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Positive Effects of Passive Voice Exposure on Children's Passive Production During a Classroom Story-telling Training

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ABSTRACT

The present study investigated the effect of classroom-based syntactic training on children's abilities to produce passive sentences. Thirty-three monolingual English children (mean age 5;2), were involved in passive-voice training based on storytelling sessions within a priming design. The training was delivered in a classroom setting, with two classes randomly allocated to either an active sentence or a passive sentence training structure. All children were individually tested at post-training. Children in the passive condition generated 3.6 more passives than the children in the active voice condition. Pre-training language and memory abilities, as measured by both grammatical level with a standardized sentence comprehension task (TROG-2) and a verbal working memory task (Digit Span), were unrelated to number of passives produced at post training. The study supports and expands recent evidence on the benefit of rich language exposure in the classroom context and on the quick dynamic adaptation of the implicit learning mechanisms to language exposure activities.

Introduction

Do the stories we read to children impact their language abilities? Do the sentence structures in these stories have an effect on their language production? How do the ways that languages are taught in schools affect how children acquire syntactic structure? Language is acquired through implicit learning from input well before explicit training starts. The present research is an intervention study on how children acquire complex structures, namely passive voice sentences, during systematic exposure in a classroom setting. In particular, it focuses on the impact-controlled exposure has on the emergence of syntactic structures. Exemplars of sentences with complex grammatical structures are sentences in the passive voice, like, "*The girl was hit by the boy*". These are also called non-canonical sentences due to the preverbal position of the non-agentive subject. Since passive sentences require integration of different linguistic components (syntax, morphology, and event structure), they do not fully emerge in speech until children are around 4 years old but their development can be seen in studies showing three year olds using short passives in English and mastering them in comprehension tasks (Marchman et al., 1991).

To address the later emergence of complex structures compared to simpler ones, research has focused on the role of exposure as a requirement to promote a rich propositional behavior in children and to promote production of both simpler and more complex sentences. Much of this research indicates that the language a child hears affects their language production later, with a direct effect of the input on the child's immediate output (Hoff, 2006; Hoff-Ginsberg, 1998; Huttenlocher et al., 2002; Kidd, 2012). Children who are exposed to a richer linguistic input both at home and at school have better syntactic and vocabulary skills compared to children exposed to less rich adult language (Huttenlocher, 1998). Huttenlocher et al. (2002) found that English-speaking children in class with

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a teacher who used more complex syntax structures themselves progressed more in using complex syntax over the school year than children whose teacher used less complex syntax structures. Furthermore, in this study a substantial difference in children's mastery of multi-clause sentences was reported, along with a positive relation between better mastering multi-clause sentences and higher exposure of multi-clause sentences in parent speech.

These findings raise questions regarding the factors that affect the development of children's language. Does what a child hear influence later language production and can this be systematically addressed in the classroom context?

Empirical investigations within a syntactic priming design have shown that children as young as 3-years old manifest the priming effect (Shimpi et al., 2007; Thothathiri & Snedeker, 2008). A priming effect was reported on a range of syntactic constructions in English such as passives (Bencini & Valian, 2008; Messenger et al., 2011), double object and prepositional object datives (Rowland et al., 2012; Shimpi et al., 2007), and indirect speech clauses (Serratrice et al., 2015).

Focusing on passive constructions, research by Kidd (2012) investigated the priming of English passive constructs in a population of 4- to 5-year-olds, confirming that syntactic priming reflects syntactic knowledge but noted individual differences in susceptibility to the priming paradigm. Children can be syntactically primed as young as 3 to 4 years (Thatcher et al., 2008), and the effects may be long lasting (Serratrice et al., 2015). Syntactic priming of passives has been observed in adults, children, and in several languages (Messenger et al., 2011 for English; Manetti, 2013 for Italian; Hartsuiker & Kolk, 1998 for Dutch; Gámez e al., 2009 for Spanish).

