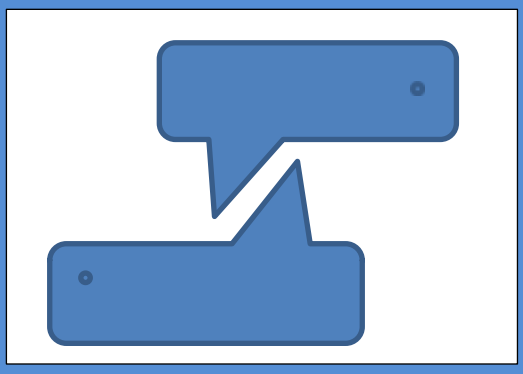
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Processing and acquisition of coreference: an investigation on Binding Principles development in Brazilian Portuguese

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José Ferrari-Neto[1]
Federal University Of Paraíba
Ruth Elisabeth Vasconcellos Lopes[2]
University of Campinas/CNPq

Abstract

This article discusses the processing and acquisition of coreference by monolingual children acquiring Brazilian Portuguese (henceforth BP). More specifically, it is about the development of the coreferential relations established in the scope of the sentence, which are ruled by the principles defined by the Binding Theory. By using a version of the cross-modal picture decision task, we investigated how children acquiring BP process the input, in order to identify the coreferential relations present in the sentences and what role the binding principles play in this process. The results showed that binding principles pose different processing costs, and they also revealed a main effect of age, with adults being faster than children... To sum up, the results of this study showed that, as expected, both children and adults know the binding principles, however, the cost of processing them effectively increases with age. The results also revealed that each binding principles poses different processing demands, as reflected in the reaction times shown in our results.

Keywords: binding principles, coreference, language acquisition, Brazilian Portuguese, language processing

1. Introduction

Coreference is the phenomenon in which two linguistic elements refer to each other within a sentence and both refer to the same being in the extralinguistic universe. Within the generative framework, the study of co-referential relations, especially anaphoric ones, has been the object of study by a specific module, the Binding Theory (Chomsky, 1981). It has sought, basically, to determine the syntactic factors that rule the establishment of coreferential relations, through the formulation of formal principles concerning each type of resumption considered by the theory, namely, anaphors, pronouns and referential expressions.

[1]Bio: Associate Professor I of Linguistics and Portuguese Language, and researcher in the Laboratory of Linguistic Processing (LAPROL), today carrying out studies in the fields of language acquisition and language processing. The present paper was made possible with the support of the Brazilian National Research Council (CNPq). Corresponding author: joseferrarin1974@gmail.com

[2]Bio: Associate Professor II of Linguistics, and researcher in the fields of the acquisition of syntax and the semantic-syntax interfaces mainly on Brazilian Portuguese.

In general lines, binding poses three different principles, each related to one specific kind of proform: Principle A, which concerns with the constraints on the reference of anaphors, such as reflexives and reciprocals, Principle B, which defines constraints on pronouns, and Principle C, which defines constraints on other referring expressions. The following sentences can be seen as examples of each proposed principle:

(1) James thinks that George likes himself.
(2) James thinks that George likes him.
(3) James thinks that George hates Paul.

A brief description of these three principles is shown below:

Principle A: an anaphor must be bound in its domain.
Principle B: a pronoun must be free in its domain.
Principle C. a R-expression must be free in any domain.

In (1), Principle A allows *George*, but not *James*, to be an antecedent for the reflexive anaphor *himself*. On the other hand, in the sentence (2), Principle B allows *James* but not *George* to be the antecedent of the pronominal *him*. Principle C is related to the reference of nouns like *Paul* in the sentence (3), which are called *R-expressions*. As Sturt (2003) says, and applying the principles above, the explanations for the contrasts among these sentences is purely syntactic: the noun *George* and the anaphor *himself* are in the same local domain (in this case, a clause), and, in according to Binding Theory, the noun *George* is c-commanding *himself,* since it is placed in a position of syntactic prominence in relation to the *himself,* and c-command is enough to establish a syntactic domain be bound. In your turn, *James* and the pronoun *him* are not in the same syntactic domain (because they are in different clauses), so, *James* is not c-commanding *him*, leaving the pronoun free in its domain. Then, Principle A allows the reflexive anaphor *himself* to refer to *George*, but not to *James*, and the Principle B allows *him* to refer to *James*, but not to *George*.
It must be said that such principles are relevant to the functioning of these forms of resumption only when inserted in a sentencing context, not going beyond the limits of the sentence. This fact implies that the binding principles apply to cases of intrasentential correspondence, but do not apply to cases in which the correspondence is established beyond the sentence, at the level of the text / speech.
Regarding the acquisition of the binding principles, studies have focused, more often than not, on the characterization of the child mastery of the binding principles defined within the scope of generative linguistic theory (Chien & Wexler, 1990; Mckee, 1992, with data from English, Grolla, 2012, Bertolino & Grolla, 2012, with data from BP), as well as in the domain of the coreferential and anaphoric use of pronouns and reflexives (Grodzinsky & Reinhart, 1993). However, there are studies in which it was attempted to determine at what stage of children's linguistic development the binding principles would emerge (Mustafawi & Mahfoudhi, 2002; Kiguchi & Thornton, 2004; Kim & You, 2000), as well as discussing whether this

acquisition would have a universal shape among human languages (Iglesias, 2007). Other studies aim to investigate possible extralinguistic factors that could influence the linguistic processing of children involved in the acquisition of principles, such as the context of enunciation and knowledge of the world (Gordon & Hendricks,1997).

The study of the acquisition of the binding principles has proved to be of great importance not only for the increment of the research on binding itself, but also for the empirical evidence brought about that supports the propositions of the formal model in which they are inserted. Indeed, since these principles are considered innate, within the framework of the language model suggested by the generative linguistic theory, it is expected that the restrictions of referential interpretation imposed by them will be operative from the initial stages of linguistic development, with the child mastering them as soon as exposed to the sentences in which they appear (Guasti, 2002, Thornton & Wexler, 1999). Furthermore, some others studies have addressed some factors that must be taken into account when knowledge of innate principles are considered, such as lexical learning (Wexler & Manzini, 1987), maturation of grammar (Grimshaw & Rosen, 1990) and the role of non-specific components, as working memory (Araújo & Ferrari-Neto, 2020). Thus, the investigation regarding the acquisition of binding principles seems to be fundamental to the so-called innate hypothesis on which the theoretical generative model has been based.

Studies in this field have shown that, crosslinguistically, children seem to master the principles around 3 to 4 years of age (Guasti, 2002). Such studies have focused, in most cases, on the interpretation given by children to pronouns, anaphors and referential expressions, using offline experimental paradigms. The evidence obtained in such studies suggests that the mistakes made by children in this age group in tasks of interpreting coreferential forms (proforms) are not due to the unavailability of the principles at a given moment in the acquisition process, but probably to difficulties in experimental procedures. With regard to the acquisition of each principle, specifically, some interesting results can be reported. Chien & Wexler (1990), researching the acquisition of Principle A, claim that children acquiring English demonstrated knowledge of this principle at around 5 years of age. McKee (1992) found that children had acquired Principle A around 3 years of age. Regarding Principle B, the studies by Chien & Wexler (1990) and McKee (1992) showed that this principle is acquired later than Principle A (so called *Principle B delay effect*), which shows a certain difficulty for children acquiring English in processing reflexive elements.

The acquisition of binding principles in BP has also been presented in a series of papers (Grolla, 2009; Grolla, 2012, Bertolino & Grolla, 2012). In these studies, it was evidenced that children around 4 years of age show knowledge of Principle C, recognizing the sentences in which there is a violation of this principle (Grolla, 2009). In addition, children acquiring BP seem to have difficulties in establishing the correct referent of reflexive expressions, like *himself* (Grolla, 2012) and that children around 6 years of

age, who speak BP, presented a performance similar to that of BP adult speakers (Bertolino & Grolla, 2012).

The common feature of all these studies is the fact that they used offline methodologies, focusing, especially, on the infantile use of the binding principles in the interpretation of the correct antecedent of pronouns, anaphors and referential expressions. This particular manner to look at the problem of acquisition of binding principles is related to child's capacity to use grammatical knowledge in the process of identification of the correct antecedents of pronouns and anaphors as well as the recognition of possible violations. In other words, this view is concerned to *binding*, here considered as the establishment of a link between the referring expression and one or more possible antecedents (Sturt, 2003). Although it is possible to extract from them a very well delineated picture in which the linguistic development related to coreference can be seen, especially with regard to the mastery of binding principles and the recognition of their violations, some questions seem to need further elaboration. It seems to be necessary to investigate the process of *resolution*, defined as the stage in which the link made in the binding process is evaluated, recomputed and integrated into the semantic interpretation, as well as the factors that can be related to this process (Sturt, 2003).

Specifically, some of these factors may be the (probable) relation between the development of working memory, which is fundamental for maintaining possible antecedents in memory and later recovery, is not considered. The role of contextual and semantic information in the processing is considered only tangentially, which prevents them from being isolated from the performance of the principles and from being analyzed as possible resources that the child in the early acquisition stage uses to establish the correct coreferentiality. Still, given that each form, whether pronoun or anaphor, or even referential expressions, has its semantic, contextual and even structural specificities, carrying information of different natures, it is reasonable to assume that they make specific demands on processing systems, which can entail different procedural costs, which, in turn, would be reflected in the way and order in which they are processed and acquired. Finally, the type of information that is presented to the child in the input, and from which the child recognizes both a certain proform and the principle linked to it, and becomes able to establish the correspondence, is neither clear nor determined. In short, the acquisition of principles has been studied so far, notably with regard to its maturation, and not in its relation with the processing systems that support them.

The present article can be considered as a first attempt to address these questions and understand them better. Here, it is considered that the task of the child when it comes to acquire coreference is, at the first moment, to identify the nouns that represent external entities as possible antecedents, and store them in working memory. Previous works do not deal with this question directly, since their focus is the identification of antecedents at the moment the retrieval is recognized. Secondly, the child must recognize proforms and classify them into anaphor or pronoun, identifying its grammatical properties. For this, the ability to process the linguistic primary input to which the child is exposed is required, alongside the development

and maturation of the binding principles. So far, the process deals with the grammatical knowledge required, its development and use in the processing of coreferential relations present in sentences in a certain language (in our case, BP). But, in a broader psycholinguistic approach, some additional steps should be taken into account. Under this view, a child must establish the coreferential relations with the nouns stored in the working memory by applying the correct binding principle, which is supposed to be linked with the development of the working memory capacity, as the child develops and the maturation of the working memory is complete. Eventually, the use of other kind of information (semantic, pragmatic) in order to determine the correct antecedent of a proform can occur in this process.

By using the experimental methodology described below, it is believed that these issues can be addressed. An experimental factor, type of binding principle, has been controlled, since each principle is represented by a specific kind of retrieval, based on the hypothesis that the binding principles pose different processing demands for their identification, with main effects of type of principle being expected. In addition, subjects already know principles A and B, despite of principle B showing a delay, when compared to principle A in tasks of interpretation of the correct antecedent (Principle B delay - Chien and Wexler, 1990, among others). Assuming this hypothesis, a main effect of matching can be expected, with the matching conditions being faster than the mismatching conditions. Such a scenario can be taken as an evidence of the subjects' intuition of the grammaticality of the sentences. Last, results can indicate that the knowledge of the binding principles increases with age, since it is part of the development of the linguistic competence (see Sekerina et al., 2004), as well as it can suggest distinct stages of working memory's maturation. A main effect of group can be expected with the adults being faster than children in both age ranges analyzed, and with the older children being faster than the younger ones.

2. Methodology

This study uses a modified version of the cross-modal picture decision task experimental paradigm (McKee et al., 1993), in a version adapted for Brazilian Portuguese. It consists of the presentation of auditory stimuli (in this case, sentences previously recorded) and, in a certain point of the stimuli, a word or a picture is shown on a screen. The subjects are asked to decide about the word or picture that they were exposed to, such as, for instance, whether the word or picture they were exposed to represents an animate or inanimate entity. The point in which the visual stimuli are shown is considered the critical point and, in the case of coreference or binding processing, it marks the position of the proforms in the sentence. The basic idea here is that the reaction times are differently affected by the kind of proform, so that the response times for the different proforms can be taken as a reliable measure of their processing cost.

So, this paradigm is based on the priming effect[3], which has been used in many psycholinguistic experiments in order to reveal some aspects of sentence processing, as well as some important issues about lexical processing. Regarding coreference and binding principles, some studies using priming effects have revealed differences in response times in sentence processing tasks involving different kinds of proforms (Fodor, 1988; Nicol and Swinney, 1989; McKee et al.,1993), thus suggesting the reliability of priming.

Last, but not least, experimental paradigms based on priming effects can be used to build on-line studies, since the responses are collected at the exact moment of the presentation of the stimuli, then increasing the reliability of the registered measures. In the case of the present study, this means that the processing cost of the proforms analyzed here will be measured in a very precise way.

