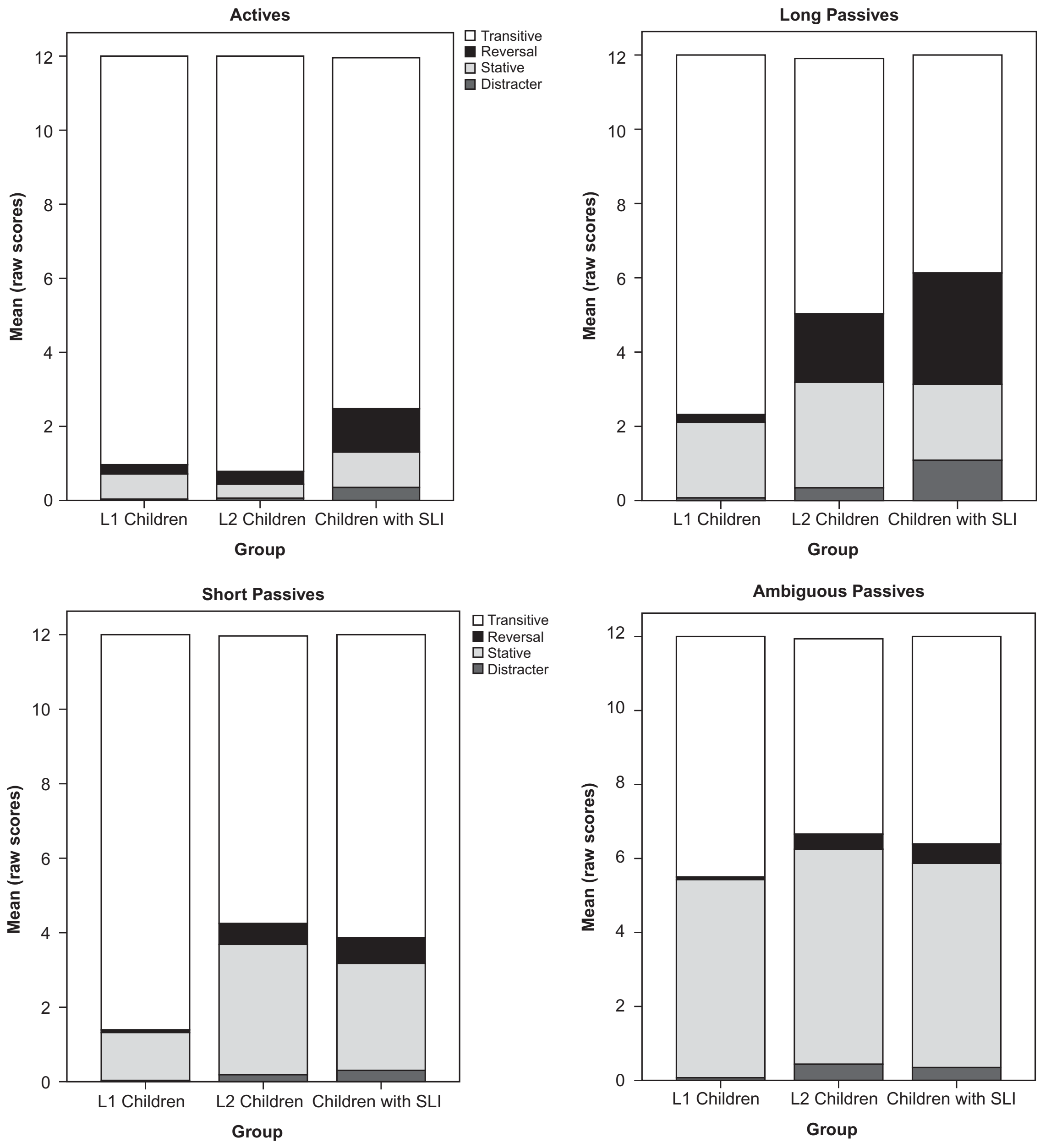

FIGURE 4 Error analysis on the raw scores of the TAPS–R.

each response type separately. Interactions were followed up using pairwise comparisons with Bonferroni adjustment.