More interestingly for investigations of the effect of priming on acquisition is a study on passive structures in preschool Russian children, where a positive facilitation effect of priming was reported to expand beyond the intended target sentence (Vasilyeva & Waterfall, 2012). In this study, the researchers reported an increasing use of non-canonical sentences as a result of the priming manipulation. This was an increase of object fronting constructions and impersonal actives. The use of non-passive structures was explained as implicit priming of the effect of passive voice more than abstract structures.

Research investigating priming of passives in children exists mostly in picture-describing or repetition tasks (Huttenlocher et al., 2004; Lempert, 1990), which arguably do not consider caregiver interactions. This is where a study by Vasilyeva et al. (2006) differs; they used narratives to expose children to passives in storytelling sessions. They found that pre-school children who heard stories during a passive voice training developed in ten sessions could produce more passives than children who heard the same stories told with the active voice.

Syntactic priming

It is well attested that adults are better at understanding certain sentence structures when they have been exposed to them in the immediate linguistic input. The tendency to reproduce sentence structures after exposure (Bock, 1986) has been described under the phenomenon of "syntactic priming". Syntactic priming is a form of facilitation in which speakers can process and produce syntactic structures because of their structural overlap to a previously heard sentence. This form of priming has nothing to do with the repetition of sounds; it is specific to the structure of the sentences (Pickering & Branigan, 1999; Branigan & Pickering, 2017 for a review) and has been demonstrated across different languages and populations (Garraffa et al., 2015, 2018; Loebell & Bock, 2003).

The phenomenon of a priming for an abstract structure has been first attributed to the residual activation of the syntactic representation previously used (see Pickering & Branigan, 2017), which significantly increases the chances in the short term that the same structures will be accessed in subsequent production. A different account has been proposed in research on persistent priming effects, supporting the idea that the priming effect, rather than being a form of residual activation, is a form of implicit learning with traceable effects in the grammatical competence of the speaker (Bock & Griffin, 2000; Chang et al., 2000).

The two accounts are not mutually exclusive, with some recent proposals aiming at integrating both residual activation and implicit learning as complementary tools for language learning (e.g., Ferreira & Bock, 2006; Pickering & Ferreira, 2008). The main supporting evidence for the implicit learning approach is based on the observation that the boost obtained by the syntactic priming effect never returns to its pre-priming baseline. More interestingly, an increase of the ability to use syntactic structure is reported during repeated sessions (Jaeger & Snider, 2013).

There is increasing evidence that the effects of priming could be better explained in terms of implicit learning, with many studies reporting longer-lasting effects and occurring in situations that are more naturalistic. The effect of priming, or better said, of implicit learning, has been reported to last for several weeks even in children and in narrative-based circumstances, opening a rich set of investigations into the factors affecting the syntactic priming effect (Kaschak et al., 2011; Savage et al., 2006).

Although significant effects of priming have been reported in numerous studies, group differences may mask a degree of individual variation, with the priming effect being driven by a small number of tokens or a small number of participants. In a recent study, Kidd (2012) found considerable individual differences in the likelihood of priming in 122 children between 4 and 6 years of age. Larger receptive vocabularies, better receptive grammar, and non-verbal reasoning skills were positively correlated with children's likelihood of being primed to use passives.

Priming in the classroom

In a recent study on the effect of classroom-based input manipulation on children's use of subordination, a persistence effect of the grammatical training after ten weeks was reported (Hesketh et al., 2016). Crucially for this study, the research was designed as a classroom story-telling task and robust changes were reported in all children and maintained at posttest ten weeks after, showing that a syntactic adaptation to the input can be manipulated in an educational setting. The priming procedure in the study was based on a two-week intensive exposure, with one story-telling session per day. The design was successful in showing adaptation of grammatical behavior, although everyday intervention plans do not naturally occur in school where weekly sessions for an activity are more often used.