2.1. Experimental Design

The experiment has two independent variables: type of binding principle and matching between the picture and the antecedent of the proform. The former contains three levels: principle A1 (represented by the BP anaphora *se*), principle B (represented by the personal pronouns *ele(a) (he/she*), and the principle A2 (represented by another type of reflexive anaphora existing in BP, *ele(a) mesmo(a) (he/she himself/herself*). The latter has three conditions as well: matching, mismatching and control. In the matching condition, the picture that appears on the screen is related to the antecedent correctly licensed by the correspondent principle, i.e., in the principle A condition, the picture is related to the closest NP, whereas in the principle B condition, the picture is related to the furthest NP. In the mismatching condition, the opposite occurs: the picture is related to the antecedent not licensed by the correspondent principle. Thus, in the principle A condition, the picture is related to the furthest NP, whereas in the principle B condition, the picture is related to the closest NP. In the control conditions the picture is not related neither to the furthest NP, nor the closest NP, but something not present in the sentence. These variables were crossed in a 3 x 3 factorial design, with 9 experimental conditions overall. A group factor (age of subjects) was included, and it has three levels too: 5-7 years old, 8-10 years old[4], and adults, thus forming a within- subjects design, as can be seen in Table 1 below:

[3] Priming is an effect in which the previous exposure to a stimulus affects the processing of a subsequent stimulus. For example, the word *nurse* is recognized faster following the word *doctor* than following the word *milk*. In general, in studies that explore this effect in experimental paradigms, the stimuli are the same kind (a pair of writing words, or a pair of sounds, for example). In the cross-modal priming tasks, the stimuli are not the same kind – in our case, we used pictures and recorded sentences.

[4] The choice of this age range was due to the fact that Grolla (2012) shows that the BP anaphor "ele mesmo" is harder for Brazilian children up to 6 years of age. Besides, according to Gathercole (2003), the development of working memory shows qualitative changes from infancy until around 7 years of age, when its function is more adult-like in organization and capacities, but showing a gradual quantitative increasing.

Table 1

The List of Stimuli

Groups (by age)	Conditions
5-7 years old	Principle A1 (matching and mismatching)
	Principle B (matching and mismatching)
	Principle A2 (matching and mismatching)
8-10 years old	Principle A1 (matching and mismatching)
	Principle B (matching and mismatching)
	Principle A2 (matching and mismatching)
Adults	Principle A1 (matching and mismatching)
	Principle B (matching and mismatching)
	Principle A2 (matching and mismatching)

A yes-no control question was included at the end of each experimental sentence, in order to verify if the subjects paid attention to the task. Reaction times for the appearance of the picture consist of the dependent variable.

2.2. Experimental Conditions

Examples of each experimental condition can be found below. The word in brackets indicates the picture that is shown, as well as the point of the sentence in which the picture appears:

- Principle A1 Matching
A professora falou que a aluna de olhos azuis se [ALUNA] penteou na aula. A aluna se penteou?
"The teacher said that the student with blue eyes brushed herself [student] during class. Did the student brush herself?"

- Principle A1 Mismatching
O policial avisou que o menino de cabelo longo se [POLICIAL] pintou na escola. O menino se pintou?
"The policeman said that the boy with long hair had painted himself [policeman]. Did the boy paint himself?"

- Principle A1 Control
A bailarina percebeu que a menina de vestido verde se [MULHER] feriu na cozinha. A menina se feriu?
"The dancer realized that the girl in the green dress hurt herself [woman] in the kitchen. Did the girl hurt herself?"

- Principle B Matching
A borboleta contou que a galinha de bico afiado arranhou ela [BORBOLETA] na fazenda. A galinha se arranhou?

"The butterfly said that the sharp beaked chicken scratched it [butterfly] in the farm. Did the chicken scratched itself?"

- Principle B Mismatching
A dançarina contou que a formiga com boca grande mordeu ela [FORMIGA] na perna. A formiga se mordeu?
"The dancer said that the ant with a large mouth bit her [ant] in the leg. Did the ant bit itself?"

- Principle B Control
A mulher percebeu que a barata de asas escuras sujou ela [ABELHA] em casa. A barata se sujou ?
"The woman realized that the dark winged cockroach messed her [bee] up at home. Did the cockroach mess itself up?"

- Principle A2 Matching
O leão contou que o urso de pelo marrom assustou ele mesmo [COBRA] no mato. O urso se assustou?
"The lion said that the brown haired bear scared itself [snake] in the bush. Did the bear scare itself?"

- Principle A2 Mismatching
A vovó percebeu que a filha de cabelo louro beijou ela mesma [VOVÓ] em casa. A filha se beijou?
"Grandma realized that her blonde haired daughter kissed herself [grandma] at home. Did her daughter kiss herself?"

- Principle A2 Control
O papai disse que o homem de braço forte cortou ele mesmo [MENINO] no trabalho. O homem se cortou?
"Dad said that the strong man cut himself [boy] during work. Did the man cut himself?"

2.3. Materials

Nine lists of stimuli were used, as seen in Table 1 above. The stimuli were recorded using a female volunteer, through the specialized software Audacity, version 2.0, and equalized and adjusted in volume, pitch, tone and level of noise. Each list had 6 experimental sentences, two per condition, and these sentences were all built following the structure [NP1[VP that [NP2...], with the proform always placed in the second clause of the sentence. All the NP´s were controlled in frequency and familiarity through a familiarity test which subjects were submitted to, in order to avoid possible effects of unfamiliarity that could have caused delay in response times. Between the second NP and the second verb, the experimental sentences had a PP modifying NP, placed there to separate away the NP from the proform, thus avoiding effects of recency. Besides that, a PP was added at the end of the experimental sentences, so that subjects could continue to process the sentence normally even after they had seen the picture. Both the gender of NPs and of the proforms that agree with them were counterbalanced. In addition to experimental sentences, 20 fillers sentences were included in each list as distractors. Among these fillers, there were 7 sentences, so called pseudo-experimental, which were similar in structure to experimental sentences. In addition, 13 filler sentences were included, whose structure were quite different from the experimental ones. This procedure was required

in order to avoid possible sentence structure effects, which could reflect in a strict correlation between sentence type and response type (cf. McKee et al, 1993). All the pictures used were controlled in size and type. The experiment was build using the software Paradigm, version 2.5, in a notebook computer HP Pavillion x360.

2.4. Participants

Children of two age ranges will be analyzed: 5-7 years old and 8-10 years old. A group of adults will also be analyzed. These three groups will be divided into three other subgroups. Each subgroup will have 10 subjects at least, totalizing 90 subjects. All the children were selected in schools in the cities of João Pessoa/PB and Campinas/SP, and adults, ranging from 18 to 40 years old, were selected among undergraduate students of the Federal University of Paraíba and University of Campinas, both located in Brazil.

2.5. Data collection

Subjects were first submitted to a pre-test, in order to verify whether the nouns used in the experiment were familiar to them. This pre-test consisted of the presentation of the pictures in the computer screen. For each picture, subjects were asked to point out if the picture was familiar or not, through pressing the correspondent key on the keyboard (previously selected). The list was composed of 80 words, among which 24 proved more familiar and were chosen to build the experimental sentences. Secondly, subjects were submitted to a test that consisted of pointing whether the pictures represented an inanimate or an animate being. The pictures used here were the same used in the experiment, so that the possibility to commit errors in the task was decreased. In the experiment properly, subjects seated in front of the computer and with the hands on the keyboard, were submitted first to a training session, in order to correctly learn the task. The task consisted of pressing either the yellow key every time the picture represented an animate being, or the green key, otherwise. After that, they listened to the sentences one by one, pressing the correspondent key (yellow key in the case of “yes” response, or green key, in the case of “no” response.). The computer collected and stored all the given responses, as well as their respective times. The training session was formed by six sentences, 2 using the pronoun ele(a), 2 using the reflexive anaphor se, and 2 using the reflexive anaphor “ele(a) mesmo(a)”. 3 sentences required a “yes” response, and 3 required a “no” response. The experimental session was composed of 26 sentences, with all the 6 experimental sentences requiring a “yes” response plus 7 pseudo-experimental filler sentences that required “no” responses, and 13 filler sentences that required either “no” responses (7 sentences) or “yes” responses (6 sentences), as to counterbalance the number of responses of each type. The complete session, including the animate-inanimate pre-test, the training session and the experimental session lasted around 20 minutes.

3. Findings

Data was submitted to a normality test (Shapiro-Wilk test), in order to check their normal distribution. Since this distribution was found in the data, a

parametric test was chosen to be applied to them. An analysis of variance with three factors (three-way ANOVA), factorial design 3 (type of principle) x 3 (age) x 2 (matching) was carried out. The results revealed a main effect of type of principle ($F(17, 1063) = 26,18$, $p<0.05$). A 2x2 comparison test (Tukey test) was also carried out, in order to reveal differences among the levels of this experimental factor, according to the Figure 1 and Table 2 below:

Figure 1

A 2x2 comparison test (Tukey test)

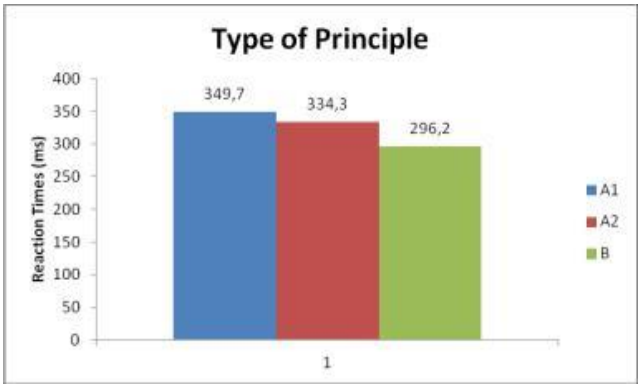


Table 2

2x2 Comparisons (Tukey Test)

Factor	Means	p.value
A1	349,7	0,142883608
A2	334,3	1,18446E-09*
B	296,2	2,55765E-05*

The results showed that principle B was processed faster than both principle A1 and A2, which is in accordance with the predictions assumed here. Besides, principle A2 was faster than principle A1, as expected. In addition, the ANOVA also revealed a main effect of age ($F(17, 1063) = 96,10$, $p<0.05$), with adults being faster than children, thus confirming the second prediction, according to the following Figure 2 and Table 3.

Figure 2

Reaction times based on the age of the participants

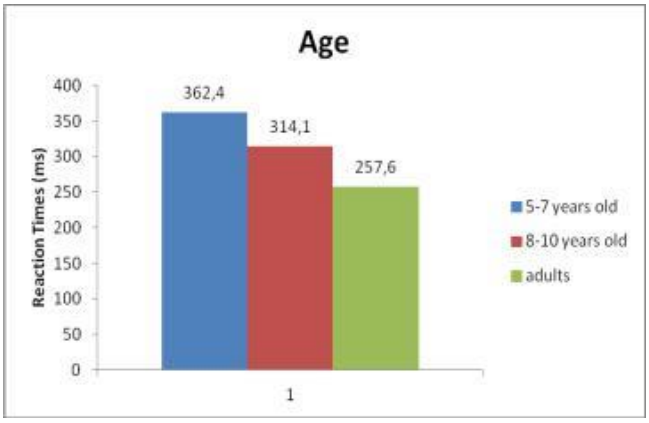


Table 3

2 x 2 Comparisons Tukey Test

Factors	Means	p.value
5-7 years old	362,4	2,43051E-09*
8-10 years old	314,1	2,07565E-10*
Adults	257,6	6,74275E-10*

No main effect of matching was found, but an interaction effect between principle and matching was found ($F(17, 1063) = 9,18$, $p<0.05$). The match conditions made the processing of principle B faster than principle A1, and the mismatch conditions made the processing of principle A1 faster than principle B, as shown in the Figure 3 below.

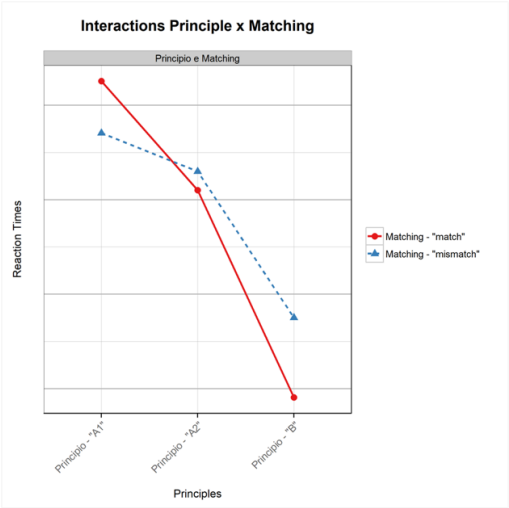


Figure 3

Interactions Principle x Matching

The significant difference observed in the reaction times in each binding principle goes in the direction of the hypothesis assumed here, that the principles impose different processing costs. Principle B, which is related to full pronouns, presented a lower processing cost than Principle A in the two reflexive forms studied here. At first glance, this seems to go in the opposite direction to what would be predicted by Principle B Delay Effect. However, it is necessary to keep in mind that this effect is related to the identification of the correct antecedent of a pronoun, more than an investigation about its processing, which implies the reactivation of an antecedent in the working memory and its subsequent binding with the retrieval. Analyzed from this perspective, it is possible to say that pronouns, at least in BP, activate an antecedent stored in working memory more easily than a reflexive anaphor, despite being able to establish relations that are not always local. A possible explanation for this effect may be the fact that the pronouns refer back to the name located in the subject position of the main clause, a more prominent topic position. In addition, the fact that it was mentioned first may contribute to make the antecedent of the pronoun more active in working memory, within what is known as the primacy effect (BADDELEY, 1986). These two factors act to facilitate the action of principle B in the search and recovery of its possible antecedents at the time the pronoun is processed. Principle A, even establishing more local relations (which is to say that the retrieval is closer to its antecedent), causes greater difficulty in reactivating its antecedent when compared with the antecedents licensed by principle B, which delays its processing in the sentences used in this experiment, probably due to the fact of the antecedent of the anaphor is placed in a less prominent topical position. To summarize, the action of the binding principles seems to be affected not only by factors of syntactic configuration, but also by effects related to the working memory, especially with regard to the way the stored antecedents are activated and retrieved when pronouns and anaphors are processed.