The analysis of reversal responses showed a main effect of Group ($F(2, 80) = 15.91$, $p < 0.001$, $\eta^2 = 0.29$), Sentence Type ($F(3, 240) = 35.12$, $p < 0.001$, $\eta^2 = 0.31$), and an interaction between Group and Sentence Type ($F(6, 240) = 9.08$, $p < 0.001$, $\eta^2 = 0.19$), reflecting that the three groups did not use reversal errors in the same way. In Actives, children with SLI made more reversal errors than L2 children and L1 controls ($p < 0.001$). In Long and Short Passives, children with SLI and L2 children made more reversal errors than L1 controls. The numerical difference between children with SLI and L2 children in Long Passives did not reach significance. No between-group difference was attested in Ambiguous Passives. L1 controls made equal number of reversal errors across the four sentence types, but the groups of L2 children and children with SLI made more reversal errors in Long Passives than in Actives ($p < 0.01$), Short Passives (L2 children: $p < 0.01$; children with SLI: $p < 0.001$), and Ambiguous Passives (L2 children: $p = 0.001$; children with SLI: $p < 0.001$).

The analysis of ambiguous responses showed a main effect of Group approaching significance ($F(2, 80) = 3.02$, $p = 0.055$, $\eta^2 = 0.01$), a main effect of Sentence Type ($F(3, 240) = 103.93$, $p < 0.001$, $\eta^2 = 0.57$), and an interaction between Group and Sentence Type ($F(6, 240) = 2.98$, $p < 0.012$, $\eta^2 = 0.07$). This difference was attributed to the children's responses in Short Passives. L2 children and children with SLI made more adjectival responses in Short Passives than L1 controls (L2 vs. L1 controls: $p < 0.001$; children with SLI vs. L1 controls: $p = 0.019$). All three groups made more adjectival responses in Ambiguous Passives than in Actives ($p < 0.001$), Long Passives ($p < 0.001$), and Short Passives (L2 children and children with SLI: $p < 0.01$; L1 controls: $p < 0.001$). However, L2 children and L1 controls also made more adjectival responses in Long Passives than in Actives ($p \leq 0.001$), and L2 children and children with SLI also made more adjectival responses in Short Passives than in Actives (L2 children: $p = 0.001$; children with SLI: $p < 0.01$).

The analysis of distracter responses also showed a main effect of Group ($F(2, 80) = 14.35$, $p = 0.001$, $\eta^2 = 0.26$), Sentence Type ($F(3, 240) = 6.61$, $p = 0.001$, $\eta^2 = 0.076$), and an interaction between Group and Sentence Type ($F(6, 240) = 3.78$, $p < 0.01$, $\eta^2 = 0.086$). This difference was attributed to the children's responses in Long and Ambiguous Passives. In Long Passives, children with SLI chose the semantic distracter more often than L2 children and L1 controls (both: $p < 0.001$). In Ambiguous Passives, L2 children chose the distracter more often than L1 controls ($p < 0.05$). L1 controls chose the distracter equally infrequently in all sentence types, but L2 children chose the distracter more often in Ambiguous Passives than in Actives ($p < 0.01$), whereas children with SI chose the distracter more often in Long than in Short Passives ($p < 0.05$).

5.3. SPL-AP

The SPL-AP provides accuracy in off-line comprehension and also reaction times.

5.3.1. Accuracy Using A-Prime

The accuracy rate in the comprehension questions was conducted using a-prime scores that correct for a potential bias towards a "yes" responses. A-prime scores are calculated on the

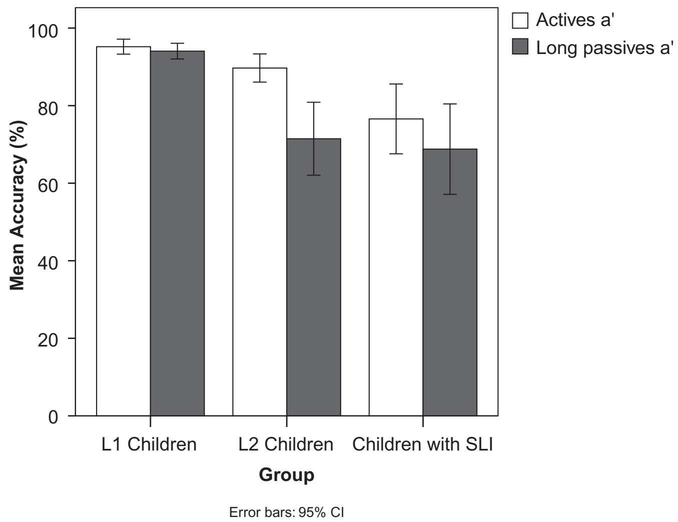

FIGURE 5 Accuracy in the comprehension questions using A-prime scores.

basis of the proportion of hits (correct acceptances) and false alarms (incorrect rejections; Grier 1971).[11] Figure 5 shows the children's accuracy. To identify differences between the three groups and the two sentence types, a mixed repeated-measures ANOVA was used with the factors Group (children with SLI, L2 children, L1 controls) and Sentence Type (Active, Long Passive). Interactions were followed up using pairwise comparisons with Bonferroni adjustment.