A notable example is that of Vasilyeva et al. (2006) who demonstrated week-long effects of priming children's use of passives in a more naturalistic setting, embedding target constructions in a series of stories in a classroom situation. Similarly, Ryokai et al. (2003) used a virtual animated child character "Sam" to take turns with 5-year-old children in telling stories about a toy figure and a magic castle. Sam modeled direct speech, temporal, and spatial expressions and relative clauses, the first three of which increased significantly in the children's own stories as they took turns. The effect was also seen when two children interacted with the character at the same time. Stories appear to have particular potential for young children as in Klein et al. (2010) comparison of procedures, ranging from free play to story re-telling: the more constrained the retell task was, the more effective it was in eliciting multi-clause sentences in children aged 4 to 7. Serratrice et al. (2015) also found that expressive grammatical skills and not just the targeted structure were positively correlated with the likelihood of priming in a group of 42 children between 5 and 6 years of age. These findings suggest that children's own linguistic skills should predict whether they will be more or less likely to use the syntactic construction modeled in the priming task.

Other research has investigated syntactic priming of children in educational environments targeting narrative abilities such as the use of indirect speech. Research by Hesketh et al. (2016) used a classroom environment to investigate priming of indirect speech using storytelling tasks with 5- to 6-year-old children. The training was delivered in ten sessions over two weeks; the researchers told each group a story and used a puppet for children to re-tell the story. What is noteworthy about this study is the use of story re-telling as a measure of spontaneous use of language. After the ten priming sessions, each child was individually asked to re-tell a story with indirect speech only. The researchers

found that children who had undergone training re-telling stories with indirect speech performed better in a story re-telling task involving indirect speech than children who had undergone training with direct speech. Furthermore, they found that the effects of priming were maintained over time.

Current study

The current study aims to contribute to the research on the effect of controlled inputs on grammatical development, expanding the evidence that syntactic priming can be turned to a tool for effective educational sessions. Furthermore, it focuses on passive voice sentences, a structure extensively investigated in the research on priming.

It implements a training program that uses stories within a classroom setting with monolingual English young speakers to strive for ecologically valid training sessions that simulate typical classroom activity. The research used a puppet for children to re-tell their stories to in-group training sessions and individually in posttest sessions. The present study differed from Serratrice et al. (2015) as it used fewer training sessions overall; instead of ten sessions, the current study has only six sessions aiming at investigating the emergence of a priming effect after a small amount of input. Additionally, we used a longer period of three weeks to deliver the training sessions, spreading the sessions with the intention of testing the implicit learning aspect of the priming and to propose a procedure similar to natural occurrence of language training (once a week).

More importantly, materials developed for the storytelling sessions where controlled across several linguistic properties, not only at sentence level but focusing more on text variables, necessary for meaning and paragraph understanding (Webster et al., 2018). Text-level controlled materials have the advantage to promote a more ecological retelling experience and to be adapted in follow-on studies. A further merit is the enabling of transparency of controlled materials for the study to be replicated in other languages and populations.

We predicted that 4- to 5-year-old children who had language training with re-telling stories using passive sentences over a six-session period would produce more passive sentences compared to children under similar circumstances who did not receive the language training. The consequence of this will be that children given the passives condition made greater gains in passive use.

Methods

Initially, 18 children (10 boys and 8 girls; age mean (SD) = 62.1 (4.2) months, range = 55 to 68 months) from 2 Primary-1 classes in a school in central Scotland (Scottish Index of Multiple Deprivation [SIMD] (http://www.gov.scot/Topics/Statistics/SIMD): rank 4780, corresponding to the 7th decile) took part in the experiment. One male participant had less than one year of exposure to English and was subsequently removed from the analysis. As there were too few data points from this first experiment, the procedure was repeated with two new cohorts of children a few months later (16 children, 6 boys and 9 girls; age mean (SD) = 63.2 (5.0). All children were tested under the same conditions as in the original experiment.

Each of two classes of 4- to 5-year-olds (corresponding to Primary-1 in Scotland) was randomly assigned to one of two priming conditions (active or passive), avoiding pre-selection of children per group and controlling for an overall non-different language baseline score in the two groups. Both cohorts were tested in their classrooms. The "Heriot-Watt University School of Life Sciences Ethics Board" gave approval for the experiment. Subsequently, parent (or legal guardian) consent was obtained prior to children participating in the study.