The differences observed with regard to the analyzed ages are consistent with the natural course of linguistic development and maturation of working memory. Adults have shorter processing times due to their full acquisition process as well as the maturation of their working memory. The same can be said of children in the intermediate age group, who are faster in response times than younger children. The age effect observed here, therefore, goes against what is proposed by the hypothesis assumed here, that there is a progressive maturation of the grammar being acquired, in addition to the working memory[5] that serves as a basis.

The lack of a significant matching effect could cause some confusion, at first, that it could denote a precarious acquisition of the binding principles, or even that adults are not able to perceive violations of these principles. However, the observation of the interaction effects resulting from ANOVA

[5] To provide more evidence on this hypothesis, the use of some working memory test should be applied. Initially, we thought about applying the standard memory span tests (digit span, word span). However, we realized that such tests focus on working memory only in terms of its capacity, which could not prove to be predictive of a more complete development of working memory. A more appropriate test would be the reading span test, like the one being developed by Vasconcelos, Almeida, Estivalet and Ferrari-Neto (2019).

may provide a possible explanation. Longer reaction times were recorded in condition A1, regardless of matching, possibly due to the fact that anaphors, as already seen, hinder the activation and retrieval of their antecedents in working memory, also causing greater difficulty in the perception of violations of principle A. In turn, shorter reaction times recorded in condition B seem to indicate a more accurate perception of the violations of principle B, since their activation and recovery in working memory are easier. Then, the perception of violations when the antecedents are not so activated is more unlikely. With pronouns, since they activate their antecedents more strongly, the perception of violations is easier, which explains the shorter reaction times of condition B in the interaction with the matching condition.
To sum up, the results of this study showed that, as expected, both children, as well as adults, know the binding principles, however, processing them effectively increases with age. The binding principles also pose different processing demands, as reflected in the reaction times shown in our results, and seems to be affected by factors related to working memory operation.

4. Conclusions and Discussion

The study of the acquisition of anaphoric coreference, together with the acquisition of the binding principles, suggested by the generative linguistic theory, focuses on determining the correct antecedent of reflexive anaphors, as expected in a theory whose main goal is to model the grammatical knowledge possessed human speakers. However, more than that, it is also necessary to include in this modeling the use of that knowledge in the processing of language, as proposed by psycholinguistics theories. Under this view, the study of processing and acquisition of binding principles must determine how the antecedents are kept in the working memory and retrieved from it, at the moment when a proform is recognized in the input, as well as it is necessary to verify how children during the acquisition process perceive linguistic elements which will enable them establishing co-referential relationships. According to Ferrari-Neto and Marinho (2015), this type of information is undoubtedly very relevant to the knowledge of the acquisition process of this module of grammar, but there is also a need to verify the influence of other factors. Thus, in this paper, we aimed to explore, through online methodology, the cost of processing of binding principles, providing some insights about how these principles are acquired and used in sentence processing. In addition, the working memory maturation factor was also investigated, by comparing different age groups. In general, the results obtained here allow us to claim that the linking principles are available early in children's grammar, in the direction of what Grodzinsky and Reinhart (1993) sustain. The differences observed in the processing times of principles A and B, here studied, suggest that they impose specific demands, at least with regard to the ages analyzed, which can be understood as evidence of the way they are perceived and processed by the child from the input to which they are submitted.

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Preschoolers' interpretation of habitual and deontic conditionals: a delayed mapping between concept and language

Jing Lin[1]
Leiden University

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Abstract

By investigating Dutch children's interpretation habitual and deontic conditionals, this paper explores their mapping of the concepts of hypotheticality and conditionality into a corresponding linguistic form of IF-conditionals. Results of 46 children (20 girls; age range = 3;11-6;00; mean = 4;11) in a truth value judgment task with three types of stimuli, i.e. habitual conditionals, deontic conditionals, and conjunctive/additive constructions, show the following. First, the preschoolers do not exhibit different interpretation performances with the two types of conditional stimuli and the conjunctive/additive type. Second, the preschoolers show more target-like interpretation performances with deontic conditionals than habitual conditionals when it comes to the concept of conditionality. These results suggest a delayed mapping of the two concepts investigated into the corresponding linguistic construction. In other words, the syntactic construction of IF-conditional in Dutch is first acquired before the two concepts are assigned to it. Taking into consideration different factors, this paper discusses possible explanations for the delay.

Keywords Conditional constructions, conditionality, Dutch, hypotheticality, truth value judgment task

1. Introduction

The way in which we conceptualize the world surrounding us is reflected in the language we speak. Gender is one example, the distinction of which is made by different linguistic means, e.g. by pronouns. Countability is another example, which can be realized in some languages by means of plural morphemes, for instance. The mapping between our mental and linguistic representations does not only exist for these concrete and simple concepts, but is also applicable for abstract and/or complex concepts like hypotheticality and conditionality. In many languages, both these concepts can be mapped into a two-clause construction marked by a conditional connective like *if* in English (Traugott, 1985), which is further referred to as IF-conditionals in this paper.

If the mapping between hypotheticality and IF-conditionals is established, one is expected to accept both the scenarios in which the event or situation referred to in the IF-clause may and may not take place, respectively. Take

[1] Bio: Dr. Lin is working currently as a lecturer at Leiden University. She studied how children acquire syntax-semantic interface phenomena. In her Ph.D. at University of Amsterdam, she investigated how children from different language backgrounds acquire the restricted distributions associated with Negative Polarity Items. She collaborated with Prof. Jeannette Schaeffer (University of Amsterdam) in a project exploring Chinese children's knowledge of mass-count distinction.
Contact: jing@la-mascotte.net

(1) as example. Both possibilities of Jong being ill and John not being ill should be admitted by both the speaker and the addressee.

(1) If John is ill, he stays at home.

If the mapping of conditionality and IF-conditionals is established, one is then expected to interpret the event or situation referred to in the IF-conditionals as merely a sufficient condition for what is referred to in the main clause to take place. Thus, John being ill in (1) is an only sufficient but crucially not a necessary condition on which he stays at home.

The syntactic complexity of IF-conditionals (i.e. two-clause structure) together with their mappings with the two conceptual representations mentioned above, gives rise to several questions from the perspective of child development. Do children first acquire the linguistic form of IF-conditionals, or do they first develop and grasp the concept of hypotheticality and that of conditionality? When both the linguistic form and the concepts are developed, how do children then establish the mapping between the two? Is the mapping immediately target-like, as described above in terms of interpretations? Or is it rather subject to development during the childhood? What facilitates the mapping, and what counts as a delaying factor?

It is hardly possible to address all these questions in one single study. Nevertheless, in order to gain some insight in some of these respects, this paper explores the mapping between hypotheticality and conditionality, and IF-conditionals in Dutch acquiring children. Since so far, little has been reported on Dutch children's syntactic, semantic or concept knowledge of conditional constructions, the current investigation moreover fills a knowledge gap. Before describing the current research and presenting the results, some common semantic types of IF-conditionals in Dutch will be first introduced, which is followed by a summary of previous findings on children's production and comprehension of IF-conditionals.

1.1. Background

1.1.1. Some common semantic types of conditionals in Dutch

The literature so far exhibits different proposals on the classification of conditional constructions in natural languages (including IF-conditionals) (Arregui, 2007; Athanasiadou & Dirven, 1997; Bryant & Mok, 2003; Celce-Murcia et al., 1983; Comrie, 1986; Dancygier, 1993; Dancygier & Sweetser, 2005; Declerck & Reed, 2001; von Fintel, 2011; Huddleston & Pullum, 2002; Jespersen, 1961; Nieuwint, 1992; Quirk et al., 1985; Rescher, 2007; Stalnaker, 1968; Sweetser, 1990; among many others). Since hypotheticality is one of the two concepts that the current research focuses on, the hypotheticality continuum of Comrie (1986) is adopted, which can be illustrated as in Figure 1.

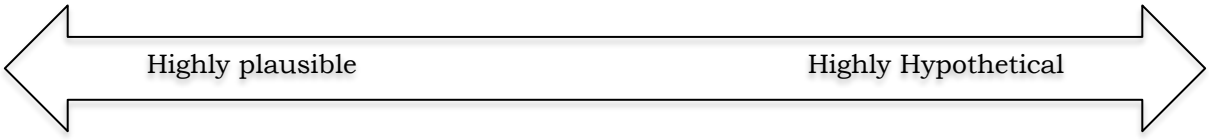


Figure 1. The hypotheticality continuum

Comrie interprets hypotheticality as a gradual concept, which refers to "the degree of probability of realization of the situations referred to in conditional, and more especially in the protasis" (Comrie, 1986: 88-89). By interpreting hypotheticality as such, factual clauses like *John speaks Dutch*, for instance, represents the lowest degree of hypotheticality, whereas counterfactual clauses like *I wish I wasn't ill* represent the highest degree of hypotheticality. Alongside the continuum, from the end of highly plausible, some commonly used conditional types in Dutch, marked by *als* 'if' will now be briefly introduced.

In Dutch, the conditional type that represents the highest degree of plausibility, and thus the lowest degree of hypotheticality, are those that express a mere temporal relationship between two future events or situations (Pollmann, 1975; Reilly, 1986: 300). The speaker is certain that the "condition" described in this type of *als*-clause is going to take place at a time following the utterance time, as a consequence of which, the event or situation referred to in the main clause follows in time in the future. Given the extremely high probability of the *als*-event/situation, we may call this conditional type *non-hypothetical future predictives*, as illustrated in (2).

(2) a. Als we thuis zijn, mag je weer spelen.
if we home are may you again play
'When we are home, you may play again.'

b. Als je klaar bent met eten, gaan we tekenen.
if you finish are with eat go we draw
'When you finish eating, we will draw.'

The conditional type of a slightly higher degree of hypotheticality than the non-hypothetical type are *low-hypothetical future predictives* (Bowerman, 1986), or *future predictives* (Dancygier, 1993). This type expresses a conditional relationship between two possible events or situations in the future, which have not taken place at the utterance time. The event or situation described in the *als*-clause are very likely to take place in the time span following the speaking moment; the event or situation referred to in the main clause, then, generally follows the *als*-event/situation as a consequence in time, as shown in (3).

(3) Als ik een baan vind, koop ik een nieuwe iPhone.
if I a job find buy I a new iPhone
'If I find a job, I will buy a new iPhone.'

Habitual conditionals, *generic conditionals*, and *deontic conditionals* are three conditional types that represent an even higher degree of hypotheticality than those two types introduced above. They all describe events or situations that may possibly but not necessarily take place, although they display other semantic differences. Habitual conditionals describe events or situations as a usual but definitely not an inevitable consequence of a certain condition being satisfied, which repeatedly take place but is still subject to uncertainty

(Bowerman, 1986; Huddleston & Pullum, 2002; Reilly, 1982; Schouten, 2000). See (4).

(4) Als papa op kantoor zit, drinkt hij koffie.
if dad on office sit, drinks he coffee
'Every time when dad is at his office, he drinks coffee.'

Generic conditionals are used to express a relationship between situations or events, which either appears to be a scientific truth or have the force of a physical law (e.g. (5a)), or belongs to part of the speaker's knowledge based on past experience (e.g. (5b)) (Dancygier, 1999; Dancygier & Sweetser, 2005). In both cases, the *als*-event/situation is to some extent hypothetical: It is possible that what is described in the *als*-clause is not going to happen.

(5) a. Als het bovennul is, gaat het ijs smelten.
if it above zero is goes the ice melt
Lit. 'If it is above zero-degree, ice will melt.'
'Ice melts above zero degree Celsius.'

b. Als ik vijf uur slaap, krijg ik hoofdpijn.
if I five hour sleep get I headache
'If I sleep five hours, I get a headache.'

Different from habitual and generic conditionals, deontic conditionals are in fact a subtype of *speech-act* conditionals (Haegeman, 1984; Sweetser, 1990; Van der Auwera, 1986). This type of conditionals normally combines a certain action or behavior referred to in the subordinate clause, and the speaker's judgment, attitude or evaluative value described in the main clause (Akatsuka & Clancy 1993). As such, this conditional type typically expresses deontic modality in a sense that it describes what the speaker thinks should or should not take place. One example in Dutch is given in (6).