The analysis showed a main effect of Group ($F(2, 80) = 15.85$, $p < 0.001$, $\eta^2 = 0.28$), a main effect of Sentence Type ($F(1, 80) = 14.28$, $p < 0.001$, $\eta^2 = 0.15$), and an interaction between Group and Sentence Type ($F(2, 80) = 4.76$, $p = 0.01$, $\eta^2 = 0.11$). Children with SLI and L1 controls performed equally well in Actives and Long Passives, but L2 children showed better performance in Actives than in Long Passives ($p < 0.001$). In Actives, children with SLI were less accurate than L2 children ($p = 0.001$) and L1 controls ($p < 0.001$). In Long Passives, children with SLI and L2 children were less accurate than L1 controls (both: $p < 0.001$). Finally, one-sample *t*-tests showed that all groups of children performed above chance in both actives and passives (L1 children, Actives: $t(27) = 48.08$, $p < 0.001$; L1 children, Passives: $t(27) = 44.64$, $p < 0.001$; L2 children, Actives: $t(31) = 22.27$, $p < 0.001$; L1 children, Passives: $t(31) = 4.66$, $p < 0.001$; children with SLI, Actives: $t(22) = 6.13$, $p < 0.001$; L1 children, Passives: $t(22) = 3.34$, $p < 0.01$). Following standard procedures, trials with inaccurate response were eliminated from further analyses.

5.3.2. Reaction Times

Raw Reaction Times (RTs) of accurate trials were transformed into residual RTs by subtracting the length of the auditory file from the raw RT. Residual RTs were screened for extreme values

[11] False alarms are trials that require a "yes" answer but where the participants provide a "no" response.

and outliers.[12] Extreme values were defined as RTs below –800 ms and above 5,000 ms on the basis of histograms and were eliminated from the dataset. Outliers were defined as RTs above and below 2 standard deviations for each condition separately per subject and item and were replaced with the mean RT for each condition per subject and item. Extreme values and outliers comprised 4.2% of the data (752 out of 17,997 data points).

Figures 6–8 present residual RTs per segment and condition for each group separately. To identify differences between groups, segments, sentence types, and matching, repeated-measures ANOVAs per subject (F1) and item (F2) were conducted for each segment separately with the Factors Group (children with SLI, L2 children, L1 controls), Sentence Type (Active, Long Passive), and Matching (Match, Mismatch).

Segment 1 and 2 are identical in the four conditions. Differences between the groups in those segments can show differences between the groups in speed of processing. Segment 1 revealed only a main effect of Group ($F1(2, 73) = 9.55$, $p < 0.001$, $\eta^2 = 0.21$; $F2(2, 117) = 30.65$, $p < 0.001$, $\eta^2 = 0.34$). L2 children showed shorter RTs than children with SLI (subjects and items: $p < 0.001$), and L1 controls (subjects: $p = 0.01$; items: $p = 0.001$), and children with SLI showed longer RTs than L1 controls in the items analysis ($p < 0.001$). Segment 2 showed also a main effect of Group in the items analysis ($F1(2, 117) = 6.92$, $p = 0.001$, $\eta^2 = 0.11$). L2 children showed shorter RTs than children with SLI ($p < 0.001$).

Segment 3 contains the subject of the sentence that is either the agent (active-match, passive-mismatch) or the theme (active-mismatch, passive-match) in the picture. RTs are expected to be shorter when the subject corresponds to the agent (canonical mapping between grammatical and thematic roles) than when it corresponds to the theme (noncanonical mapping between grammatical and thematic roles). Therefore, analyses were conducted with the factors Group (children