The Test of Receptive Grammar 2 (TROG-2; Bishop, 2003) was adopted at pretest to profile language ability before the language intervention. A digit-span backward recall test (Wechsler, 2003) was used to control for any differences in recall caused by working memory individual differences. Only children with age standard scores on TROG-2 and a digit-span above 3 were included in the study. Results of background tests are reported in Table 2 below.

Materials

Seven stories based on fairy tales were written and illustrated with a PowerPoint presentation. Six stories were used for the training phase and one at post-training phase.

Every story in the training-phase had versions in both active voice and passive voice. While the control group class heard only stories in the active voice, the test group class heard only stories in the passive voice. The post-training story was in the passive voice only and was used to test both experiment groups. Each story comprised 22 sentences, with an average of 8 words per sentence. Both versions of each story had the same first two sentences. Each story had 12 verbs tokens modified to generate the active or the passive conditions. For example, the active conditions used sentences in the active voice such as, "The young boy poked the dragon." The passive condition versions used the same lexical materials but in the passive voice, like "The dragon was poked by the young boy." Besides this manipulation between active and passive voices, the stories were identical. An example of a story in both active and passive syntax is given in the Appendix in Table A1.

Each story in the passive voice was designed to match as close as possible its active voice counterpart, considering variables at both sentence level and text level. These include total number of sentences, number of modified sentences, average number of words per sentence, as well as variables at text level identified as important for text readability by the Dale and Chall Readability formula (Dale & Chall, 1948). These variables were: *lexical level* (words not found in Dale & Chall list of common words identified by 4^{th} grade students), number of words repeated in the text, and overall *grade level* (determined by the total number of sentences and average length of sentences).

The passive voiced stories differed from their active voiced counterparts on variables identified by the Computerized Propositional Idea Density Rater, CPIDR-3 (Brown et al., 2008), and consist of: (i) *number of propositions* and (ii) *propositional density* (= Number of propositions/word count). Story 7 was used in the post-training and only had a passive voice.

Each active story and its passive counterpart were designed to match on total number of sentences, number of modified sentences, average words number per sentence (7.9), and readability scores at text level (Dale & Chall, 1948).

A summary of the linguistic variables for the paragraphs adopted in the study can be found in Table 1. The full set of stories and pictures is now available online on the OSF Home platform in category Methods and Measures. (Identifier: DOI 10.17605/OSF.IO/XPHW6.)

Procedure

Other priming design studies have adopted a three-stage process: a pre-training phase, training phase, and the final post-training phase, with the structure elicited during the training tested at pre-training (see Hesketh et al., 2016; Kidd, 2012; Serratrice et al., 2015). The pre-training phase for the current study took place over two school days and involved testing all children individually on background inclusion criteria measures, a standard level score on TROG-2, and minimum digit-span of six digits.

The second stage of the study comprised of the training phase, which started one week after pre-training. This training phase consisted of three story-telling sessions over a three-week period and involved listening to two stories per session. Each session lasted around 45 min, with participants sitting together in their usual classroom groups. The session was introduced as a story-time session. The children were told that they were going to hear a story that also had pictures. They were asked to listen to the story carefully, as they would need to re-tell the story to a puppet afterward. Children then watched the story illustrations being shown on a projector while the researcher narrated the story from a script. After the story was told, the researcher pointed out that the puppet had fallen asleep and asked the children to re-tell the story when it woke up. The children were then asked to collectively re-tell the story while the story images played on the screen again.

The final stage of the study was the post-training phase, which took place one week after the training phase. The posttest followed a similar format to the training phase. However, this time

Table 1. Linguistics factors controlled for each story included in the training. Readability variables (Readability score and Readability grade) are based on the Dale–Chall Readability formula (Dale & Chall, 1948). Proposition-related variables (number of propositions and propositional idea density) were controlled with the computerized propositional idea density rater, CPIDR-3 (Brown et al., 2008).