(6) Als je je bordje leegeet, krijg je een ijsje.
if you your plate empty eat get you one ice-cream
'If you eat your plate empty, you will get an ice-cream.'

According to the speaker, the addressee should eat his or her plate empty. However, he or she is not sure whether this is indeed going to happen. The plausible but uncertain state of the *als*-event/situation here is similar to what is illustrated for habitual and generic conditionals. Therefore, habitual, generic, and deontic conditionals are considered representing a similar degree of hypotheticality.

Conditional types that exhibit higher degrees of hypotheticality are those that are generally referred to as *unreal conditionals*. These types of conditionals normally describe an imagined condition that can hardly take place, including *hypothetical conditionals* (Athanasiadou & Dirven, 1997; Comrie, 1986; Edgington, 2011; Nieuwint, 1992; Palmer, 1971; Quirk et al., 1985; among many others) and *counterfactuals* (see e.g. Athanasiadou &

Dirven, 1997; Bennett, 1988; Comrie, 1986; Dancygier & Sweetser, 1996; Edgington, 2011; Goodman, 1947; Lewis, 1973; Wierzbicka, 1997). Examples of such types will not be given since they are beyond the current research aim.

Recall Comrie's interpretation of hypotheticality as the degree of probability of realization of the event or situation described in the conditional clause. The above-introduced conditional types can be presented alongside the hypotheticality continuum as shown in Figure 2.

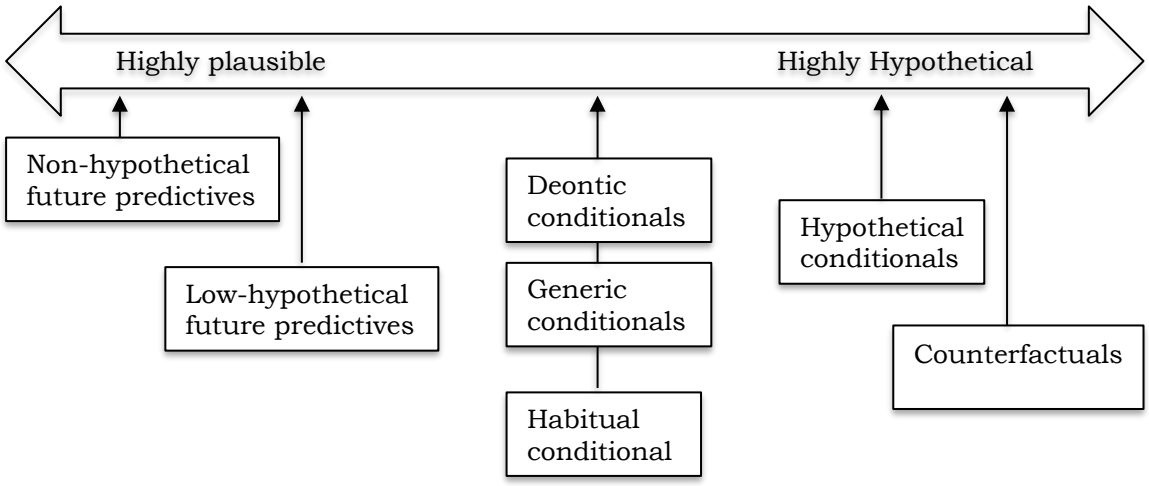


Figure 2. Commonly used conditional types on the hypotheticality continuum

1.2. Children's production and perception of IF*-conditionals*

Cross-linguistically, conditional constructions explicitly marked by a conditional connective like English *if* first arise around the age of two and a half years old. Data supporting this finding are collected from children's spontaneous speech, longitudinally recorded or cross-sectionally analyzed, in but definitely not restricted to the following languages: Italian (Bates, 1976), German and Turkish (Clancy et al., 1976), English (McCabe et al., 1983; Bowerman 1986; Reilly 1982, 1986), Polish, (Smoczyńska, 1986), French (Bowerman, 1986), Japanese and Korean (Akatsuka & Clancy, 1993), Chinese (Erbaugh, 1992), and Dutch (Lin, under revision), among others. There thus seems to be a clear cross-linguistic picture of the acquisition of the two-clause syntactic form of IF-conditionals.

However, the semantic types that children first acquire differ from language to language. In English, French, and Italian, for instance, the first emerged type is low-hypothetical future predictives. Although the low-hypothetical type predominates among children's early production of IF-conditionals in these languages, other conditional types are used as well. For example, English three-year-olds are able to use *if*-conditional constructions to describe habitualized activities in the present (Bowerman, 1986; Reilly, 1986). Generic conditionals are attested with three-year-olds as well (Bowerman, 1986; Reilly, 1986). According to Bowerman (1986), the observed similarities in cross-linguistic research on the production of IF-

conditionals should be explained in terms of some linguistic universality. She argues that children start the acquisition by cutting into the semantic range of IF-conditionals with a universal meaning of low-hypothetical future predictives, and then extend their usage to more particular meanings of conditionals based on linguistic experience.

Akatsuka and Clancy's (1993) investigation of the spontaneous speech of Japanese and Korean children, however, shows a different picture. Different from their English peers, for instance, the first conditionals used by Japanese and Korean children are not low-hypothetical future predictives, which refer to an uncertain but predictable event or situation in the future, but rather deontic conditionals, i.e. a subtype of speech-act conditionals. Akatsuka and Clancy propose that deontic conditionals may be the starting point for children to acquire the semantics of IF-conditionals in Japanese and Korean because deontic conditionals combine a certain behavior referred to in the subordinate clause with an evaluative value described or inferred in the main clause. As such, this conditional type can be considered involving reinforcement, which is very common in children's communication with caregivers. Therefore, deontic conditionals are conceptually speaking very easy for young children to grasp, explaining their early emergence in child language.

Recently, by analyzing Dutch children's spontaneous speech, Lin (under revision) reports that the conditional type that first emerges in child Dutch is non-hypothetical future predictives, which are already attested before 2;06. As already introduced, this type of conditionals describes a temporal relationship between two propositions, and exhibits the lowest degree of hypotheticality, which is explained by the temporal layer in the semantics of the Dutch conditional connective *als* 'if'. Similar to their English peers, Dutch toddlers are reported to be able to produce some other conditional types in their spontaneous speech as well, such as habitual conditionals, which first appeared around 2;06, low-hypothetical future predictives and generic conditionals, both of which first emerge around 2;11. In order to explain the emergence pattern of different conditional types in Dutch, Lin adopts the notion of concept complexity. She argues that the order in which different conditional types emerge in child Dutch development represents the degree of complexity of the concepts underlying different conditional types: the more concepts a conditional type involves, the more complex the involved concepts are, the later this conditional type emerges in child language.

Let's now look at some crucial findings on children's interpretation of IF-conditionals. A substantial body of research on this topic can be found in the literature (Brainerd, 1977; Dias & Harris, 1988, 1990; Ennis, 1971, 1975, 1976; Evans, 1982; Knifong, 1974; Kuhn, 1977; Markovits, 1984, 1985; Matalon, 1962; O'Brien et al., 1989; Overton, 1990; Paris, 1973; Staudenmayer & Boume, 1977; Taplin et al., 1974; Ward & Overton, 1990; among many others). Due to space limitations, only crucial findings reported for English-acquiring children will be summarized below.

A majority of the previous research in which children's interpretation of IF-conditionals is investigated has aimed to explore the development of logical reasoning in children from the perspective of material conditionals, which is associated with the truth table of conditionals presented in Table 1.

Table 1
The truth table of IF-conditionals (i.e. *If John is ill, he stays at home.*)

Condition	*p*: John is ill	*q:* he stays at home	*IF P, q.*
1	T	T	T
2	T	F	F
3	F	T	T
4	F	F	T

Viewing IF-conditionals as such, a great number of the previous studies have employed a truth value judgment task (Badger & Mellanby, 2018; Crain & McKee, 1985; Crain, 1991; Crain & Thornton, 1998; Gordon, 1998; Thonton, 2017; among others) or some variant of it, e.g. the prediction mode (Chierchia et al., 1988) to investigate children's interpretation of *IF p, q* by manipulating the truth-values of the propositions *p* and *p* as described in Table 1. For example, children were asked to give a truth-value judgment, which was either true or false, to a conditional sentence having of the form of *IF p, q*, after seeing some pictures or a video clip illustrating a certain manipulation of the truth-values of *p* and *q* (Barrouillet et al., 2008; Gauffroy & Barrouillet, 2009; O'Brien & Overton, 1982; O'Brien et al., 1989; Paris, 1973; Taplin et al., 1974; among others).
Results collected in these previous studies all show that children, both preschoolers (e.g. Dias & Harris, 1988, 1990) and adolescents (e.g. Barrouillet et al., 2008; Gauffroy & Barrouillet, 2009; Paris, 1973; Taplin et al., 1974) perform poorly on tasks that require them assigning or selecting a truth-value to conditional statements that have the form of *IF p, q*, when they are confronted with different truth-values of the propositions *p* and *q*. In particular, there is a lack of a target-like interpretation response in Condition 3, and Condition 4 (if applicable) in Table 1. Children below eight years old treat IF-conditionals as either conjunctions or biconditionals, since instead of a target-like reasoning pattern of conditionals (i.e. Table 1), they either display an interpretation pattern of conjunctions as presented in Table 2, or that of biconditionals as illustrated in Table 3. Although a target-like conditional interpretation pattern gradually supersedes the conjunctive or biconditional interpretation patterns when children grow older, there does not seem to be convincing evidence showing that children have developed the target-like interpretation pattern of IF-conditionals until sixteen years old.

Table 2
The truth table of AND-conjunctions (i.e. *John is ill and he stays at home.)*

Condition	*p*: John is ill	*q:* he stays at home	*P AND q.*
1	T	T	T
2	T	F	F
3	F	T	F
4	F	F	F

Table 3
The truth table of IFF-biconditionals (i.e. *If and only if John is ill, he stays at home.*)

Condition	*p*: John is ill	*q:* he stays at home	*IFF p, q.*
1	T	T	T
2	T	F	F
3	F	T	F
4	F	F	T

How can we then understand the late emergence of a target-like interpretation pattern of IF-conditionals, which does not even seem to be developed around the age of sixteen years old? Different explanations have been proposed in this respect. Whereas some scholars claim that the child's general cognitive development is responsible for the delayed emergence of a logical interpretation pattern of conditionals that have the form of *IF p, q* (Inhelder & Piaget, 1958; Matalon, 1962; Taplin et al., 1974), others argue that the child's interpretation is (negatively) influenced by their limited working memory capacities (Barrouillet et al., 2008; Gauffroy & Barrouillet, 2009; 2011; Evans, 2006; 2008). From a more linguistic perspective, Reilly (1986), for instance, tries to link the delay of a target-like interpretation pattern of IF-conditionals to the semantic overlap shared by conditional connectives like *if* and temporal connectives like *when* in English (König 1985; Harris 1986). As discussed in O'Brien et al. (1998), it has also been questioned whether conditional reasoning performance based on material implication (i.e. Table 1) represents one's interpretation of conditionals in real life scenarios.
Summarizing the previous results presented so far, it is clear that there is a large age gap between the production and the comprehension of IF-conditionals, which is also confirmed by a recent study by Badger & Mellanby (2018). On the one hand, children seem to have acquired the linguistic form of IF-conditionals as early as two and a half years old. On the other hand, a fully target-like interpretation pattern of this conditional construction does not seem to arise until sixteen years old.

2. Methodology

2.1. Design

Recall that the aim of the current study is to explore Dutch children's mapping of conditionality and hypotheticality into IF-conditionals. Based on what has been introduced in 1, examining the mapping between the two concepts and the corresponding linguistic structure in fact amounts to examining the comprehension of IF-conditionals in terms of their hypotheticality and conditionality. The current research therefore followed the previous studies on children's comprehension of IF-conditionals (see relevant references in 2.2) in employing the truth value judgment task (hereafter TVJT), in particular, the prediction mode of the TVJT (Chierchia et al. 1988; see also Gualmini & Crain, 2005; Su & Crain, 2013). Moreover, the current research also adopted the perspective of material implication in

investigating children's comprehension of IF-conditionals. Therefore, the four truth-value conditions in Table 1 were all included in the current design.

The current TVJT took the form of a game with Mickey Mouse and his friends, to make it interesting and accessible to preschoolers. In order to maximize the ecological validity of the experiment, a context was first introduced to the child. Mickey Mouse and his friends were just back from vacation. They had a lot of fun. However, Mickey forgot what he and his friends had planned to do. The task of the child was whether he or she could help Mickey finding it out. First, children heard a conditional stimulus having the form of *IF p, q*, presented as a prediction. They then saw two pictures on a laptop screen illustrating the truth-values of the propositions *p* and *q*, respectively. After the presentation of the visual stimulation, children were asked to assign a truth-value to the conditional stimulus by giving a Yes- or No-response, representing a true or false truth-value judgment, respectively.

