Syntactic Priming in Child Language: Evidence from CHILDES Database[*]

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1 Introduction

The phenomenon that language users tend to repeat certain syntactic structures they have previously encountered is called syntactic priming (Bock 1986, Pickering & Branigan 1998, Tooley 2023). Syntactic priming is pervasive in either language production (Bock 1986, Cleland & Pickering 2003, Mahowald, James, Futrell & Gibson 2016) or comprehension (Arai, Van Gompel & Scheepers 2007, Fine & Florian Jaeger 2013, Tooley 2023) in various experiments. Generally, the priming effect has been documented in different linguistic levels, such as phonological priming (Slowiaczek, Nusbaum & Pisono 1987), lexical priming (Hoey 2012), and syntactic priming (Bock 1986, Coumel, Ushioda & Messenger 2023, Jaeger & Snider 2008) and has also been investigated with both kids (Huttenlocher, Vasilyeva & Shimpi 2004, Kemp, Lieven & Tomasello 2005) and adults in either monolingual or cross-linguistic (Chen, Jia, Wang, Dunlap & Shin 2013) circumstances.

Specifically, in first-language acquisition, the syntactic priming effect is a direct evidence supporting abstract syntactic representations and hence engages in the argument between the Item-based Hypothesis and the Generalization Hypothesis (Branigan 2007, Tomasello 2000b). So far, the results are conflicting with some studies indicating the existence of abstract representations of specific syntactic structures in child language (Huttenlocher et al. 2004), while others suggest only children who grow to a certain age (e.g., 3 years old) can show lexically non-specific syntactic priming (Branigan 2007, Savage, Lieven, Theakston & Tomasello 2003). Moreover, the age scale of the children mentioned in previous studies is all between 3 and 6, very few of them elaborate the study to children older than 6 years old.

Since it has been brought to attention, the studies investigating syntactic priming effects all fall into two approaches: the experimental approach and the corpus (observational) approach, with the former being more popular than the latter in the last four decades. Nonetheless, recent advancements in corpus methodologies enable researchers to investigate syntactic priming with a promising degree of internal validity. Thus, it seems sensible to talk about how observational data can be used in syntactic priming studies (Gries & Kootstra 2017).

Hence, this paper explores the syntactic priming effect from a corpus-based perspective. By analyzing naturalistic data in the CHILDES database, it aims to answer two questions: first, do children show abstract syntactic representations

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from 4 to 9 years old? And second, does the syntactic priming effect grow as they grow up?

2 Literature Review

2.1 Syntactic priming and its alternative terms

Syntactic priming has been a central topic in the psycholinguistics of language production and comprehension. The term syntactic priming refers to interlocutors' tendency to repeat sentence structures they've recently encountered, either by comprehension or production (Gries & Kootstra 2017). Among experiments investigating syntactic priming, two popular syntactic structures have been tested widely: transitive verbs in active or passive voice and dative constructions in double-object structure or prepositional object construction. According to the priming of dative constructions theory, language users who have recently met or applied a double-object (DO) construction (1a) are more likely to reuse it again than a prepositional object construction (1b) when attempting to utilize another dative verb (Gries & Kootstra 2017).

(1) a. [NP The man] [VP gave [NP *Recipient* the squirrel] [NP *Patient* the nuts]].

b. [NP The man] [VP gave [NP *Patient* the nuts] [PP to [NP *Patient* the squirrel]]].

(examples taken from Gries & Kootstra (2017))

Such priming effects are pervasive and have been observed from both experimental methods and observational methods, in either production to production paradigm or comprehension to production paradigm, in multiple tasks (picture description, sentence completion, dialog tasks, etc.), and in monolingual scenarios or cross-linguistic situations (Pickering & Ferreira 2008).

Apart from syntactic priming, two other different terms have also been adopted to indicate the same situation. For example, structural priming was used to describe a similar phenomenon, but beyond solely abstract syntactic linguistic priming (Bock, Loebell & Morey 1992). Syntactic persistence (Bock 1986, Jaeger & Snider 2008) is another term used to emphasize the persistent cognitive effect caused by previous syntactic structures, but, to some extent, neglecting the 'priming' effect resulting from the 'target' by its name. Therefore, the term syntactic priming is adopted in this paper, to exclusively refer to the priming effect of dative constructions.