Story	N of words	N words per sentences	N of Sentences	Total of repeated words	Readability Score	Readability grade	N Propositions	Propositional Density
1a Active Training	170	7	23	89 52% of total text	0.8	Grade 4 and Below	173	0.45
1b Passive Training	194	8	23	112 58% of total text	0.8	Grade 4 and Below	194	0.46
2a Active Training	173	8	22	87 50% of total text	0.9	Grade 4 and Below	167	0.33
2b Passive Training	187	8	23	103 55% of total text	0.9	Grade 4 and Below	189	0.34
3a Active Training	176	8	23	87 49% of total text	0.9	Grade 4 and Below	174	0.37
3b Passive Training	199	9	22	108 54% of total text	0.9	Grade 4 and Below	197	0.37
4a Active Training	167	8	22	89 53% of total text	0.9	Grade 4 and Below	164	0.33
4b Passive Training	195	8	22	116 59% of total text	0.9	Grade 4 and Below	188	0.36
5a Active Training	170	7	23	96 56% of total text	0.9	Grade 4 and Below	170	0.37
5b Passive Training	195	8	22	120 62% of total text	0.9	Grade 4 and Below	194	0.37
6a Active Training	173	8	22	87 50% of total text	0.9	Grade 4 and Below	170	0.48
6b Passive Training	194	8	22	112 58% of total text	0.9	Grade 4 and Below	191	0.48
7 Passive Post-training	192	8	22	114 59% of total text	0.8	Grade 4 and Below	187	0.36
Mean (range)	183 (164–197)	7.9 (7–9)	22					

Table 2. Descriptive statistics [N or mean (SD)] for participants in both priming conditions, for the two cohorts combined.

Condition	N	Age (months)	TROG-2	Digit Span	MLU	N of Passives
Active	18	62.3 (3.77)	105.8 (13.05)	4.3 (0.57)	5.7 (0.92)	1.3 (1.32)
Passive	15	61.9 (3.86)	107.9 (9.28)	4.5 (0.99)	5.7 (1.34)	4.9 (2.1)

each child was tested individually and heard story 7 in the passive voice only. Each child sat at a table with a laptop in front of them. They were told they would be re-telling the story to the puppet this time. During the story telling, the puppet fell asleep at the same moment for every participant. Once the story was finished, the child was then asked to re-tell the story to the puppet whilst the story pictures were on the screen. Children were audio-recorded so that their spontaneous use of syntax could be later transcribed and coded for analysis. Figure 1 describes the timeline of phases.

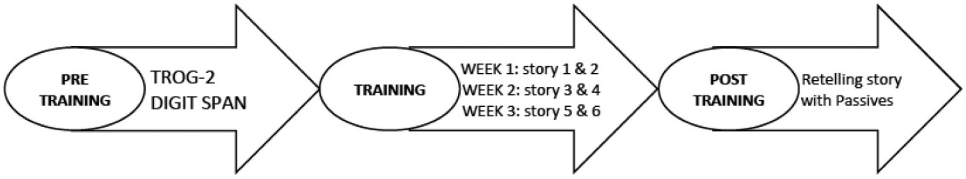

Figure 1. Timeline of pre-training, training, and post-training, and what was involved in each phase.

Scoring

Children's re-telling of story 7 were transcribed from the audio recordings and coded to determine the number of passives generated and the mean length of utterance (MLU) for each child. Productions were coded as PASSIVE if they were of the form *X was (or other form of auxiliary "be") transitive verb (by Z)*. Responses that had the correct elements of a passive but used the wrong past participle were still coded as passives, for example: "the pig was spanned by the princess".

A two-way scoring system is usually adopted in scoring passives during priming manipulations, with a strict version not including short passive and morphological errors as correct and a more lenient scoring with short passives and morphological errors counted as correct passive forms. The full scoring system adopted, based on other studies on priming passive (Garraffa et al., 2018), is included in the Appendix, in Table A2. Children in this study produced full passives and no other forms or errors. A measure of the MLU was also recorded to keep track of any possible effect of a richer propositional attitude of the priming manipulation.

Results

Children's production in the post-training phase were transcribed and coded for passive and active forms. It is important to note that no truncated passives or morphosyntactic errors were reported in the productions, with no difference between strict and lenient scoring results.