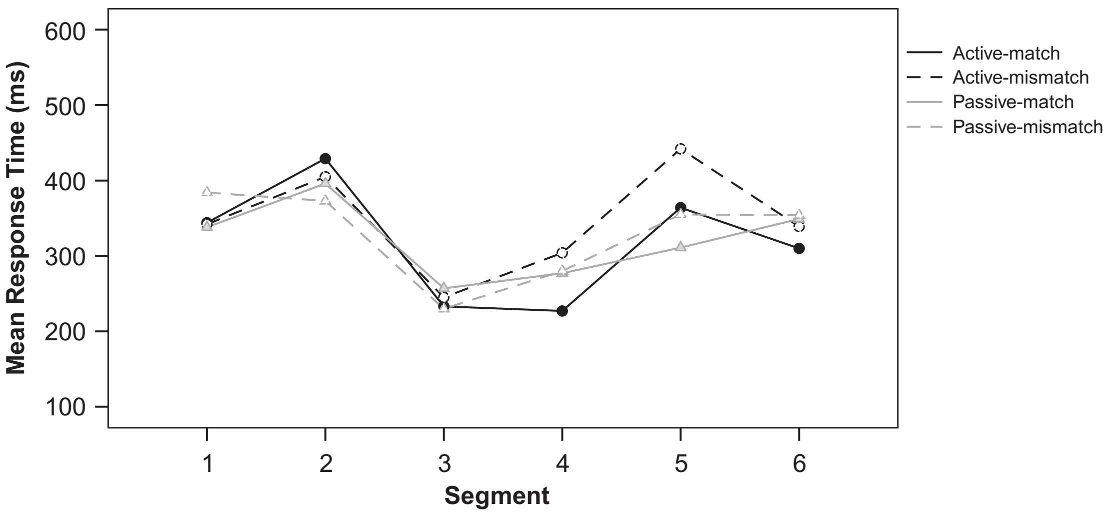

FIGURE 6 Response times per condition in L1 controls (in ms).

[12]Extreme values are extremely long or short RTs and could result from interruption of the trial or pressing the button extremely quickly. Outliers are also considerably longer or shorter RTs than the mean, but are often the end of the tail. See Ratcliff (1993) for the difference between extreme values and outliers in RT experiments and the rationale behind eliminating extreme values and replacing outliers.

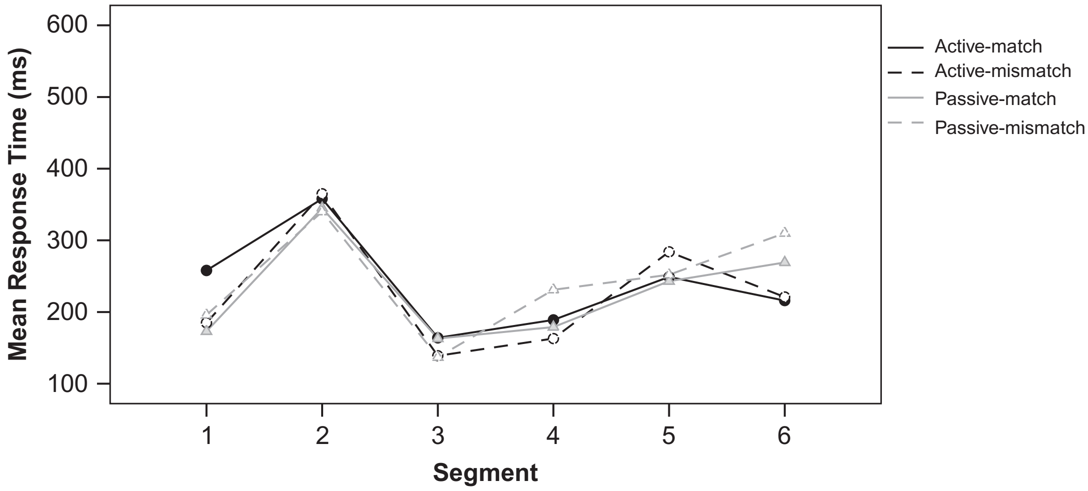

FIGURE 7 Response times per condition in L2 children (in ms).