2.2 Argument between corpus-based approach and experiment-based approach

The earliest mention of priming was based on observational data: Sankoff & Laberge (1978) first rejected the hypothesis that speakers randomly switch from one realization to another based on their research on Montreal French, thereby implying the effect of priming. However, the first systematic attempt to investigate priming by corpus was Schenkein (1980), who studied repetitions based on the language

of burglars over walkie-talkies, even though the term priming is not necessarily mentioned. In the early corpus-based studies, syntactic priming of voice alternation between active and passive voices has already started to gain attention. In their research, Weiner & Labov (1983) explored aspects that encourage speakers to choose passive structures over active voices, on the basis of interviews with working-class speakers in North America. Although they did not mention the term priming directly either, they found a strong connection between structural similarities and subsequent preceding passives, which is identical to the definition of syntactic priming. It is also important to note that they have already looked at the potential for a cumulative priming effect and the significance of the prime-target distance (Gries & Kootstra 2017). Followingly, based on Weiner & Labov (1983), Estival (1985) still discovered a robust priming effect of passive voice after excluding some potential confounding effects, such as discourse structure repetitions(including lexical repetitions), the availability of multiple competing referents, and so on (Gries & Kootstra 2017).

However, ever since Bock (1986), the experimental approach to priming gradually emerged and gained more popularity over the corpus-based approach. For the next two decades, the experimental approach has been regarded as a preferable way to study syntactic priming since the corpus approach was criticized for being difficult to rule out compound factors and control variables (Gries 2005). Before the influential study of Bock (1986), Levelt & Kelter (1982) first began experiments on syntactic repetition. During their research, they focused on the repetition of prepositions speakers would articulate when facing interview questions such as 'At what time does your shop close?' or 'What time does your shop close?'. A highly influential experiment was then conducted by Bock (1986), who employed a picture-description paradigm to investigate the prime of both transitive sentences in active or passive voice and dative sentences in a prepositional-object or double-object form. Her findings indicate that speakers tend to produce passive sentences after encountering passive voices and produce prepositional-object construction after comprehending prepositional-object sentences and vice versa. Based on the initial findings, Bock and colleagues continued to explore beyond the syntactic priming effect to its implications (Bock 1989, Bock & Loebell 1990, Bock et al. 1992, Branigan, Pickering, Liversedge, Stewart & Urbach 1995).

Nevertheless, the experimental-based approach is not perfect, as it is criticized for relying on comparatively artificial language contexts and non-natural language behavior (Gries & Kootstra 2017). And with the new developments in data analysis, usage-based linguistics, and psycholinguistics, more corpus-based studies are inspired by within-language priming. For example, Gries (2005) further explored the dative alternation based on the British Component of the International Corpus of English (ICE-GB) and used a multifactorial statistical approach and a general linear model to test several priming predictors such as CPPRIME, DISTANCE, SPEAKERID, and so on. Szmrecsanyi (2005, 2006) went even beyond Gries (2005) by proposing two types of priming: α-persistence and β-persistence and using better-suited binary logistic regressions. Jaeger & Snider (2008) extended previous work by exploring the notion of surprisal and cumulativity and proposed that syntactic priming is sensitive

to prime surprisal and priming is cumulative, thereby discouraging the transient activation account (Branigan, Pickering, Stewart & McLean 2000) of priming and supporting that syntactic priming is an implicit learning process (Bock & Griffin 2000). Lastly, Gries (2011) again introduced a generalized linear mixed effects model (GLMM) to handle lexically and speaker-specific variance and find truly relevant priming determinants. All these studies indicate the possibility of studying priming corpus-linguistically without amplifying priming results (Gries & Kootstra 2017).

2.3 Syntactic priming and syntactic abstract representations

In the realm of first language acquisition, there has been much discussion on how syntax is learned, with the main point of contention being the nature of young children's syntactic representations (Conwell & Demuth 2007, Fisher 2002, Naigles 2002, Tomasello 2000a, Tomasello & Akhtar 2003). On the one side, the Generalization Hypothesis proposed that early syntactic representations are abstract. Preschool-aged children have made generalizations about their mother tongue's syntax (Golinkoff, Hirsh-Pasek, Cauley & Gordon 1987). On the other side, Tomasello (2000a) strongly suggested that the children's development of syntax is lexically specific and proposed the Item-Based Hypothesis. However, the discussion around it is not always polar, as Fisher (2002) suggested a combination of item-specific facts and abstract descriptions of linguistic input in early language use.

In numerous experiments, syntactic priming has been used to shed light on the features of young children's representations (Thothathiri & Snedeker 2008), but the results turned out to be controversial. Huttenlocher et al. (2004) explored syntactic priming effects of dative constructions in 4- and 5-year-old children. Their findings corroborate the item-based hypothesis by demonstrating that children represent syntactic forms independently of individual lexical items and that they are more likely to use a particular syntactic form if the experimenter has previously employed it (Huttenlocher et al. 2004). Another experiment carried out by Shimpi, Gámez, Huttenlocher & Vasilyeva (2007) focused on dative priming of 3- and 4-year-old children and indicated that very young children (e.g., 3-year-olds) have abstract syntactic representations that are sensitive to different task demands. Similar results were drawn by Thothathiri & Snedeker (2008), who demonstrated syntactic priming from comprehension to comprehension in 3- and 4-year-old children. However, Gamez, Shimpi & Huttenlocher (2005) claimed no structural priming of datives with 3.5- to 4.5-year-olds (Thothathiri & Snedeker 2008). In short, the results of syntactic priming of the previous studies are controversial and mainly focus on children between 3 and 5 years old. Very few of them look into the language of relatively older children (e.g., 7-, 8-, or 9-year-olds).