Preliminary analysis was carried out to test for any differences between the two sets of children. The two sets of children assigned to the "Active" (i.e., active-voice) condition did not significantly differ on any of the background measures. While the first cohort in the "Passive" (i.e., passive-voice) condition had higher means on baseline language abilities (TROG-2 and MLU) than the other cohort, these differences were not significant between the two settings. Nevertheless, these background measures were included in the regression models to test for any covariate effect on the dependent variable, namely, number of passives generated at posttest. Consequently, the two cohorts in the same experiment conditions were combined for the following analyses; see Table 2.

The TROG-2 (Bishop, 2003), administered before training, was used to check for any differences in baseline measures of language ability. The test consists of 20 blocks that target different grammatical structures, including passives. An independent samples t-test revealed no significant differences (t (31) = −0.54, p = .596) between the scores obtained by the Active-voice group (m (SD) =105.8 (13.05)) and by the Passive-voice group (m(SD) = 107.9 (9.28)) in the TROG-2 overall and no differences if looking at the Passive block in the two groups; see Table 2.

To test for any possible differences in working memory capacity, a Digit Span test (Wechsler, 2003) was administered before the training phase started. An independent samples t-test revealed no significant difference (t (31) = −0.68, p = .499) between the scores obtained by the Active-voice group (m (SD) = 4.3 (0.57)) and the Passive-voice group (m (SD) = 4.5 (0.99)). However, three members of the Passive-voice group achieved scores of 6 while none of the Active-voice group managed to score above 5. Consequently, Digit Span will be tested for covariate contribution in the models below.

Table 3. Generalized linear regression for number of passives produced in story 7, with Poisson error distribution and stepwise elimination.

	Estimate (log)	Expected N passive generated	Standard Error	Z value	Prob. (>|Z|)
Active-voice group (Intercept)	0.240	1.27	0.214	1.12	0.261
Passive-voice group	1.311	4.71	0.244	5.38	0.000
MLU	0.198	1.55	0.084	2.36	0.018

MLU was calculated for each child from the statements they made in retelling story 7. The Active-voice group scored slightly lower (m (SD) =5.7 (0.92)) than the Passive-voice group (m (SD) =5.7 (1.34)). However, this difference was not significant, t (30) = 0.04, p = .968 (see Table 2).

The number of passives generated by each child at post-training (story 7) was used as the critical experimental measure. The mean (SD) number of passives for the Active-voice and Passive-voice groups was 1.3 (1.32) and 4.9 (2.1), respectively; see Table 2.

Regression modeling was used to test the hypothesis that children who underwent training with the Passive-voice syntax would be better at producing passives than children who had training with the Active-voice syntax. Regression modeling allows for other possible confounds to be included, and thus test for their relative contribution to explaining the production of passives by the children in story 7. Furthermore, since the dependent variable is a count variable, generalized linear regression with a Poisson distribution was used. All variables gathered in the experiment were initially added in to the model. Table 4 shows the final generalized linear regression model (with Poisson fit) after stepwise elimination of non-significant parameters. Only *Experiment condition* and *MLU* remain as significant predictors to the number of passives produced post-training.

Additional tests on these variables were carried out to test for confounds. Collinearity was tested for by regressing the significant covariates (*Experiment condition* and *MLU*) in Table 3 against each other. The covariates were not significantly correlated with each other (data not shown).

Two further generalized regression models were produced to test for the independent and significant contribution of experiment group (Active voice vs. Passive voice). While the Null hypothesis model included only *MLU* as a predictor of number of passives generated, the Alternate hypothesis model added Experiment condition to the Null hypothesis model. An ANOVA test between these two nested models (using Chi-squared testing) showed that the Alternate hypothesis was significantly more capable of explaining the variance in number of passives generated (df = 1, Deviance = 34.7, Chi-squared < 0.001), confirming our working hypothesis that passive-voice training regime significantly aids children in their ability to produce passives.

The regression model in Table 3 shows the following.

(1) Children in the Active training group generated 1.272 passives, at average MLU performance.
(2) Children in the Passive training group generated 4.72 passives, for average MLU and average age in the sample than the children in the Active training group. This increment is significant compared with children in the Active training group (z = 5.38, p < .001).
(3) For each unit increase in MLU, 1.219 more passives are expected to be generated. This increment is significant (z = 2.36, p = .018).