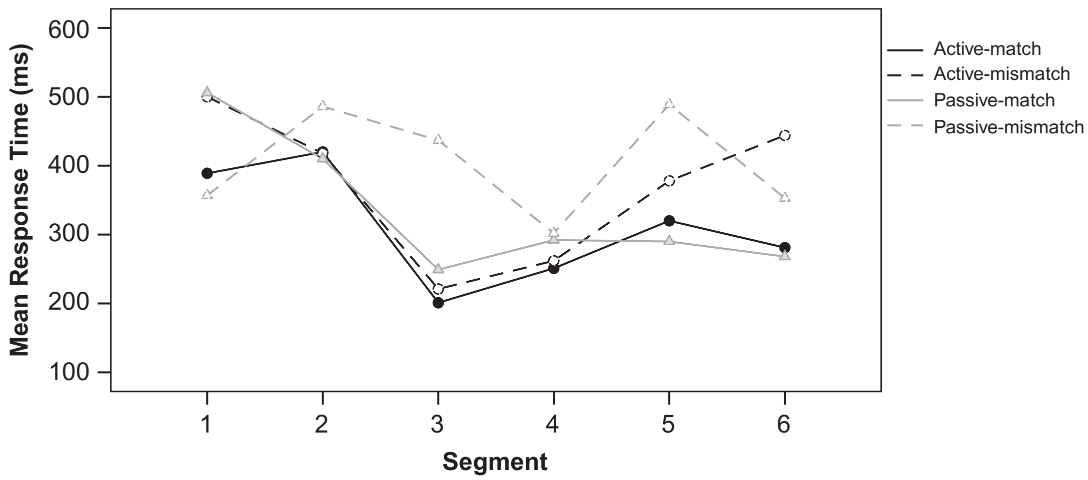

FIGURE 8 Response times per condition in children with SLI (in ms).

with SLI, L2 children, L1 controls) and Thematic roles (Agent, Patient). The analyses showed only a main effect of Group ($F1(2, 73) = 4.02$, $p < 0.05$, $\eta^2 = 0.1$; $F2(2,117) = 7.41$, $p < 0.001$, $\eta^2 = 0.11$) reflecting shorter RTs in the L2 group compared to the children with SLI (subjects: $p < 0.05$; items: $p = 0.001$) and also the L1 controls in the items analysis ($p < 0.05$).

Segments 4 and 5 are the critical segments. RTs in both segments are expected to be longer in the mismatch compared to the matched condition for both actives and passives if children are able to use the cue at the suffix of the verb and the *by*-phrase to process the sentence. The analyses in Segment 4 showed longer RTs in the mismatch compared to the matching condition in the items analysis ($F2(1, 117) = 6.01$, $p = 0.016$, $\eta^2 = 0.05$) and a main effect of Group in the items analysis ($F2(2, 117) = 8.86$, $p < 0.001$, $\eta^2 = 0.13$) reflecting shorter RTs in L2 children compared to children with SLI ($p < 0.001$) and a marginally significant difference between L2 TD children and L1 controls ($p = 0.05$). The analyses in Segment 5 showed a main effect of Matching ($F1(1,72) = 8.9$, $p < 0.01$, $\eta^2 = 0.11$; $F2(1, 117) = 10.18$, $p = 0.002$, $\eta^2 = 0.08$) reflecting longer

RTs in the mismatch compared to the matching conditions and a main effect of Group in the items analysis ($F2(2, 117) = 4.86, p < 0.01, \eta^2 = 0.08$) reflecting shorter RTs in L2 children compared to children with SLI ($p = 0.01$) and L1 TD children ($p < 0.05$).

Segment 6 is the postcritical segment and can reveal a spillover or a late effect in the processing of actives and passives. The analysis showed a main effect of Sentence Type in the items analysis ($F2(1, 117) = 8.52, p < 0.01, \eta^2 = 0.07$), a main effect of Matching in the items analysis ($F2(2, 117) = 6.64, p = 0.01, \eta^2 = 0.05$), an interaction of Group by Matching in the items analysis ($F2(2, 117) = 4.7, p = 0.01, \eta^2 = 0.07$) and an interaction of Group by Sentence Type in both the subjects and items analyses ($F1(2, 73) = 4.34, p < 0.05, \eta^2 = 0.11$; $F2(2, 117) = 3.45, p < 0.05, \eta^2 = 0.06$). The interactions were caused by three effects. L2 TD children showed shorter RTs than children with SLI in actives (subject: $p < 0.05$; items: $p = 0.016$). L2 children showed shorter RTs than L1 controls in the matching conditions in the items analysis (items: $p < 0.05$). Children with SLI and L1 controls did not show any difference in speed between actives and passives, whereas L2 children showed longer RTs in passives compared to actives (subjects: $p = 0.02$; items: $p < 0.01$).

5.4. Correlations Between Baseline Tasks and Experimental Tasks

To investigate the relationship between the children's comprehension of actives and passives and their nonverbal abilities, grammar, vocabulary, and WM, Pearson's correlations were conducted between the children's scores for each group separately, as shown in Table 2. In children with SLI, there was a correlation between grammar and vocabulary and both were correlated with nonverbal abilities. The scores on Actives (TAPS and SPL-AP) correlated with grammar and there was a correlation between Actives on the TAPS and on the SPL-AP.

Moreover, Actives on the SPL-AP correlated with Passives on the SPL-AP. The scores on Long Passives (TAPS and SPL-AP) correlated with grammar. Long Passives on the SPL-AP correlated also with nonverbal abilities, vocabulary and with Short Passives on the TAPS, and Long Passives on the TAPS correlated with Short and Ambiguous Passives. WM correlated with Ambiguous Passives.