Two conditional types were examined in the current study, namely habitual conditionals (e.g. (4) in 2.1), and deontic conditionals (e.g. (6) in 2.1). Habitual and deontic conditionals first appear at 2;05:03 and 2;11:09, respectively (Lin, under review: Table 2). The early emergence of these two conditional types in child Dutch helped exclude the possibility that the child would be confronted with unknown or unfamiliar constructions. More relevant and crucial for the current research, the two conditional types express similar degrees of hypotheticality (see Figure 2 in 2.1). Thus, possible differences between children's interpretations of habitual and deontic conditionals should not be a consequence of different hypotheticality degrees.

In addition to the two conditional types motivated above, the current experiment also had a third sentence type, namely *AND*-conjunctions, marked by *en* 'and' in Dutch (see also Table 2). Conjunctions do not involve the concept of conditionality; nor do they require children's understanding of hypotheticality. They therefore functioned as a baseline sentence type, further referred to as *additive* due to their conjunctive meaning. Since the additive stimuli differed from the two conditional types in both syntax and semantics, they also functioned as distracters in the current experiment.

Each sentence type was manipulated for four test conditions, based on the truth-values of the two propositions of a stimulus: a TT-condition in which both *p* and *q* were true, a TF-condition in which *p* was true and *q* was false, an FT-condition in which *p* was false whereas *q* was true, and an FF-condition in which both *p* and *q* were false. The current design is given in Table 4, and examples of the stimuli follow in 3.3.

Table 4
The experimental design

Sentence type	Test condition	Number of stimuli
Habitual	TT-condition	3
	TF-condition	3
	FT-condition	3
	FF-condition	3

Sentence type	Test condition	Number of stimuli
Deontic	TT-condition	3
	TF-condition	3
	FT-condition	3
	FF-condition	3
Additive/Distracters	TT-condition	6
	TF-condition	2
	FT-condition	2
	FF-condition	2
Total		36

By comparing children's interpretation responses in TT- and TF-conditions, and their comprehension performances in FT- and FF-conditions of the conditional stimuli, we may obtain insight into their knowledge of hypotheticality encoded in the linguistic construction in question. By investigating children's interpretation of *IF p, q* in each of the four truth-value conditions, we may learn more about their knowledge of conditionality as mapped into IF-conditionals.

The number of the conditions in TT is 6, as it is seen in Table 4. There were two reasons for this. First, the TT-condition of additive/distracter functioned as the most important indicator for whether the experiment went as it should. Thus, this indicator category contained a relatively large number of stimuli. But on the other hand, we could not enlarge the number of other conditions too much as the pre-schoolers normally only have 15 minutes of good attention. Increasing the stimuli number in all other conditions too much would give us a larger number of unusable results. We therefore opted for this "non-logical" design regarding the stimuli number.

2.2. Participants

A total of 49 monolingual Dutch children, all typically developing, as reported by their teachers, recruited via two primary schools in the Province of Noord-Holland in the Netherlands, participated in the current experiment (20 girls; age range = 3;11-6;00; mean = 4;11). Although children as young as two years old are reported to be able to participate in TVJTs (Crain & McKee, 1985), two- and three-year-olds were not included in the current experiment as they may have difficulties with stimuli containing a complex syntactic structure, due to e.g. the presence of two clauses.

Ten adult native speakers of Dutch also participated (6 females; all 18 years old). They were bachelor students at the Faculty of Humanities of the University of Amsterdam (non-linguistic majors), and formed the control group.

2.3. Stimuli

Bearing the limited working memory capacity of preschoolers in mind, which has been reported as a confounding factor in explaining their interpretation behavior in similar experiments (e.g. Barrouillet et al., 2008; Gauffroy & Barrouillet, 2009; 2011), the length of the stimuli – both conditional ones and additive ones – was restricted to a maximum of ten words. Words appearing in the stimuli were familiar to Dutch preschoolers, excluding the

possibility that the child would have difficulty comprehending a stimulus due to the lack of lexical knowledge of a certain word.
Whereas some examples of the employed stimuli are given below, the reader is referred to Appendix I for a complete overview of the test stimuli. Examples (7) and (8) represent the habitual and the deontic type, respectively. Example (9) is an additive stimulus.

(7) Als Mickey ziek is, eet hij ijs.
if Mickey sick is eats he ice cream
'When Mickey is ill, he eats ice cream.'

(8) Als Pluto bijt, moet hij buiten slapen.
if Pluto bites must he outside sleep
'If Pluto bites, he'll have to sleep outside.'

(9) De zon schijnt en Minnie voetbalt.
the sun shines and Minnie plays football
'The sun is shining and Minnie is playing football.'

To ensure that the participants' performance was not influenced by the audio presentation of the stimuli, all stimuli were pre-recorded using a smartphone with a young female native Dutch speaker. The stimuli were pronounced as naturally as possible, avoiding any special intonation or stress on a particular word. The order was counterbalanced.

2.4. Procedure

The experiment was structured as a PowerPoint presentation on a laptop and was conducted individually. The procedure is as follows. First, a child was invited from the classroom for a game by a female experimenter. She then explained to the child how the game proceeded and what he or she was expected to do by the instruction in (10):

(10) *Hallo daar! Welkom bij Mickey en zijn vrienden! Mickey is vergeten wat hij en zijn vrienden deze vakantie gedaan hebben. Kan je hen helpen? Vertel Mickey of het plaatje klopt met de zin!*

"*Hi there! Welcome to Micky and his friends! Micky forgets what he and his friends have done in their holiday. Can you help them? Tell Micky whether the picture matches the sentence!*"

Each participant underwent two trials to become familiar with the experimenter and the experiment. If the participants appeared to understand that they were expected to give either a Yes- or No-response (representing the true and false truth-value, respectively), the experiment continued. Two experimenters (both female) were present during the experiment: one for communicating with and testing the child and the other for recording the child's responses for later transcription and taking notes. The procedure with the adult participants was similar, except that they were aware that they formed the control group in a child experiment. The experiment lasted

an average of ten minutes per child, and approximately seven minutes per adult.

2.5. Response categorization

Responses were divided into three categories: Yes-responses, No-responses, and non-responses. Yes-responses referred to responses in which the participants answered "Yes" to a stimulus, whereas No-responses referred to those in which the participants answered "No" to a stimulus. Non-responses referred to situations in which neither "Yes" nor "No" was given by the child. Non-responses were further treated as missing values.

2.6. The target-like interpretation pattern

Different truth-value judgments were expected for different stimulus types in different truth-value conditions. Habitual and deontic conditionals both belong to the category of conditionals and are associated with the truth table in Table 1, whereas additive sentences belong to the category of conjunctions and are associated with the truth table in Table 2. These two truth tables together give rise to the following target-like response pattern. See Table 5.

Table 5
The target-like interpretation responses

	Target-like interpretation response		
Test condition	Habitual	Deontic	Additive
TT-condition	Yes-response	Yes-response	Yes-response
TF-condition	No-response	No-response	No-response
FT-condition	Yes-response	Yes-response	No-response
FF-condition	Yes-response	Yes-response	No-response

2.7. Data analysis

In order to investigate Dutch preschoolers' comprehension of the three tested sentence types manipulated in four truth-value conditions over time, which provides us with insight into their mapping of conditionality and hypotheticality into the linguistic IF-conditionals, a general linear mixed-effect logistic regression model was employed. R (Version 3.6.0; R Core Team, 2019) was used. Packages *ggplot 2* (Version 3.2.0; Wickham, 2016), *lme4* (Version 1.1-21; Bates et al., 2015), and *sjPlot* (Version 2.7.0; Lüdecke, 2019) were employed.

There were three fixed factors: Age, Type, and Condition. Age, coded in terms of months, centered, was a continuous factor. Type, representing the different stimulus types, was a categorical factor. Condition, representing the different truth-value conditions, was a categorical factor as well. Type had three levels: Habitual, Deontic, and Additive, representing the three sentence types. Condition had four levels: TT, TF, FT, FF, representing the four truth-value conditions. Participant and Stimulus were modeled as random factors. The main effect of the fixed factors, together with the interaction effects of the two categorical fixed factors, was included in the model. The predicted variable was the interpretation performance of the participants, in terms of adult-likeness, i.e., Adult-like response, coded as 1 or 0, representing an adult-like or a non-adult-like response, respectively. It will become clear in

the next section why adult-likeness but not target-likeness was used when interpreting the child responses.

Since both of the two categorical fixed factors had more than two levels, contrasts needed to be manually set in order to obtain theoretically informative interpretation of the regression results. Two contrasts were set for the three-level factor Type. The first was set between Habitual and Deontic on the one hand, and Additive on the other. The reason was straightforward: Additive sentences were the baseline in the experiment. This gave rise to the second contrast between Habitual and Deontic. Table 6 shows the two contrasts for Type.

Table 6
Two contrasts for Type

Contrast (Ctr.)	
1	(Habitual, Deontic) vs. (Additive)
2	(Habitual) vs. (Deontic)

Condition was a four-level categorical factor, suggesting three contrasts. Since one of the aims of the current study was to explore the mapping of hypotheticality into IF-conditionals, which was examined by manipulating the truth-value of the proposition *p* being either true or false, the first contrast for Condition was set between the two truth-value conditions in which *p* was true (i.e. the TT- and TF-conditions), and those two in which *p* was false (i.e. the FT- and FF-conditions). This first contrast being made, the other two contrasts logically followed, which were set between the TT- and TF-conditions, and the FT- and FF-conditions, respectively. The three contrasts made for the fixed factor Condition are summarized in Table 7.

Table 7
Three contrasts for Condition

Contrast (Ctr.)	
1	(TT, TF) vs. (FT, FF)
2	(TT) vs. (TF)
3	(FT) vs. (FF)

As for the adult results, only the frequencies of different response types were counted in each test condition. No further statistical analysis was run on the adult results given the current research aim.

3. Findings

3.1. Adult results

The percentages of target-like responses with adult controls are presented in Table 8, which clearly shows few variations. Depending on the sentence type and the test condition, the adult participants gave either almost always (between 90% and 100% of the time) or virtually never (0% to 7% of the time)

target-like responses. This first impression of the control group results strongly suggests that in the current experiment, target-likeness is not the same as adult-likeness.

Table 8
Percentages of target-like responses with adult controls

	TT-condition	TF-condition	FT-condition	FF-condition
Habitual	100%	97%	7%	7%
Deontic	100%	97%	0%	7%
Additive	100%	90%	100%	90%

Zooming in at the percentages of target-like responses of each sentence type, it becomes clear that the control group only showed a target-like interpretation pattern with additive stimuli. Since the additive type also functioned as baseline in the experiment, the extremely high percentages of target-like responses of the adult control group with this sentence type at least indicate that the experiment went as expected.
As for the two conditional types, i.e. habitual and deontic conditionals, target-like responses of the adult controls are only found in the TT- and TF-conditions. In the other two conditions, the adult participants gave exactly the opposite truth-value judgments, echoing previous findings reported for English adolescents, for instance (see further 2.2). Table 9 presents the adults' interpretation pattern found in the current experiment.

Table 9
The adults' interpretation responses

Test condition	Habitual	Deontic	Additive
TT-condition	Yes-response	Yes-response	Yes-response
TF-condition	No-response	No-response	No-response
FT-condition	No-response	No-response	No-response
FF-condition	No-response	No-response	No-response

Comparing Table 5 with Table 9, it is clear that the adult participants, instead of a target-like Yes-No-Yes-Yes-pattern, show a Yes-No-No-No-pattern when interpreting the conditional stimuli. Now the question arises as how the differences between these two interpretation patterns can be explained. After presenting first the child results, possible answers to this question will be discussed in Section 5.

3.2. Child results

As introduced in 3.2, a total of 49 monolingual Dutch children, all typically developing, participated in the experiment (20 girls; age range = 3;11-6;00; mean = 4;11). However, three out of these children were excluded from the dataset and further statistical analyses as they either always gave a Yes-response to all the stimuli, or always answered "No" to all the stimuli, irrespective of the type or the condition. Thus, only the results of the

remaining 46 child participants were considered. Since even the adult participants did not exhibit an entirely target-like interpretation pattern, the child results were encoded in terms of adult-likeness.
Table 10 reports the results of the logistic regression analysis. Note that only the results of the three fixed factors (including the interaction effect) are included. Results regarding the two random factors, i.e. Participant and Stimulus, are given in Appendix II.