Additional tests on these variables were carried out to test for further confounds. Separate regression models and linear correlations showed that there were no interactions between the predictors in the regression model in Table 3, as well as no collinearity between MLU and experimental condition (data not shown).

Discussion

The present study reveals in relation to what we know about language training intervention in the educational setting. The aim of this research was to investigate if gradual language-training sessions with passive voice sentences over a three-week period in a classroom would improve children's production of passive sentences. The first hypothesis was that children who underwent passive voice language training would be able to produce more passives in a post-training story re-telling task than children who underwent training with active voice sentences. The results from the present study support this hypothesis. Children in the active condition produced around 1.2 passives for each possible verbal context in the post-training re-telling, while children in the passive voice condition produced 4.7 passives, generating more than 3 times the number of passives compared to children in the Active condition.

The second hypothesis was that children who had better language ability prior to the training would be better at producing passives post-training. Analyses revealed that pre-training tests (TROG-2 and Digit Span) were not related to a better mastery of the passive voice. What is important for our study was that language abilities at pretest could not account for the effect of the passive voice training. More interestingly for the present study was the positive increase in production of passives (1.219) with each unit increase in MLU. Although it is correct to say that the longer the utterance the more passives are produced, the increase due to MLU is smaller than the increase due to condition and more important, no interaction was found between groups and MLU, confirming a clear effect of the training manipulation.

It is not that passive group generates more passives because they made longer sentences than the active group. The findings support the idea of the effective boosting of language in children who are exposed to a controlled language structure during training.

A limitation of this study is the lack of a baseline measure of children's passive production, which calls for more evidence to better understand the effect of language-controlled manipulations in different groups. Also, the allocation of one class in one condition and another class in the other condition is not necessarily bias-free and it could be addressed with more measures collected at pre-training.

The findings from the present study are in line with previous research showing that children can be syntactically primed to produce specific sentence structures (Bencini & Valian, 2008; Hoff, 2006). More specifically, the present study supports research investigating syntactic priming as a form of gradual implicit learning that can be applied in educational settings (Serratrice et al., 2015; Vasilyeva et al., 2006).

The present study used fewer training sessions compared to previous research (only three training sessions once a week spread over a period of three weeks) but found a similar benefit of training with complex language structure and a possible related increase of language expressive abilities. The fact that a comparable effect of training was found after fewer training sessions than in previous research suggests that training children to produce complex language may require less effort than previously believed. Given that the effect of priming was still found with less intensive training and fewer sessions, this may mean that implementing this type of training into curriculums may be less time-consuming with similar benefits and not difficult to integrate in the school routine due to the weekly session format.

A merit of the present study was the controlled design of the materials used in the training sessions in terms of text related variables and the degree to which the two conditions (active and passive syntax) were matched. Creating stories with reversible verbs has been effectively done in studies researching the passive voice (Bever, 1970; Maratsos, 1974). The present study, however, went further using specific readability formulae to make the text more cohesive and controlling for quantitative measures at both lexical and grammatical level, such as number of words and propositions (Brown et al., 2008; Dale & Chall, 1948).

Concluding remarks

The findings from the current research add to the literature on syntactic priming in schools and reveal the benefits of passive voice training on passive productions. It was found that children who heard and

re-told stories with passive syntax over a three-week period were able to generate over three times as many passives as children who had training with active syntax. The study found no effect of pre-training language ability and no effects of sentence length on the number of passives produced at post-training, implying a strong and narrow influence from the training manipulation. The number of training sessions required for priming was lower than previous studies, suggesting that future research could focus on optimum number of training sessions required for increased production of specific language structures and the ideal spread of sessions, in terms of temporal distribution/spacing of the priming sessions aiming at developing effective intervention plans in the classroom.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Table A1. The story "The Sad Dragon" active version and passive version.