3 The Present Study on Dative Construction Priming

The current study explores structural priming and differentiates it from previous studies in two ways. First, instead of designing complex experiments, this study examines priming by analyzing the natural data from the CHILDES database and using

a corpus-based approach to investigate the dative priming in daily conversations. Hence, the data collected won't be criticized for being controlled or manipulated. Second, this study expands the age interval to six years: children from 4 to 9 years old and explores the effect of age on dative priming. In this way, a clearer trend in the development of syntactic priming effect could be observed.

The current study consists of two tests. Test 1 aims to determine whether children are more likely to produce a DO dative construction after comprehending the same construction. The research question for Test 1 is whether children have formed sufficiently abstract syntactic representations for DO construction to increase the possibilities of reusing that form again. Test 2 aims to explore the age effect on the overall successful priming effect, with a research question on whether the syntactic priming effect would increase as children grow old.

3.1 Database

The CHILDES corpus consists of more than 100 databases of transcripts of in-person conversations between young children and their caretakers. Multiple kid interviews conducted over a range of dates are included in many datasets within the corpus to allow for comparisons of priming at different ages. The corpus studied in this paper used two subsets of CHILDES databases (MacWhinney 2014) called OCSC (Wagner, Alghowinhem, Alwan, Bowdrie, Breazeal, Clopper, Fosler-Lussier, Jamsek, Lander, Ramnath et al. 2024) and MacWhinney (MacWhinney 2014), which present children's interactions with their parents or investigators from 4 to 9 years old in North American English. In OCSC databases, children are mostly monolingual English speakers, the majority are White, and they come from a highly educated background,and approximately half are female (Wagner et al. 2024). In MacWhinney's database, recordings were collected from his daily study of the development of his two sons, who were born in 1977 and 1979, respectively (MacWhinney 2014).

In this paper, data files in both OCSC and MacWhinney are selected and further analyzed. In the pre-analysis period, transcripts that do not show any priming effect in adjacent sentences are discarded. As a result, for each age group, 15 transcripts are included in the final data analysis. In the following paper, the phrase 'the corpus' will particularly refer to the OCSC (Wagner et al. 2024) and MacWhinney section (MacWhinney 2014) of the CHILDES database. The morpheme and syntactic category annotations in CHILDES are automatically produced by supervised taggers (MacWhinney 2014). Based on the grammatical relationships between words, the annotations are utilized to create labeled dependency structures (Sagae, Lavie & MacWhinney 2005).

3.2 Test 1: DO ratio test

3.2.1 Data analysis

This annotation system of the corpus labels double objects (indirect objects) as OBJ2 or IOBJ. However, for prepositional objects, there is not a specific label. Therefore, for prepositional objects, a combined CASE and OBL are used to first filter all

the prepositional objects' construction. And then, in order to make sure that the PO construction is led by a dative verb rather than other verbs, they are double scrutinized manually.

Priming sentences and target sentences are filtered by Python based on the same grammatical annotation these sentences contain, and adjacent sentences containing the same dative construction are detected to be successfully primed ($PO-PO$ or $DO-DO$). Otherwise, adjacent sentences containing each of the dative constructions(one of them shows DO construction, while the other contains PO construction) are detected to be unsuccessfully primed ($PO-DO$ or $DO-PO$).

Priming/Target	DO(Prime)	PO(Prime)
DO(Target)	$DO-DO$ (successfully primed)	$PO-DO$ (unsuccessfully primed)
PO(Target)	$DO-PO$ (unsuccessfully primed)	$PO-PO$ (successfully primed)

Table 1   Four possibilities of dative construction priming.

The data analysis method is adopted from Pickering, Branigan & McLean (2002) and Salamoura & Williams (2007). The dependent variable is the DO target ratio, which calculates the proportion of DO versus PO target completions, excluding other target completions. Since this study mainly focuses on the priming of dative structures, sentences that have other structure targets except PO and DO are discarded from the analysis. Instead of evaluating the absolute numbers of PO and DO target completions, this study chooses to study their proportions. That is because the absolute number of a particular structure could be easily influenced by speakers' oral habits or preferences (Pickering & Branigan 1998) and results in bias in the data analysis period. In this case, the proportion of sentence completion structure would provide a better foundation for comparison across different primes (Salamoura & Williams 2007). The DO target ratio is calculated as the number of DO target completions divided by the sum of the number of PO and DO target completions (Salamoura & Williams 2007).