In L2 children, there was also a correlation between grammar and vocabulary and both were correlated with nonverbal abilities. Actives did not correlate with any other scores, but there was a correlation between Long Passives on the SPL-AP and nonverbal abilities, grammar, vocabulary, and WM. Long Passives on the TAPS correlated with Short Passives.

L1 children showed a correlation between grammar, vocabulary and nonverbal abilities and also between vocabulary and WM. Actives on the TAPS correlated with Short Actives and Long Passives on the TAPS with Ambiguous Passives.

6. DISCUSSION

This study used a combination of on-line and off-line comprehension tasks to address the nature of the difficulties in the comprehension of passives in children with SLI, L2 children, and L1 age-matched controls. Break down in the comprehension of passives can result from difficulties in one or more processes involved when processing passives. The on-line RT data measured the children's processing of morphosyntactic cues of the verb and the reanalysis process of the thematic

TABLE 2
Correlations Between Baseline and Off-Line Comprehension Results

	Raven's	*TROG-2*	*BPVS-II*	*WM*	*Actives-A'*	*Passives-A'*	*Actives*	*Long Passives*	*Short Passives*
Children with SLI									
TROG–2	.784***								
BPVS–II	.728***	.753***							
WM	.172	.191	−.068						
Actives-A'	.341	.537**	.306	.187					
Passives-A'	.476*	.515**	.435*	.118	.354				
Actives	.263	.507**	.390	.126	.557**	.385			
Long passives	.358	.464*	.329	.330	.525**	.474	.402		
Short passives	.072	.393	.302	.378	.322	.569**	.296	.596**	
Ambiguous passives	−.134	−.210	−.204	.571**	.055	.008	−.006	.447*	.270
L2 children									
TROG−2	.674***								
BPVS−II	.523**	.684***							
WM	.259	.284	−.024						
Actives-A'	.226	.188	.188	.278					
Passives-A'	.414*	.431**	.361*	.407*	.294				
Actives	−.015	.094	.262	.289	.225	.261			
Long passives	.049	.144	.305	.175	.177	.328	.088		
Short passives	.328	.250	.337	.256	.090	.171	.270	.453**	
Ambiguous passives	−.274	−.234	−.333	−.099	−.184	−.263	−.139	.274	.141
L1 controls									
TROG–2	.461**								
BPVS–II	.355	.383*							
WM	.047	.171	.412*						
Actives-A'	.312	−.077	−.160	−.009					
Passives-A'	−.017	−.085	.050	.074	.097				
Actives	.215	.015	.024	.146	.039	−.028			
Long passives	.251	−.007	.138	.133	.052	.192	.317		
Short passives	−155	−.049	−.092	−.006	−.280	.206	.470**	.288	
Ambiguous passives	.163	.152	.142	−.139	−.085	−.006	−.081	.400*	.137

*$p \leq 0.05$. **$p \leq 0.01$.***$p \leq 0.001$.

role of the first NP, whereas the off-line data measured the children's comprehension accuracy at the end of the sentence that reflects post-interpretative processes. Error analysis in the off-line task showed how children interpreted passives when they made errors. Finally, comparison of the results on passives with the children's nonverbal, grammatical, vocabulary, and working memory abilities provided information about the relationship between the comprehension of passives and the children's verbal and nonverbal abilities.

6.1. Comparing Children With SLI to L2 Children

The three groups of children were matched on age and nonverbal abilities, but the children with SLI and the L2 children had lower grammatical and vocabulary abilities than the L1 children; the children with SLI had also lower WM than both groups of TD children. Furthermore, grammar was a particular weakness in children with SLI who performed less well than L2 children, whereas the opposite pattern was attested in vocabulary.

The off-line comprehension data from the TAPS-R and the accuracy data from the SPL-AP showed that the children with SLI and the L2 children had difficulties in the comprehension of passives off-line in both tasks. The pattern of performance of the children with SLI on the TAPS-R was similar to the children with SLI in van der Lely (1996b) and the young children in Norbury et al. (2002). This replicated previous studies and established that both groups of children of this study have difficulties in the comprehension of passives.

The on-line RT data addressed the nature of their difficulty by shedding light into the underlying processes involved in the comprehension of passives. RTs in the critical Segments 4 and 5 could indicate whether or not children were able to process morphosyntactic cues for actives (*-ing*) and passives (*-ed*, *by*) and whether they were able to do a reanalysis when there was a mismatch between the picture and the sentence; RTs in the postcritical Segment 6 could indicate whether or not the reanalysis was completed.