Table 10
Results of the regression analysis

	Adult-like response					
	OR	CI (95%)	Coef. *β*	SE *β*	*z*	*P*
Predictor						
(Intercept)	1.88	1.49-2.36	0.63	0.12	5.38	<.001
Age	1.01	0.98-1.04	0.01	0.01	0.84	0.40
Condition (Ctr.1)	0.17	0.09-0.33	-1.79	0.34	-5.26	<.001
Condition (Ctr.2)	0.99	0.63-1.56	-0.01	0.23	-0.05	0.96
Condition (Ctr.3)	4.07	2.51-6.59	1.40	0.25	5.71	<.001
Type (Ctr.1)	0.81	0.56-1.17	-0.21	0.19	-1.13	0.26
Type (Ctr.2)	1.05	0.59-1.90	0.05	0.30	0.18	0.86
Type (Ctr.1):Condition (Ctr.1)	0.90	0.21-3.85	-0.10	0.741	-0.14	0.89
Type (Ctr.2):Condition (Ctr.1)	0.17	0.02-1.77	-1.79	1.201	-1.45	0.14
Type (Ctr.1):Condition (Ctr.2)	0.58	0.22-1.52	-0.55	0.490	-1.11	0.27
Type (Ctr.2):Condition (Ctr.2)	5.48	1.01-29.79	1.70	0.864	1.97	0.04
Type (Ctr.1):Condition (Ctr.3)	1.40	0.47-4.16	0.34	0.555	0.61	0.54
Type (Ctr.2):Condition (Ctr.3)	7.42	1.45-38.11	2.00	0.835	2.40	0.02

As is summarized in Table 10, not each (contrast) of the three main factors has a significant effect on the participants' responses in terms of adult-likeness. In fact, only Ctr.1 of Condition (i.e. (TT, TF) vs. (FT, FF)) and Ctr. 3 of Condition (i.e. (FT vs. FF)) are significant. As for the interaction effects, only two out of the six are significant, namely that between Type (Ctr.2) and Condition (Ctr.2), and that between Type (Ctr.2) and Condition (Ctr.3). In the next section, these regression results will be further described and interpreted.

3.3. Interpretation

As reported in 3.1, there is a lack of target-likeness when we look at the adult participants' interpretation responses to the two types of conditional stimuli manipulated in the FT- and FF-conditions. This section will first propose some possible explanations in this respect. Before doing that, let's use (15) as example to illustrate the relevant test conditions: *Als Mickey ziek is, eet hij ijs* 'If Micky is ill, he eats ice-cream'.
In the FT-condition, participants first saw a picture showing Mickey happily playing outside, representing the false truth-value of the proposition *p*, after which they saw a picture showing Mickey eating an ice-cream, representing the true truth-value of the proposition *q*. Recall that in the FT-condition, the adult participants almost always gave a No-response (representing a false

truth-value judgment) to the conditional stimuli, irrespective of their semantic types. This non-target-like performance reflects a phenomenon which is commonly observed in real life communications and is explained as a consequence of language speakers' application of a pragmatic mechanism, usually referred to as Conditional Perfection in the literature (Geis & Zwicky, 1971; Horn, 2000; van Canegem-Ardijns & Van Belle, 2008; van der Auwera, 1997; among others). As introduced at the beginning of the paper, the proposition *p* in IF-conditionals merely expresses a sufficient but not a necessary condition under which the proposition *q* takes place. This means that the conditional is logically true when *p* is false and *q* is true. However, when *p* is not only a sufficient but moreover a necessary condition for *q* to take place, like in biconditionals introduced by *if and only if* in English, for instance, the conditional sentence is false when *p* is false and *q* is true, as in the FT-condition in the experiment.

The non-target-like performance of adults in this test condition then strongly suggests that they "perfected" the conditional stimuli to the corresponding biconditional stimuli, by upgrading *p* from being merely the sufficient condition for *q* to take place to being a not only sufficient but moreover necessary condition for *q* to happen. Since this is a common observation in real-life conditional reasoning (e.g. Horn, 2000; van Canegem-Ardijns & Van Belle, 2008), it is not unexpected that the adult participants were applying Conditional Perfection to the conditional stimuli in the current experiment too.

As for the lack of target-likeness in the adult participants' responses to the conditional stimuli in the FF-condition, let's again use (15) as example to illustrate the manipulation. After hearing *Als Mickey ziek is, eet hij een ijsje* 'If Mickey is ill, he eats an ice-cream', participants first saw a picture showing Mickey happily playing outside, representing the false truth-value of the proposition *p*, after which they saw a picture showing Mickey drinking lemonade, representing the false truth-value of the proposition *q*. Recall that in this FF-condition, the adult participants almost always gave a non-target-like No-response. Why did they fail to perform target-like in this condition? A possible answer is that the adult participants were not viewing the conditional stimuli through the lens of material implication, as previously noticed in O'Brien et al. (1998). Instead, they took absence of evidence as evidence of absence, and thus gave a false truth-value judgment to the stimuli in the FF-condition. Such a finding strongly suggests that conditional reasoning based on material implication (i.e. as presented by means of the truth table in Table 1) is not the same as conditional reasoning in real life scenarios.

Let us now turn to the regression results summarized in Table 11. As can be clearly read, among the three main factors included in the regression model, only two contrasts of Condition, i.e. Ctr. 1 and Ctr. 3, turn out to be significant. The non-significance of Age (Coef. $\beta = 0.01$) suggests that there is no evidence showing that the child participants became more adult-like when growing older. This may seem unexpected at first sight, as we know that both children's language and cognitive abilities do develop over time. How should we then interpret the non-significance of Age? Adopting Meyer et al. (2016, 2018), who investigate Dutch children's knowledge of cardinality

and number words, a language-concept interface phenomenon as well as that explored in the current study, it can be assumed that when it comes to the mapping of conditionality and hypotheticality into IF-conditionals, each Dutch child follows a distinct trajectory.

Like Age, Type is non-significant either. In particular, neither contrasts made for Type (Coef. β = -0.21 for Ctr. 1; Coef. β = 0.05 for Ctr. 2) are significant. There is thus no evidence showing that the children's interpretation responses in terms of adult-likeness were likely to vary across the different sentence types. It thus seems that Dutch four- and five-year-olds have assigned the same conceptual representation to the different sentence types, i.e., habitual, deontic, and additive. This suggests the same semantic analysis of both conditional *als* 'if' and conjunctive *en* 'and' in the child grammar. A conclusion that can be drawn here is that neither the concept of hypotheticality nor that of conditionality has been mapped to IF- conditionals in Dutch before the age of six.

The main factor Condition, of which Ctr.1 (Coef. β = -1.79), i.e. (TT, TF) vs. (FT, FF) and Ctr. 3 (Coef. β = 1.40), i.e. (FT vs. FF) are significant, whereas Ctr. 2 (Coef. β = -0.01), i.e. (TT vs. TF) are not, can be interpreted as follows. First, the child participants were likely to show different performances in terms of adult-likeness between the two truth-value conditions in which the truth-value of *p* was true, and those in which the truth-value of *p* was false (i.e. Ctr. 1). The negative sign of the corresponding *z*-value, i.e. -5.26, further indicates that the children were less likely to give adult-like responses to the stimuli in the two *p*-false conditions (i.e. the FT- and FF-conditions) than the two *p*-true conditions (i.e. the TT- and TF-conditions) – irrespective of their semantic type. The preschoolers thus exhibited more difficulties interpreting the stimuli in an adult-like way in the FT- and FF-conditions than the TT- and TF-conditions. Recall that Ctr. 1 of Condition was set to examine the mapping between the concept of hypotheticality and the conditional stimuli. If the mapping was established, the participants, when confronted with the conditional stimuli, should not only allow the interpretation of *p* being true but also accept that of *p* being false. The significance of Ctr. 1 of Condition therefore gives rise to the conclusion that Dutch preschoolers have not mapped the concept of hypotheticality into the corresponding IF-conditionals, in line with the conclusion drawn based on the non-significant effect of Type.

Second, the significant effect of Ctr. 3 of Condition, together with the corresponding *z*-value of 5.71, suggests that the child participants were more likely to show adult-like interpretation performance with the stimuli in the truth-value condition in the FF-condition than in FT-condition. The Dutch preschoolers had thus more difficulties giving adult-like responses in the FT- than the FF-condition, irrespective of the sentence type. In the case of additive sentences, which had the logic form of *p AND q*, this significant difference seems to suggest that it was easier for the child to give an adult/target-like No-response when both the propositions *p* and *q* were false (representing the FF-condition) than when merely one of the two was false (representing the FT-condition).

As for the conditional stimuli, the significant effect of Ctr. 3 of Condition is interpreted differently. Recall that with the two types of conditional stimuli, the adult-like responses were exactly the opposite of the target-like

responses in the FT- and FF-conditions. Thus, the significance of Ctr. 3 of Condition actually suggests that the Dutch four- and five-year-olds were more likely to give target-like interpretation responses to the conditional stimuli in the FT-condition than the FF-condition. In order to understand this difference, we need to revisit Conditional Perfection, a pragmatic mechanism that plays a crucial role in explain the lack of target-likeness in the adults' interpretation response to the conditional stimuli in the FT-condition. In particular, the adult participants "perfected" the conditional stimuli to the corresponding biconditional stimuli and interpreted the proposition *p* as not only a sufficient but moreover a necessary condition for *q* to take place. The more target-likeness in the child's interpretation responses to the conditional stimuli in the FT-condition thus indicates less often application of Conditional Perfection by the child, which does not seem to be surprising given the four- and five-year-olds' underdeveloped pragmatic knowledge.

Finally, the non-significant result with respect to Ctr. 2 of Condition suggests that we cannot report any likely differences in the children's performances in terms of adult-likeness between the TT- and TF-conditions – irrespectively of the type.

Now let's look at the two interaction effects that turn out to be significant. One is the interaction between Ctr. 2 of Type and Ctr.2 of Condition (Coef. β = 1.70). Recall that Ctr. 2 of Type was set between the two conditional types, i.e. habitual and deontic conditionals, and that Ctr.2 of Condition was set between the TT-condition and the TF-condition. Given the positive sign of the relevant z-value, which is 1.97, the significance of this interaction effect means that in the TF-condition, the child participants were more likely to show more adult-like performances with the deontic conditional type than with the habitual conditional type, than in the TT-condition. Figure 3 visualizes this interaction effect. The black circles indicate the probabilities of adult-like responses in each truth-value condition when the participants were confronted with habitual conditionals; and the red triangles demonstrate the probabilities of adult-like responses in each truth-value conditions when the participants were provided with deontic conditionals.

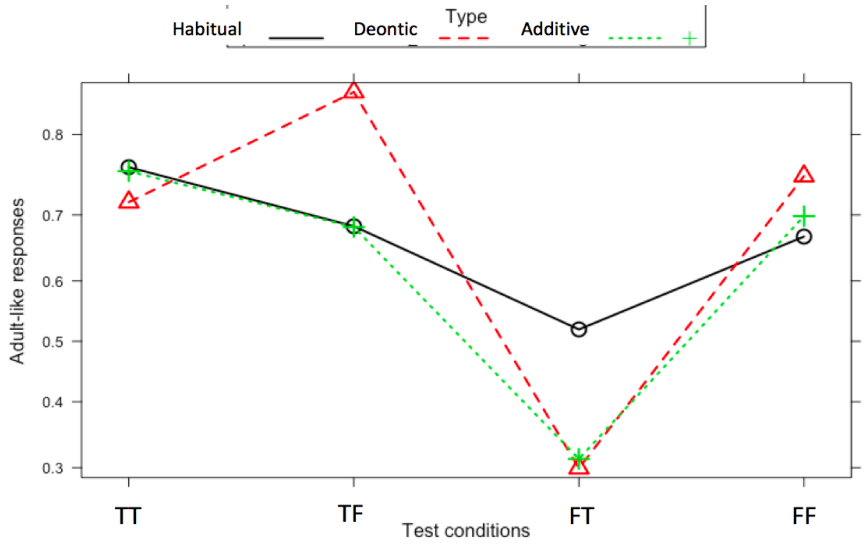


Figure 3. Interaction effect between Type and Condition

As illustrated in Figure 3, the significant interaction effect under discussion is in fact related to the extremely high probability of adult/target-like performance of the participants with deontic conditionals in the TF-condition (the red triangle above TF in Figure 3). This means that the child participants were the most adult/target-like with the deontic conditional stimuli manipulated in the TF-condition. In other words, the preschoolers had the least difficulties with the deontic conditionals in the TF-condition.

The other significant interaction effect is found between Ctr. 2 of Type and Ctr. 3 of Condition (Coef. β = 2.00, z = 2.40). Given that Ctr. 2 of Type was set between habitual and deontic conditionals, and that Ctr.3 of Condition was set between the FT-condition and the FF-condition, the significance of this interaction effect means that when p and q were both false, the child participants were more likely to show more adult-like responses with the deontic stimuli than the habitual stimuli, than when p was false and q was true.

If we look at Figure 3, in which the interaction effects of the current regression model are visualized, it is not hard to see that the significant interaction effect between Ctr. 2 of Type and Ctr. 3 of Condition is actually related to the extremely low probability of adult-like performance with the deontic stimuli in the FT-condition. This means that between the two conditional types manipulated in the FT- and FF-conditions, the Dutch preschoolers were the least adult-like with the deontic conditional stimuli in the FT-condition. Since the adult-like responses to the conditional stimuli in the FT-condition were exactly the opposite of the target-like responses, we can also say that the Dutch preschoolers were the most target-like with the deontic conditional stimuli in the FT-condition.