(2)   Dependent variable:

$$\text{DO ratio} = \frac{\text{DO}-\text{DO}}{\text{DO}-\text{DO}+\text{DO}-\text{PO}}$$

The use of DO rather than the PO proportion is random, as the sum of the proportion of PO and DO target ratio should equal to one (Salamoura & Williams 2007). The data of DO ratio is then tested by the Normal Distribution test (Shapiro-Wilk Test) and a significance test (Wilcoxon Signed-Rank Test) in Python. The assumption for Test 1 is that if there is no difference between the overall PO and DO target ratio, both of them will equal .50. In contrast, if the DO target ratio is significantly different from .50, then it will also be significantly different from the PO target ratio, which reveals a preference for speakers to continue to produce a DO sentence after a DO prime. Besides, the DO ratio is also tested across six ages.

Significant differences between DO ratios across different ages would suggest an age effect on priming.

3.2.2 Results

The Normal Distribution test showed that the DO ratio is not normally distributed ($p = 1.35e - 09$). The significance test (Wilcoxon Signed-Rank Test) is then applied and reports a significant difference in the DO ratio median from .50 ($p = .00$). To test the DO ratio differences across six ages, another ANOVA test reports a non-significance difference in DO ratios between the six age groups ($F = 1.94$, $p = .09$).

For each age group, 15 transcripts were transcribed and analyzed. Table 2 shows the mean, standard deviation, Minimum and Maximum of DO ratio for each age group.

| Age group	Number of Transcripts	Mean	Standard Deviation	Minimum	Maximum
4	15	0.666	0.449	0.0	1.0
5	15	0.548	0.383	0.0	1.0
6	15	0.545	0.387	0.0	1.0
7	15	0.550	0.424	0.0	1.0
8	15	0.411	0.392	0.0	1.0
9	15	0.244	0.407	0.0	1.0

Table 2 Description data of DO ratios across six age groups.

Following Table 2, Figure 1 uses a strip plot to indicate the distribution of DO ratio for each transcript in six age groups. DO ratio equals one indicates that all the DO prime sentences are followed by DO target sentences. DO ratio equals zero indicates that DO primes sentences are followed by PO target sentences.

3.3 Test 2: successful priming ratio test

3.3.1 Data analysis

Within the four possibilities of Prime-target pairs, $PO - PO$ and $DO - DO$ patterns are scored as successful priming pairs, while $PO - DO$ and $DO - PO$ patterns are scored as unsuccessful priming pairs. The successful priming ratio is calculated as the number of successful priming pairs divided by the number of all priming pairs. The successful priming ratio is treated as the dependent variable and age is treated as the independent variable. An ANOVA test is applied to the successful priming ratio.
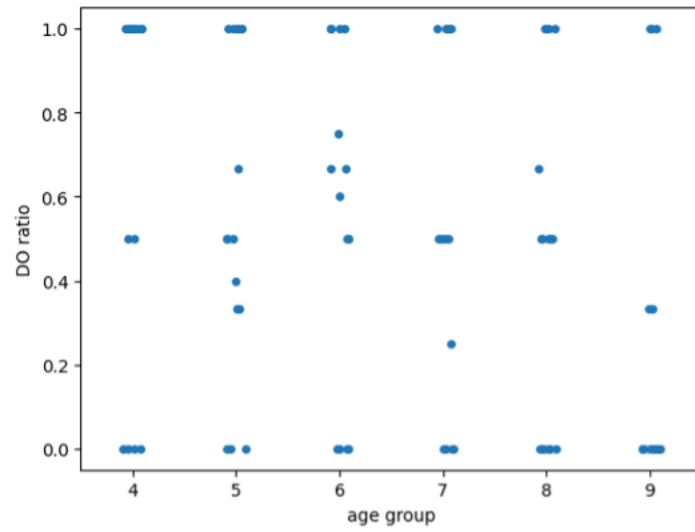
Figure 1   Strip plot of DO ratio by age groups.

(3)   Dependent variable:

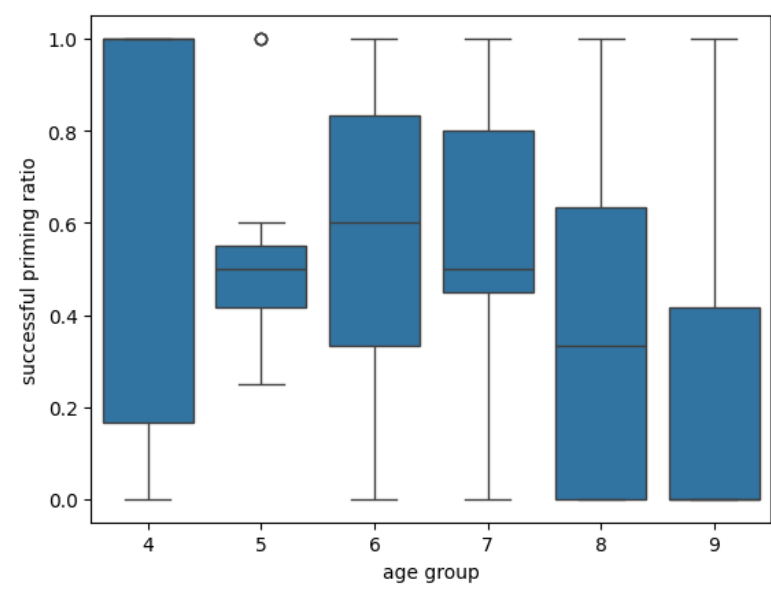Successful priming ratio $=$

$$\frac{(DO - DO + PO - PO)}{(DO - DO + DO - PO + PO - PO + PO - DO)}$$

3.3.2 Results

The ANOVA test reports a significant difference in the successful priming ratios median across the six age groups ($F = 2.89$, $p = .02$). A regression analysis is further applied and shows a trend of decaying priming effects (see Figure 3).

The boxplot in Figure 2 describes the range of values on successful priming ratio for six age groups. For example, the successful priming ratio for children at 4 years old ranges from zero to one. The lower bound for the blue rectangle is the first quartile and the upper bound for the blue rectangle is the third quartile.

Figure 2   Boxplot on successful priming ratio of six age groups.

There are six age groups considered in this paper. For each age group, 15 transcripts were transcribed and analyzed. Table 3 shows the mean, standard deviation, minimum and maximum number of the successful priming ratio for each age group.

| Age group	Number of Transcripts	Mean	Standard Deviation	Minimum	Maximum
4	15	0.655	0.456	0.0	1.0
5	15	0.556	0.247	0.25	1.0
6	15	0.551	0.363	0.0	1.0
7	15	0.533	0.353	0.0	1.0
8	15	0.401	0.381	0.0	1.0
9	15	0.211	0.305	0.0	1.0

Table 3   Description data of Successful priming ratios across six age groups.

Since the successful priming ratio is calculated as in (3), the following table shows the frequencies of four prime-target possibilities in each age group.

Age group	DO-DO	PO-PO	DO-PO	PO-DO
4 years old	14	2	7	2
5 years old	17	6	14	8
6 years old	21	3	13	5
7 years old	14	4	14	4
8 years old	12	5	15	11
9 years old	6	4	21	9

Table 4 Total frequencies of four prime and target pairs in each age.

In order to investigate the relation between successful priming ratio and age, a regression model was applied to the data of successful priming ratio. A downward linear line was shown in Figure 3, indicating that as the children grow up, their successful priming ratio tends to decrease.
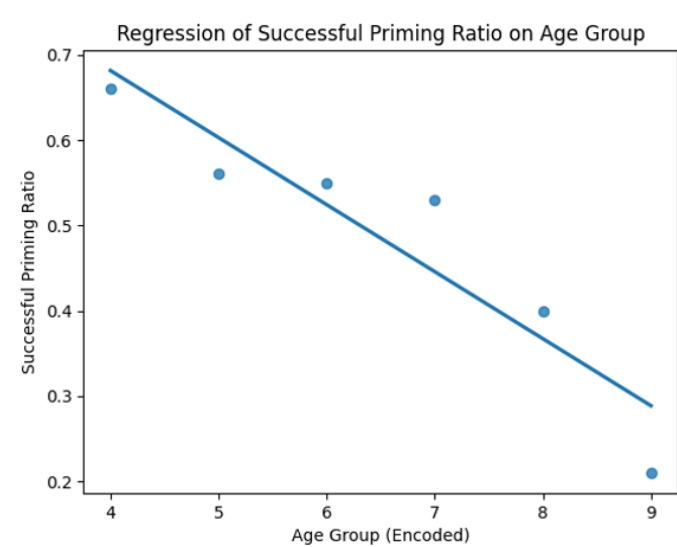
Figure 3 Regression of successful priming ratio on age groups.

4 DISCUSSION

4.1 Abstract syntactic representation in child language

This study mainly shows two findings: first, children older than 4 years old have already formed abstract syntactic representations. Second, the overall successful priming effect turns out to have a decreasing tendency for children aged from 4 to 9.

As previous studies mention, the Item-based Hypothesis proposed that lexical elements serve as the foundation for very early syntactic representations (Olguin & Tomasello 1993, Pine, Lieven & Rowland 1998, Tomasello 2000a). After a certain

age period (e.g., 3 years old), with the help of general cognitive and social-cognitive skills, abstract representations are gradually formed and children start to reach adult linguistic competence (Tomasello 2000b). Therefore, syntactic priming would only be found in the later age of children but not in the early use of language. This first finding aligns with part of this opinion, suggesting that children have demonstrated priming effects on a range of lexical items after four years old, and they can articulate dative interactions using generalized syntactic forms.