The RT results showed that all groups performed in the same way in the critical Segments 4 and 5; they showed longer RTs in the mismatch compared to the matching condition. This demonstrates that children with SLI and L2 children process the morphosyntactic cues for both actives (*-ing*) and passives (*-ed*, *by*) and start to reanalyze when there is a mismatch between the picture and the sentence.

If children with SLI and L2 children are capable of processing morphosyntactic cues when there is a mismatch between the sentence and the picture, what could cause the break down in the comprehension of passives? Could the source of breakdown be the same for both groups of children? These questions are addressed by focusing on: (1) between-group differences in the postcritical segment, (2) between-group differences in speed of processing, (3) the error pattern on the TAPS-R, and (4) the relationship between the children's performance on passives and their nonverbal and verbal abilities.

RTs at the postcritical segment differed between the groups. Visual inspection of Figures 6–8 shows that L1 children have elevated RTs in the mismatch compared to the matching conditions in Segments 4 and 5, but this difference disappears in Segment 6. This demonstrates that they processed the morphosyntactic cues and they completed the reanalysis prior to Segment 6. The processing difficulty caused by the mismatch between the sentence and the picture resolved quickly. The RTs of the L2 children show a similar pattern in Segments 4 and 5, but in Segment

6, they have longer RTs in passives compared to actives. This indicates that they processed the morphosyntactic cues and reanalysed, but it took them longer to process passives compared to actives. This is not surprising since passives are more complex to process than actives (Ferreira 2003). Children with SLI, show a strong mismatch effect in Segment 5, but this seems to continue into Segment 6. This indicates that they were capable of processing morphosyntactic cues and start to do a reanalysis, but it took them longer to integrate information into the syntactic structure and complete the reanalysis. In Segment 6, children with SLI were still processing the mismatch between the sentence and the picture, thus, the reanalysis was not complete.

In terms of speed of processing, the children with SLI had longer RTs than the other two groups of children at the beginning of the sentence. This is consistent with previous studies showing slower speed of processing in children with SLI compared to TD children (Montgomery & Leonard 1998; Montgomery & Leonard 2006; Marinis & van der Lely 2007). The slower speed of processing has been proposed to stem from less efficient use of linguistic processing operations, such as slower lexical retrieval and integration (Montgomery 2002). The L2 children, on the other hand, had consistently shorter RTs than the other two groups in all segments of the sentence. This is unlike two previous studies showing longer RTs in L2 children compared to L1 controls (Marinis 2007; Chondrogianni & Marinis 2012), but could result from better executive control in bilingual children (Bialystok 2009). Given the individual variation between L2 children in terms of their onset, exposure, input, and output, differences in speed between the present study and previous studies may relate to differences in the L2 children's language history and language use. This issue remains open for future research.

The RTs of the SPL-AP task include only correct trials and provide information about how children processed the sentences they comprehended successfully. Information about how they comprehended sentences when they make comprehension errors can be provided from the errors they made on the TAPS-R. Results from the TAPS-R can also provide information about differences between long and short passives. The TAPS-R showed between-group differences. First, the L2 children had difficulties in both long and short passives, but not in actives. This is in line with the RT data from Segment 6, demonstrating that L2 children find passives more difficult to process than actives. On the other hand, the children with SLI had more difficulties with long than with short passives. Apart from the difference in length that may affect performance due to WM limitations, long passives also involve the ambiguous preposition *by* and transmission of an additional thematic role. The children with SLI in the present study had lower grammatical, vocabulary, and WM abilities than the other two groups. A combination of low WM and grammatical abilities could account for the lower accuracy in long compared to short passives. This could result from slower and/or less efficient use of processing operations (Montgomery 2002).

The error analysis from the TAPS-R showed that the predominant error in all groups was providing a stative interpretation, but there were several between-group differences. The children with SLI and the L2 children showed a higher proportion of reversal errors in passives than the L1 children and the proportion of reversal errors was higher in long passives than in the other conditions. However, the children with SLI made more reversal errors than the other groups also in actives. In long passives, the children with SLI selected more often the semantic distracter than the other groups. A final between-group difference regards the children's performance on actives. The children with SLI had lower performance than the two groups of TD children not only in passives, but also in actives on both the TAPS-R and the SPL-AP. Reversal errors in actives and lower performance in actives compared to the L1 and L2 children provides evidence that the comprehension difficulties of children with SLI are not restricted to passives. Moreover, choosing the semantic distracter could indicate that occasionally they were not able to remember the sentence when they had to choose the picture.