The interaction effects interpreted so far gives rise to the conclusion that the preschoolers were more target-like in comprehending deontic conditionals than habitual conditionals in two out of the four truth-value conditions (i.e. TF- and FT-conditions). Although there is no statistical evidence showing any differences in the child's interpretation performances between deontic and habitual conditionals in the other two conditions, we may still conclude that Dutch children become first target-like with deontic conditionals. This, together with the absence of any significant effect of the main factor Age, suggests that the concept of conditionality is first mapped to deontic conditionals in child language, which seems to have already taken place before the age of four, i.e. the lower boundary of the tested age range. Along this line of reasoning, we may further draw the conclusion that at least until the age of six, i.e. the upper boundary of the tested age range, Dutch children have not yet mapped the concept of conditionality into habitual conditionals.

Summarizing the regression results interpreted so far, it seems that the concept of hypotheticality is not mapped to IF-conditionals in child Dutch, at least not before the age of six years old. Since the linguistic IF-structure is first attested in child Dutch already before the age of three (see 2.2), there is a clear delay in children's mapping of the conceptual representation of hypotheticality into the corresponding linguistic representation. As for the concept of conditionality, there also seems to be a delay, although this delay

turns out to be only attested with one of the two examined conditional types, namely with habitual but not with deontic conditionals.

4. Discussion

A straightforward way to understand the delayed mapping of hypotheticality and conditionality into the corresponding linguistic construction in Dutch preschoolers is to assume that Dutch four- and five-year-olds have not yet developed the concept of hypotheticality or that of conditionality. If that is the case, it is far from surprising that they show a delay in mapping the two concepts into the corresponding linguistic structure. However, Bowerman (1986) reports evidence showing that the cognitive basis underlying different conditional types (thus including hypotheticality and conditionality) are already present in toddlers. This means that at the moment that the child can linguistically utter his or her first explicitly marked conditional construction, which, cross-linguistically speaking, takes place around two and a half years old (see 2.2), he or she has already grasped the relevant cognitive basis. How shall we then explain the delay?

As presented in 2.1, Dutch IF-conditionals can be divided into different types depending on their meanings and functions. One of these types is termed non-hypothetical future predictives (see (2) and (3) in Introduction), which, although categorized as conditionals, express a mere temporal relationship between two future events or situations (Pollmann 1975; Reilly 1986: 300). As can be inferred from its term, this type of conditionals is associated with little hypotheticality, as there is little chance that the event or situation referred to in the subordinate clause will not take place. This means that even in the adult's grammar, hypotheticality is not necessarily present in this conditional type. Let us assume the same for the child grammar.

Recall that non-hypothetical future predictives are the first conditional type used by Dutch-acquiring children, which emerge already before the age of two and a half (see 2.2; see also Lin, under revision: Table 2). As also reported in Lin (under revision: Table 1), non-hypothetical future predictives are moreover one of the two most frequently used conditional types by Dutch two- and three-year-olds. The early acquisition of this conditional type, in which the concept of hypotheticality is not necessarily present, may hinder Dutch children's development of hypotheticality for the connective *als*. This in turns explains the delayed mapping of hypotheticality into IF-conditionals as found in the current study.

Another possibility in this respect is to assume that the so-called delay is caused by the children's difficulties in processing a conditional stimulus in the two *p*-false conditions. This explanation is inspired by Dancygier & Sweetser's proposal (1997, 2005), in which the notion of mental space play a central role. They authors illustrate that when hearing a conditional sentence having the form of *IF p, q*, the addressee sets up a mental space containing only the possible worlds in which *p* is true. By doing so, the addressee is not considering all possible worlds in which *p* can be either true or false but disregards those in which *p* is false. This may be what happened with the preschoolers in the current experiment. When hearing a conditional stimulus, irrespective of its semantic type being either habitual or deontic, the child participants immediately set up a mental space that only contained

the possible worlds in which *p* was true. This prevented them from considering other possible worlds in which *p* was false. When confronted then with a scenario in which *p* indeed took place, i.e. the TT- and TF-conditions in the experiment, which "validated" the already set-up mental space, the preschoolers displayed little difficulties in giving an adult/target-like truth-value judgment to the stimulus. However, when confronted with the FT- and FF-conditions, which represented possible worlds in which *p* was false, the preschoolers showed difficulties in giving a target/adult-like truth-value judgment to the stimulus since these two test conditions "falsified" the already set-up mental space.

In terms of Evans (2007), the above-sketched explanation can be also formulated as follows. When the participants encountered a conditional stimulus, they placed *p* being true into their stock of knowledge and judged the truth-value of the stimulus based on the assumption that *p* had to be true. This was compatible with the two *p*-true conditions, i.e. the TT- and TF-conditions. The FT- and FF-conditions, representing the scenarios in which *p* was false, were therefore considered irrelevant, and then disregarded. This gave rise to difficulties in giving target/adult-like truth-value judgments to the conditional stimuli in the relevant conditions, resulting in an apparent delay of the mapping of hypotheticality into IF-constructions in child Dutch.

Turning to the concept of conditionality, the question that we need to address is why this concept is mapped into deontic conditionals before the age of four whereas there is a delay of such a mapping when it comes to habitual conditionals. As already argued in Akatsuka and Clancy (1993) (see also 2.2), conditional constructions expressing deontic modality are conceptually speaking very easy for young children to grasp. This is because such conditionals normally link certain behaviors of the addressee to certain evaluative values or judgments of the speaker, involving reinforcement as shown by (8), which is very common in parental speech, for instance. This reinforcement layer in the semantics of deontic conditionals may facilitate the child's mapping of the concept of conditionality into the corresponding conditional type.

Turning to habitual *als*-conditionals, which describe events or situations as a usual but definitely not an inevitable consequence of a certain condition being satisfied that may repeatedly take place, such a layer of reinforcement is clearly missing in the semantics. Instead, habitual *als*-conditionals are more like temporals than conditionals in their meanings and functions, as they describe habits, to which the notion of condition may seem less crucial than that of temporality. It can therefore be assumed that the semantic overlap of habitual conditionals with temporals may hinder Dutch children's mapping of conditionality into habitual *als*-conditionals. This, together with the conceptual ease of the deontic type, may explain the current finding with respect to the mapping between conditionality and IF-conditionals in Dutch preschoolers.

The findings reported in this paper strongly suggests that the mapping between our conceptual representations and the language we speak is not influenced by just one single factor. Language-specific properties, our pragmatic knowledge, conceptual transparency or ease, together with the function or meaning of a particular linguistic construction with respect to

the rest of its category all seem to influence the mapping pace. On top these, the current study also shows that the way in which the mapping is examined also matters, which calls for further exploration of similar language-concept interface phenomena using different test paradigms.

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Appendices

Appendix I: Test items

Trials:

(1) De zon schijnt en Minnie voetbalt.
the sun shines and Minnie plays football
'The sun is shining and Minnie is playing football.'

(2) Als de zon schijnt, danst Goofy.
if the sun shines dances Goofy
'If the sun shines, Goofy dances.'

Deontic conditional stimuli:

(1) FF-condition
Als Donald schreeuwt, moet hij in de hoek staan.
if Donald shouts must he in the corner stand
'If Donald shouts, he'll have to stand in the corner.'

(2) TT-condition
Als Pluto gaat liggen, krijgt hij botten.
if Pluto goes lie gets he bones
'If Pluto lies down, he'll get bones.'

(3) FT-condition
Als Minnie een kus geeft, krijgt ze bloemen.
if Minnie a kiss gives gets she flowers
'If Minnie gives a kiss, she'll get flowers.'

(4) TT-condition
Als Mickey appels plukt, krijgt hij een taart.
if Mickey apples picks gets he a cake
'If Mickey picks apples, he'll get a cake.'

(5) FT-condition
Als Mickey schoonmaakt, krijgt hij een lolly.
if Mickey cleans gets he a lollipop
'If Mickey cleans, he'll get a lollipop.'

(6) FF-condition
Als Minnie koekjes bakt, krijgt ze een cadeautje.
if Minnie cookies bakes gets she a present
'If Minnie bakes, she'll get a present.'

(7) TF-condition
Als Goofy in een zwembadje springt, krijgt hij een appel.
if Goofy in a swimming pool jumps gets he an apple
'If Goofy jumps into a swimming pool, he'll get an apple.'

(8) FT-condition
Als Donald een foto maakt, krijgt hij snoepjes.
if Donald a picture makes gets he candies
'If Donald makes a picture, he'll get candies.'

(9) TF-condition
Als Mickey gaat voetballen, krijgt hij een banaan.
if Mickey goes play football gets he a banana
'if Mickey plays football, he'll get a banana.'

(10) TT-condition
Als Pluto bijt, moet hij buiten slapen.
if Pluto bites must he outside sleep
'If Pluto bites, he'll have to sleep outside.'

(11) TF-condition
Als Donald boos wordt, moet hij binnen blijven.
if Donald angry becomes must he insidestay
'If Donald loses his temper, he'll have to stay inside.'

(12) FF-condition
Als Donald zijn bord leegeet, krijgt hij een ijsje.
if Donald his plate empty eat gets he an ice cream
'If Donald eats his plate empty, he'll get an ice cream.'

Habitual conditional stimuli:

(1) TF-condition
Als Pluto uitgelaten is, gaat hij slapen.
if Pluto go for a walk is goes he sleep
'When Pluto is back from a walk, he goes to sleep.'

(2) TF-condition
Als Mickey ziek is, eet hij ijs.
if Mickey ill is eats he ice cream
'When Mickey is ill, he eats ice cream.'

(3) TT-condition
Als de chocopasta op is, pakt Minnie
if the chocolate spread finished is takes Minnie
kaas.
chees
'When the chocolate spread is finished, Minnie takes chees.'

(4) FF-condition
Als er een regenboog is, gaat Minnie vliegen.
if there a rainbow is goes Minnie fly
'When there is a rainbow, Minnie flies a kite.'

(5) FT-condition
Als de thee op is, krijgt Katrien limonade.
if the tea finished is gets Daisy lemonade
'When the tea is finished, Daisy gets lemonade.'

(6) FT-condition
Als Donald pannenkoeken bakt, eet hij ze op.
if Donald pancakes bakes eats he them up
'When Donald bakes pancakes, he eats them.'

(7) FF-condition
Als het regent, blijft Donald thuis.
if it rains stay Donald home
'When it rains, Donald stays at home.'

(8) TT-condition
Als de trein vol is, rijdt Mickey in de auto.
if the train full is drivesMickey in the car
'When the train is full, Mickey drives the car.'

(9) FT-condition
Als de zon schijnt, gaat Minnie rolschaatsen.
if the sun shines goes Minnie roller skate
'When the sun shines, Minnie roller skates.'

(10) FF-condition
Als het sneeuwt, gaat Mickey sleeën.
if it snows goes Mickey sleigh
'When it snows, Mickey sleighs.'

(11) TT-condition
Als Mickey buiten is, krijgt hij een kus.
if Mickey outside is gets he a kiss
'When Mickey goes outside, he gets a kiss.'

(12) TF-condition
Als Mickey jarig is, krijgt hij twee taarten.
if Mickey birthday is gets he two cakes
'When it's Mickey's birthday, he gets two cakes.'

Additive stimuli (baseline):

(1) TT-condition
Mickey heeft appels geplukt en Mickey krijgt een
Mickey has apples picked and Mickey gets a
taart.
cake
'Mickey has picked apples and Mickey gets a cake.'

(2) TF-condition
Mickey is jarig en Mickey krijgt twee taarten.
Mickey is birthday and Mickey gets two cakes
'It's Mickey's birthday and Mickey gets two cakes.'

(3) TT-condition
De trein is vol en Mickey rijdt in de auto.
the train is full and Mickey drivesin the car
'The train is full and Mickey drives the car.'

(4) FF-condition
Het sneeuwt en Mickey gaat sleeën.
it snows and Mickey goes sleigh
'It is snowing and Mickey is going to sleigh.'

(5) TT-condition
Mickey is buiten en Mickey krijgt een kus.
Mickey is outside and Mickey gets a kiss
'Mickey is outside and Mickey gets a kiss.'

(6) FF-condition
Donald eet zijn bord leeg en Donald krijgt een
Donald eats his plate empty and Donald gets an
ijsje.
ice cream
'Donald eats his plate empty and Donald gests an ice cream.'

(7) TT-condition
Pluto gaat liggen en Pluto krijgt botten.
Pluto goes lie and Pluto gets bones
'Pluto lies down and Pluto gets bones.'

(8) FT-condition
Minnie geeft een kus en Minnie krijgt bloemen.
Minnie gives a kiss and Minnie gets flowers
'Minnie gives a kiss and Minnie gets flowers.'

(9) TT-condition
De chocopasta is op en Minnie krijgt
the chocolate spread is finished and Minnie gets
kaas.
chees.
'The chocolate spread is finished and Minnie gets chees.'

(10) TF-condition
Mickey gaat voetballen en Mickey krijgt een
Mickey goes play football and Mickey gets a
banaan.
banana
'Mickey plays football and Mickey gets a banana.'