Besides, this study shows the possibility that syntactic priming could be investigated through a corpus-based approach. Even though the observational approach has been criticized for accounting for non-syntactic reasons in syntactic priming effect (Pickering & Branigan 1999), the corpus method still has its values: it could function as a complementary and compensate for the unnaturalness or artificialness of the experimental approach. As it is confirmed by Gullberg, Indefrey & Muysken (2009), although naturalistic data have their limits, they can never be replicated or replaced by experiments.

4.2 Unexpected finding of decaying priming performance

Contrary to expectations, Test 2 demonstrates a gradually declining effect of syntactic priming over age. In previous studies, the age effect has always been a controversial factor, with some reporting an increasing priming effect of passive and active voices among children with 2 to 7.5 age intervals (Gerard, Keller & Palpanas 2010), while others claim that syntactic priming is unrelated to age (Kidd 2012). Only a few studies suggest younger children are more affected by the syntactic priming effect than older ones (Rowland, Chang, Ambridge, Pine & Lieven 2012).

Given the arguable findings, my decaying result may seem counterintuitive at first, but it can be explained from the following three perspectives: increasing stability of syntactic representations, increased metalinguistic awareness, and different task paradigms. First, the dual-path model proposed by Chang, Dell & Bock (2006) suggests that language acquisition includes error-based learning to acquire mechanisms and meaning-form mappings to derive syntactic representations. It indicates that the more exposure children have received, the more stable representation they would form. Therefore, for younger language learners with less stable representations, recent input would exert a stronger influence, resulting in larger priming effects. For older children, as they have a relatively settled representation, the impact exerted by previous input tends to be mild, hence showing less priming performance. In addition, by around 7–8 years of age, children start to demonstrate metalinguistic awareness, which allows them to think critically about and work with the structural elements of spoken language instead of just using the language system to understand and construct sentences (Edwards & Kirkpatrick 1999, Tunmer & Herriman 1984). This awareness may make older children more deliberate in their linguistic choices, thus reducing unconscious imitation of the prime. Lastly, the controversial findings may also result from different experiment paradigms. Provided that various paradigms and tasks are applied to test the priming effect among experiments, simpler and highly engaging tasks such as interviews or dialogs

may amplify the priming effect for young children. In contrast, older children may receive less supportive tasks, leading to lower measured effects.

4.3 Limitations of the current study and future research

The results of the current study could come from the limitations of this study. First, the current study fails to explore lexical boost, a well-studied phenomenon describing a rise of structural repetition when the target and prime contain the same content word (Pickering & Ferreira 2008). Recall the data analysis of two tests, although adjacent sentences containing the same DO/PO structure are filtered, the dative verbs in the prime and target sentences have not been scrutinized and matched. Hence, the lexical repetition effect has been ignored and unmeasured in both two tests. Moreover, as in previous literature works, the ages of 3 and 3.5 are the critical periods of forming abstract syntactic representations (Shimpi et al. 2007, Thothathiri & Snedeker 2008), the child language included in this study is relatively late to examine the precise time when children start the transition process from lexically-based to general abstract representation. Second, it is possible that the database included is relatively small (15 transcripts for each age and 90 transcripts in total) to draw the same result with experimental studies, and the results are easily influenced by extreme values. Besides, other important factors such as discourse and pragmatics factors, and frequency of verbs, are not examined in this test either, which may greatly influence overall priming effects.

For future studies, the precise timing at which children begin to generalize abstract representations has not been settled and could be investigated. Additionally, if the two systems do not operate sequentially, it would be worth exploring whether young infants have an adult-like language processing system that involves the interaction of lexical and abstract representations.

5 Conclusion

In sum, this paper reports a two-test study of syntactic priming during first language acquisition. Both two tests focus on the syntactic priming of dative constructions. Test 1 reports a significant priming effect on DO structure, suggesting that children older than four have already formed abstract syntactic representations. Test 2 examines the overall priming effects and finds a decaying priming effect in children from 4 to 9 years old. It also demonstrates the possibility of examining the syntactic priming effect through a corpus-based approach. Future studies could investigate whether there is a critical period for children to form abstract representations or whether children are born with a mature language processing system.

References

Arai, M., R. P. Van Gompel & C. Scheepers. 2007. Priming ditransitive structures in comprehension. *Cognitive Psychology* 54(3). 218–250.

Bock, J. K. 1986. Syntactic persistence in language production. *Cognitive Psychology* 18(3). 355–387.

Bock, K. 1989. Closed-class immanence in sentence production. *Cognition* 31(2). 163–186.