Correlations between the children's performance on the experimental tasks and the baseline tasks are also very informative about the source of the children's difficulties. In children with SLI, there was a relationship between the performance on passives and the children's nonverbal abilities, vocabulary, and WM. Moreover, their grammatical abilities correlated with their performance on both actives and passives. The L2 children's performance on passives was also related to their nonverbal abilities, grammar, vocabulary, and WM, but none of these tasks correlated with actives. These correlations demonstrate that in both children with SLI and L2 children, there are multiple interactions between the children's performance on passives and their nonverbal and verbal abilities including WM. However, in children with SLI, grammatical abilities relate also to the children's accuracy in actives.

6.2. Implications for SLI Theories

The RDDR argues that errors in the comprehension of passives occur because children with SLI have underspecified syntactic representations, and therefore, movement is optional. This predicts that although children with SLI will be able to process the grammatical morphemes *–ed/-ing* and the preposition *by,* this should lead to elevated RTs in the mismatch conditions only for actives. This is because according to van der Lely (1996a:267), the children's "representation for a verbal passive is not sufficiently specified to rule out an adjectival-stative interpretation." This is not what we found in this study. The children with SLI showed elevated RTs in the mismatch conditions for both actives and passives. This demonstrates that morphosyntactic cues triggered a reanalysis. The second prediction of the RDDR is chance performance in the comprehension of passives due to optional movement. This was also not borne out in the data. The third prediction is occurrence of reversal errors and adjectival interpretation of passives. This was supported in this study. Finally, several patterns in the data cannot be accounted for by the RDDR: (1) slower speed of processing at the beginning of the sentence (*I think*), before the active/passive is encountered; (2) lower accuracy in actives than L1 TD children; (3) reversal errors in actives; (4) choosing the semantic distracter in long passives; (5) correlations between nonverbal abilities and passives; and (6) correlations between actives and passives.

Can the SA account for these patterns? The SA proposes that the children's language deficits stem from processing limitations that affect their verbal along with their nonverbal abilities. Therefore, the six observations just listed that were incompatible with the RDDR can be accounted for within the SA. Slower speed unrelated to passives, low accuracy and errors in actives, and choosing a semantic distracter can result from general processing limitations. Processing limitations should affect all sentence types to some extent. This can also account for the correlation between actives and passives. The correlations between nonverbal abilities and passives can easily be explained if the children's deficits affect both verbal and nonverbal abilities. However, not all predictions of the SA were supported by the data. According to the SA, children with SLI should have difficulties with grammatical morphemes that have short duration and low phonetic saliency; therefore, they should be insensitive to morphological elements, such as *–ed* and *by*. This predicts that children with SLI should not show elevated RTs in the mismatch conditions for passives. This pattern was not attested in the data. Children with SLI were sensitive to the grammatical morphemes *–ed* and *by*.

The results from this study are best captured within Montgomery & Evans's (2009) account, according to which difficulties with passives are attributed to WM limitations. This account predicts a correlation between the comprehension of passives and WM. This was partially supported by the data; WM correlated with the children's performance on ambiguous passives. Another prediction is that performance in long passives should be better than in short passives, which was also borne out by the data. This hypothesis is also in line with the six observations already described that were not accounted for by the RDDR. Importantly, it can capture the pattern of the children with SLI in the RT task. The children with SLI were able to process morphosyntactic cues for both actives and passives, but the reanalysis did not seem to be complete at the last segment of the sentence. This demonstrates that the children's deficits are not limited to passives, but extend also to actives if the task requires a reanalysis of thematic roles, and thus, increases the complexity of the syntactic algorithm.

7. CONCLUSION

This is the first study to compare how children with SLI, L2 children, and L1 controls process passives in real-time compared to their accuracy in off-line comprehension. The results showed important between-group differences in both on-line and off-line comprehension. L2 children do not show the same profile with children with SLI. The pattern observed in the children with SLI indicates that their difficulties lie in reanalysing thematic roles on-line and in postinterpretative processes related to WM limitations. These are not specific for passives, but extend to a smaller extent to actives. In contrast, L2 children have difficulties only in passives; this is likely to relate to the complex syntactic algorithm involved in processing passives and could be caused by their lower language abilities in terms of grammar and vocabulary. The data do not support the RDDR or the SA, but can be best accommodated within Evans & Montgomery's (2009) account, according to which difficulties in the comprehension of passives stem from processing limitations.

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