Sentence	Active voice	Modified	Passive voice
1	There once was a sad dragon.	Unmodified	There once was a sad dragon.
2	He was sad because he was not allowed in the town.	Unmodified	He was sad because he was not allowed in the town.
3	One day, a young boy visited the dragon.	Modified	One day, the dragon was visited by a young boy.
4	The dragon watched the young boy.	Modified	The young boy was watched by the dragon.
5	"Why are you sad?" the boy asked the dragon.	Modified	"Why are you sad?" the dragon was asked by the boy.
6	"People are scared of me" the dragon told the boy.	Modified	"People are scared of me" the boy was told by the dragon.
7	The young boy poked the dragon.	Modified	The dragon was poked by the young boy.
8	"You don't seem scary to me" said the boy.	Unmodified	"You don't seem scary to me" said the boy.
9	The dragon lifted the boy.	Modified	The boy was lifted by the dragon.
10	The dragon held the boy.	Modified	The boy was held by the dragon.
11	"I really am nice" the dragon said.	Unmodified	"I really am nice" the dragon said.
12	The dragon sneezed and fire came out!	Unmodified	The dragon sneezed and fire came out!
13	"I have an idea" the boy told the dragon.	Modified	"I have an idea" the dragon was told by the boy.
14	The dragon hugged the boy.	Modified	The boy was hugged by the dragon.
15	The dragon dropped the boy.	Modified	The boy was dropped by the dragon.
16	"The town has been very cold" said the boy.	Unmodified	"The town has been very cold" said the boy.
17			
18	"Your fire could heat the water for our baths and tea".	Unmodified	"Your fire could heat the water for our baths and tea".
19	"My father is the king; I can talk to him" said the boy.	Unmodified	"My father is the king; I can talk to him" said the boy.
20	The dragon followed the boy to town.	Modified	The boy was followed to town by the dragon.
21	The king said the dragon could stay and heat the water.	Unmodified	The king said the dragon could stay and heat the water.
22	The dragon loved the boy for being so nice.	Modified	The boy was loved by the dragon for being so nice.

Each story had 22 sentences, 10 sentences that matched in both versions and 12 sentences which were modified. The modified column in the table refers to if this sentence was the unmodified (unmod) between the stories or if it was modified (mod).

Table A2. Code scoring for passive sentences. Strict coding (SC) does not include as correct truncated passives and passives with morphological errors. The lenient coding (LC) considers truncated passives and morphological errors as correct.

Active correct	*a horse is hitting a fireman, a fairy licks a pig, a horse chased a soldier*	ACC	Y	Y
Active with change of lexical item	*a lion – a bear is pinching a fireman* *a horse pull – er kicking the fireman*	ACC	Y	Y
Active with phrasal transitive verb	*a dog is pushing over the girl*	ACC	Y	Y
Active with morphology error: omitted morphology or over-regularized	*a horse hit a fireman, a horse hitted a fireman*	ACM	N	Y
Active minus aspect auxiliary	*and a pig ø eating a fairy*	ACU	N	Y
Reversed complete Active	*a man hugging a sheep*	ARC	N	N
Complete passive	*a queen is being kissed by a sheep, a king is getting licked by a cow, the robber got bitten by the dog*	PAC	Y	Y
Passive with change of lexical item	*a king – queen was pinched by the cat, a queen was pull – pinched by the cat*	PAC	Y	Y
Passive with phrasal transitive verb	*a girl is being pushed over by the dog*	PAC	Y	Y
Passive with morphology error omitted morphology or over-regularized	*a soldier's being holded by a bear, a girl's been huggen by a rabbit, a king's being liftø by a bear*	PAM	Y	Y
Passive minus aspect auxiliary	*a witch ø being grabbed by an elephant*	PAU	Y	Y
Short Passive	*the robber's being watered ø*	PAS	N	Y
Reversed complete Passive	*a cow's being licked by a king*	PRC	N	N
Complete Intransitive	*a bear was running* *the elephant is laughing*	INC	N	N
Ditransitive verb utterance	*an elephant giving the robber a wash*	OOO	N	N
No verb	*a king and a frog*	OOO	N	N
Uncodable/indecipherable utterances	*a king, a bear, sit, ow!*	OOO	N	N