Bock, K. & Z. M. Griffin. 2000. The persistence of structural priming: Transient activation or implicit learning? *Journal of Experimental Psychology: General* 129(2). 177.

Bock, K. & H. Loebell. 1990. Framing sentences. *Cognition* 35(1). 1–39.

Bock, K., H. Loebell & R. Morey. 1992. From conceptual roles to structural relations: bridging the syntactic cleft. *Psychological Review* 99(1). 150.

Branigan, H. 2007. Syntactic priming. language and linguistics compass, 1, 1-16.

Branigan, H. P., M. J. Pickering, S. P. Liversedge, A. J. Stewart & T. P. Urbach. 1995. Syntactic priming: Investigating the mental representation of language. *Journal of Psycholinguistic Research* 24. 489–506.

Branigan, H. P., M. J. Pickering, A. J. Stewart & J. F. McLean. 2000. Syntactic priming in spoken production: Linguistic and temporal interference. *Memory & Cognition* 28(8). 1297–1302.

Chang, F., G. S. Dell & K. Bock. 2006. Becoming syntactic. *Psychological review* 113(2). 234.

Chen, B., Y. Jia, Z. Wang, S. Dunlap & J.-A. Shin. 2013. Is word-order similarity necessary for cross-linguistic structural priming? *Second Language Research* 29(4). 375–389.

Cleland, A. A. & M. J. Pickering. 2003. The use of lexical and syntactic information in language production: Evidence from the priming of noun-phrase structure. *Journal of Memory and Language* 49(2). 214–230.

Conwell, E. & K. Demuth. 2007. Early syntactic productivity: Evidence from dative shift. *Cognition* 103(2). 163–179.

Coumel, M., E. Ushioda & K. Messenger. 2023. Second language learning via syntactic priming: investigating the role of modality, attention, and motivation. *Language Learning* 73(1). 231–265.

Edwards, H. T. & A. G. Kirkpatrick. 1999. Metalinguistic awareness in children: A developmental progression. *Journal of Psycholinguistic Research* 28. 313–329.

Estival, D. 1985. Syntactic priming of the passive in english. *Text-Interdisciplinary Journal for the Study of Discourse* 5(1-2). 7–22.

Fine, A. B. & T. Florian Jaeger. 2013. Evidence for implicit learning in syntactic comprehension. *Cognitive Science* 37(3). 578–591.

Fisher, C. 2002. The role of abstract syntactic knowledge in language acquisition: a reply to. *Cognition* 82(3). 259–278.

Gamez, P., P. Shimpi & J. Huttenlocher. 2005. Emerging syntactic representations as evident through priming. In *Poster presented at the 2005 SRCD Biennial Meeting, Atlanta, GA*, .

Gerard, J., F. Keller & T. Palpanas. 2010. Corpus evidence for age effects on priming in child language. In *Proceedings of the Annual Meeting of the Cognitive Science Society*, vol. 32 32, .

Golinkoff, R. M., K. Hirsh-Pasek, K. M. Cauley & L. Gordon. 1987. The eyes have it: Lexical and syntactic comprehension in a new paradigm. *Journal of Child Language* 14(1). 23–45.

Gries, S. T. 2005. Syntactic priming: A corpus-based approach. *Journal of Psycholinguistic Research* 34. 365–399.

Gries, S. T. 2011. Studying syntactic priming in corpora. In *Converging evidence: Methodological and theoretical issues for linguistic research*, 143–164. John Benjamins Publishing Company.

Gries, S. T. & G. J. Kootstra. 2017. Structural priming within and across languages: A corpus-based perspective. *Bilingualism: Language and Cognition* 20(2). 235–250.

Gullberg, M., P. Indefrey & P. Muysken. 2009. Research techniques for the study of code-switching. In *The Cambridge handbook on linguistic code-switching*, 21–39. Cambridge University Press.

Hoey, M. 2012. *Lexical priming: A new theory of words and language.* Routledge.

Huttenlocher, J., M. Vasilyeva & P. Shimpi. 2004. Syntactic priming in young children. *Journal of Memory and Language* 50(2). 182–195.

Jaeger, T. F. & N. Snider. 2008. Implicit learning and syntactic persistence: Surprisal and cumulativity. In *Proceedings of the 30th annual conference of the cognitive science society*, vol. 827812, Cognitive Science Society Austin, TX.

Kemp, N., E. Lieven & M. Tomasello. 2005. Young children's knowledge of the" determiner" and" adjective" categories. *Journal of speech, language, and hearing research* 48(3). 592–609.

Kidd, E. 2012. Individual differences in syntactic priming in language acquisition. *Applied Psycholinguistics* 33(2). 393–418.

Levelt, W. J. & S. Kelter. 1982. Surface form and memory in question answering. *Cognitive Psychology* 14(1). 78–106.

MacWhinney, B. 2014. *The childes project: Tools for analyzing talk, volume i: Transcription format and programs.* Psychology Press.

Mahowald, K., A. James, R. Futrell & E. Gibson. 2016. A meta-analysis of syntactic priming in language production. *Journal of Memory and Language* 91. 5–27.

Naigles, L. R. 2002. Form is easy, meaning is hard: Resolving a paradox in early child language. *Cognition* 86(2). 157–199.

Olguin, R. & M. Tomasello. 1993. Twenty-five-month-old children do not have a grammatical category of verb. *Cognitive Development* 8(3). 245–272.

Pickering, M. J. & H. P. Branigan. 1998. The representation of verbs: Evidence from syntactic priming in language production. *Journal of Memory and Language* 39(4). 633–651.

Pickering, M. J. & H. P. Branigan. 1999. Syntactic priming in language production. *Trends in Cognitive Sciences* 3(4). 136–141.

Pickering, M. J., H. P. Branigan & J. F. McLean. 2002. Constituent structure is formulated in one stage. *Journal of Memory and Language* 46(3). 586–605.

Pickering, M. J. & V. S. Ferreira. 2008. Structural priming: a critical review. *Psychological Bulletin* 134(3). 427.

Pine, J. M., E. V. Lieven & C. F. Rowland. 1998. Comparing different models of the development of the English verb category. *Linguistics* 36(4). 807–830.

Rowland, C. F., F. Chang, B. Ambridge, J. M. Pine & E. V. Lieven. 2012. The development of abstract syntax: Evidence from structural priming and the lexical boost. *Cognition* 125(1). 49–63.

Sagae, K., A. Lavie & B. MacWhinney. 2005. Automatic measurement of syntactic development in child language. In *Proceedings of the 43rd Annual Meeting of the Association for Computational Linguistics (ACL'05)*, 197–204.

Salamoura, A. & J. N. Williams. 2007. Processing verb argument structure across languages: Evidence for shared representations in the bilingual lexicon. *Applied Psycholinguistics* 28(4). 627–660.

Sankoff, D. & S. Laberge. 1978. Statistical dependence among successive occurrences of a variable in discourse. *Linguistic Variation: Methods and Models* 119–126.

Savage, C., E. Lieven, A. Theakston & M. Tomasello. 2003. Testing the abstractness of children's linguistic representations: Lexical and structural priming of syntactic constructions in young children. *Developmental Science* 6(5). 557–567.

Schenkein, J. 1980. A taxonomy for repeating action sequences in natural conversation. *Language Production/Academic Press* .

Shimpi, P. M., P. B. Gámez, J. Huttenlocher & M. Vasilyeva. 2007. Syntactic priming in 3-and 4-year-old children: evidence for abstract representations of transitive and dative forms. *Developmental Psychology* 43(6). 1334.

Slowiaczek, L. M., H. C. Nusbaum & D. B. Pisono. 1987. Phonological priming in auditory word recognition. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 13(1). 64.

Szmrecsanyi, B. 2005. Language users as creatures of habit: A corpus-based analysis of persistence in spoken English. *Corpus Linguistics and Linguistic Theory* 1(1). 113–150.

Szmrecsanyi, B. 2006. *Morphosyntactic persistence in spoken English: A corpus study at the intersection of variationist sociolinguistics, psycholinguistics, and discourse analysis*. Mouton de Gruyter.

Thothathiri, M. & J. Snedeker. 2008. Syntactic priming during language comprehension in three-and four-year-old children. *Journal of Memory and Language* 58(2). 188–213.

Tomasello, M. 2000a. Do young children have adult syntactic competence? *Cognition* 74(3). 209–253.

Tomasello, M. 2000b. The item-based nature of children's early syntactic development. *Trends in Cognitive Sciences* 4(4). 156–163.

Tomasello, M. & N. Akhtar. 2003. What paradox? A response to Naigles (2002). *Cognition* 88(3). 317–323.

Tooley, K. M. 2023. Structural priming during comprehension: A pattern from many pieces. *Psychonomic Bulletin & Review* 30(3). 882–896.

Tunmer, W. E. & M. L. Herriman. 1984. The development of metalinguistic awareness: A conceptual overview. *Metalinguistic awareness in children: Theory, research, and implications* 12–35.

Wagner, L., S. Alghowinhem, A. Alwan, K. Bowdrie, C. Breazeal, C. G. Clopper, E. Fosler-Lussier, I. A. Jamsek, D. Lander, R. Ramnath et al. 2024. The Ohio Child Speech Corpus. Available at SSRN 4846086.

Weiner, E. J. & W. Labov. 1983. Constraints on the agentless passive. *Journal of Linguistics* 19(1). 29–58.

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