(11) FT-condition
De thee is op en Katrien krijgt limonade.
the tea is finished and Daisy gets lemonade
'The tea is finished and Daisy gets lemonade.'

(12) TT-condition
Pluto bijt en hij moet buiten slapen.
Pluto bites and Pluto must outside sleep
'Pluto bites and Pluto has to sleep outside.'

Appendix II: Results of the random parts of the regression model

Random Effects	
σ^2	3.29
$\tau_{00\ Participant}$	0.29
$\tau_{00\ Stimulus}$	0.12
ICC	0.11
$N_{\ Participant}$	46
$N_{\ Stimulus}$	36
Observations	1648
Marginal R^2 / Conditional R^2	0.121 / 0.220

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Bangla Tense Inflections Productivity among Pre-School Children[1]

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S. M. Sanzana Rahman[2]
Southeast University
Lubaba Sanjana[3]
Brac University

Abstract

Although there have been different types of studies regarding Bangla verbs, acquisition of Bangla verbs and different types of Bangla tenses; there is a lack of research on the relationship between age and productive tense inflections and development of these inflections for Bangla speaking children. This paper studies the relation between age and productivity of tense inflections of typically developing Bangla speaking pre-school children. The data have been collected from speech samples of 30 children aged 24 months to 48 months through elicited production method. The study finds out the different age range when different tense inflections become productive. It proposes an order of use of the morphological verb inflections of tense and tense inflections for the 30 children in this study. In addition, it explores the probability of a developmental sequence in these inflections in relation to *Tomasello's* (2008) *usage-based approach* for typically developing Bangla speaking pre-school children. The findings of this research can be used to help future studies in the field of Bangla Tense acquisition as well as to create a profile for typically developing children. Moreover, studies dealing with children with language impairments may benefit from the findings.

Keywords Tense inflections; Bangla Tense; Productivity; Bangla Verbal Morphology; First Language Acquisition

1. Introduction

In Bangla language, different morphological inflections are used with bare verb stems to denote different types of tenses. As a result, Bangla tense system is extraordinarily complex including different range of morphological verb inflections. Sultana (2016) asserted that in Bangla language, an in-depth scenario of typical growth in language has not been established by analysing child language data. This research will measure typical Bangla speaking children's productive use of tense inflections in relation to age. It will conduct a comparative analysis of the usage of the productive morphological verb inflections of Bangla tense to propose a developmental

[1] The authors have made equal contributions to the paper

[2] S. M. Sanzana Rahman is a lecturer currently working in the Department of English, Southeast University, Dhaka, Bangladesh. Her areas of research interest include child language development, SLA, language and identity and CALL. She teaches EAP courses.

[3] Lubaba Sanjana is a lecturer in the Department of English & Humanities, Brac University, Dhaka, Bangladesh. Her areas of research interest include child language development, reading development and SLA. Currently, she is pursuing her PhD in the Faculty of Education at Mount Saint Vincent University, Nova Scotia, Canada.

Corresponding author: lubaba.sanjana273@gmail.com

trend in these inflections which can be later used to create assessments and interventions for children with language impairment. The researchers have tried to figure out the answers to these questions:

a. When do children start to use different tense inflections productively?
b. What is the comparative range of usage of the productive morphological verb inflections of Bangla tense among the children?
c. Is there any developmental trend in the productive verb inflections of tenses in relation to Tomasello's (2008) *usage-based approach*; for typically developing Bangla speaking pre-school children?

1.1. Bangla Tense

Rácová (2009) mentioned that there are eight tenses in Bangla language; simple present, present imperfect or present continuous or present progressive, present perfect, preterite or simple past, past imperfect or past continuous or past progressive, pluperfect or past perfect, past habitual, and future. In Bangla language, finite verb forms are marked for person, tense, aspect, and honour features, each attaching itself to the verb stem in a fixed order (Kar, 2009; Thompson, 2012). Unlike English, they are unmarked for plurality or gender. The markers attach to the verb in an incremental or agglutinative fashion (Kar, 2009). In Bangla language, the finite verb form not only includes the root morpheme which has the lexical meaning of the verb but also, tense marking grammatical morpheme + aspect marking grammatical morpheme + personal endings (Rácová, 2009; Sultana et al., 2016). Therefore, the designations of finite verbal forms include information about the aspect as well as the tense (e.g., present perfect, past imperfect or past continuous etc.) (Rácová, 2009). In case of present tense, verbs do not have overt tense markers. Also, aspect markers are seen in case of only two contexts; progressive and perfective. There are distinct person markers to indicate first, second, and third person agents (Sultana et al., 2016), and young children tend to acquire third person marker comparatively easily (Sanjana, 2018). Also, Paramita (2006) explained that in Bangla, each tense is incorporated with a set of five term person morphemes which include the honour features. They are, person 1 (p1), person 2. status 1 (p2sl), person 2 status 2 (p2s2), person 2 status 3 (p2s3) and person 3 (p3). It is possible for these tense-person morphemes to have some allomorphs that might be suffixed to the verb root. Bangla tense-aspect paradigm in all the three persons is included in Appendix A.

Chakraborty and Leonard's study (2012) found present progressive and past progressive forms to gain high accuracy. In her study, Sultana (2016) found that present perfect form is produced in the highest number (over 92%) by the children. Present progressive verb forms in Bangla obtains a moderate production score. Performance of the children has suggested that they frequently substitute past simple verb forms by the present perfect forms. The overall production of past progressive and past perfect verb forms is incredibly low due to their structural and cognitive demands. Another study by Sultana et al. (2016) stated that the highest accuracy of acquisition is in present simple forms (88%), then in present progressive forms (67%), and the lowest in past progressive forms (44%).

1.2. Bangla Verbal System

There are two types of verbs in Bangla verbal system; simple verbs and complex verbs which refer to both conjunct and compound verbs (Chatterjee, 2014). Complex verbs can be of several constrictions as well. For example; Noun/Adjective + do type, Noun/Adjective + do + Verb type and Verb + Verb type. N/A + do and N/A + do + V constructions are called conjunct verbs whereas, V+V constructions are called compound verbs (Thompson 2012). Bangla language has a limited use of simple verbs and abundant usage of conjunct verbs. In two-part conjunct verbs, noun or adjectives appear with a helping verb such as, *kora* (do). For example, *bhul kora* (to mistake). Here, the helping verb bears tense, person and aspect inflection. In three-part conjunct verbs, noun or adjectives appear with two verbs; a helping verb such as, *kora* (do) and a vector verb such, *neya* (to take). For example, *bhul kore niyechi* (to take mistakenly). Here, the helping verb is in the perfective participle form, whereas the vector verb bears tense, person and aspect inflection (Chatterjee, 2014). Ramchand (1990) viewed that the vector verb also affects the aktionsart or the lexical aspect, and provides semantic meaning (as cited in Chatterjee, 2014).

Compound verbs contain two verbs to express a single action. The first or the main verb is in nonfinite perfective participle form which is known as the pole. The second verb is a light verb which bears tense, aspect and person inflection is known as the vector verb (Butt, 2010). In these types of verbs, the pole always bears conjunctive participial form "-e" or infinitive form "-te" (Paul, 2003) despite the kind of aspect the vector has. For example, *pore giyeche* (have fallen). The vector verbs in compound verbs carry inflections and affects the aktionsart of the verbal construction (Chatterjee, 2014; Paul, 2003).

(1) Por-chi-l-am (Bangla)
/por-/ is the verb stem 'to read'; /-chi/ denotes the progressive aspect marker; /-l-/ is the past tense marker; and /-am/ is the first-person marker.
I was reading.

Hopper and Traugott (1993) explained that verbs which occur as a pole or simple verb contains its full meaning (as cited in Chatterjee, 2014). However, as vectors, these verbs tend to lose their inherent meanings and create slight difference in meaning (Chatterjee, 2014; Paul 2003). Bangla language has 16 vector verbs in total (Paul, 2003).

1.3. Usage-based Approach

According to Tomasello (2008), usage-based approach to language acquisition views that children acquire language structure from language use and frame language based on their general cognitive skills. Tomasello (2000a; 2008) viewed that instead of learning words directly, children try to understand adult utterances which results into comprehension of a word by deciding its functional role in the utterance and commonalities of this functional role across utterances (2008). Tomasello (2000a) further explained that when children want to communicate, they use these set expressions

which they have already mastered from their "stored linguistic experience" (p. 76). However, when there is no ready set expression, they modify their already mastered previous utterances or stored linguistic experiences to produce new utterances. This is known as "usage based syntactic operations" (Tomasello, 2000a, p.76); which explains that children create their new utterances by assorting or "cutting and pasting" their "pre-existing psycholinguistic units" according to the communicative situation; instead of building their utterances from scratch, morpheme by morpheme. According to usage-based model, children's early linguistic knowledge involves an "inventory of item-based constructions" which includes "utterance schemas" to structure new whole utterances (Tomasello, 2000a, p.77). These processes of continuous learning, chunking, making categories, and inferencing, in addition to fragmental or complete repetition later result into establishment of the language categories and structures (Bybee & Beckner, 2009).

1.4. Item Based Approach

According to Tomasello (2000b), in early language acquisition period children follow an item-based approach. Their early utterance includes particular words and phrases which lacks "system-wide syntactic categories or schemas" (p.156). Owens Jr. (2014) also mentioned that children observe the patterns of language in use in the environment around them and form a "hypothesis" about the rules of the patterns and test them in their own speech. As the child reaches cognitive and social maturity, he/she learns to use the "linguistic codes" with sophistication in his/her speech (p.294). MacWhinney (2005) went on stating that in each item-based construction there is a set of specific slots. In the initial phase, children's comprehension of the first words encountered in these slots assign the features of these slots. Thus, item-based learning is an ongoing process of generalisation of the semantic features of the arguments, where each item-based construction is related to a particular lexical item. This approach towards language acquisition inspired Tomasello (2000b) to propose a "usage based model" which argued that children learn new linguistic expressions naturally by imitating language around them and using cognitive and social-cognitive skills to "categorise, schematise and creatively combine" these new expressions in order to reach adult like competence (p.156).

1.5. Productivity

Yang (2005) explained that a structure or rule is productive when it can be automatically used with a set of lexical items having properties and can be used with novel items having similar properties. Brandt et al. (2011) explained that language acquisition, comprehension and production include three main processes which are segmentation, categorisation, and recombination. Children's productive acquisition takes place in rapid rate in a morphologically rich language (Xanthos et al., 2011). Hohenstein & Akhtar (2007) mentioned that children's vocabulary includes verbs only in the ways they have experienced them to be used around them as long as they do not experience other verbs. Here, Sultana (2016) mentioned that the children's early morphological production is strongly determined by the structural and the cognitive complexities of the target forms, where usually the structure of

substitute verb forms are simpler than the target forms. In case of Bangla, study shows that the productivity in early verb paradigm significantly increases with increasing age (Sanjana & Sultana, 2019). It is to be mentioned that simply adding inflections to verb stems does not mean that the child can use verbal inflections productively, since using appropriate inflection in the relevant syntactic context is important (Hohenstein & Akhter, 2007).

2. Methodology

Burns, Grove & Gray (2015) interpreted research design as, "a blueprint for conducting a study with maximum control over factors that may interfere with the validity of the findings" (p. 195). This research has been designed to understand the productive nature of tense inflections in relation to age, and to find a developmental pattern in these inflections. To investigate these issues, the researchers have collected language data from 30 typically developing Bangla speaking pre-school children aged 24 months to 48 months (age 2 to 4) from 3-day care centers in Dhaka. The language data is collected through elicited production. Elicited production or narrative is a data collection measure used for various numbers of purposes which includes eliciting particular structure or narrative from the participants by placing them in a discourse scenario where the target response is particularly appropriate (Ambridge, 2012; Mackey & Gass, 2005). Elicited production methods can lie along with a continuum from least to most structured. Moreover, sentence or stem completion technique can allow the researcher to exert more control (Ambridge & Rowland, 2013). Ambridge (2012) viewed that this paradigm is useful when the researcher wants to investigate children's acquisition of rarely used structures. Furthermore, the researchers have done a complete morphological transcription of the language data in order to analyse them to answer the research questions stated for this study. The data collected from the sample has been analysed following the *usage-based approach* proposed by Tomasello (2008). Frequency is one of the main factors in a usage based model to explain the productivity of language schemas, and structures as well as the abstractness of these language structures (Brandt et al., 2011; Bybee 2008). Frequency can be further divided into token and type frequency (Brandt et al., 2011; Bybee 2008). Yang (2005) mentioned that constitution of early vocabulary is directly related to token frequency, whereas productivity is depended on the type frequency of words in the early child vocabulary. Here, token frequency includes how many times a specific item is used in a specific pattern (Brandt et al., 2011; Ellis & Collins, 2009). It can refer to the number of times a lexical item occurs in child language data, i.e., a specific verb. Compared to low token frequency words, high token frequency items are strongly represented in memory, and are easily accessible (Rispens & De Bree, 2014). On the other hand, type frequency is a characteristic of patterns or constructions. It deals with a number of distinct items which either occur in the open slot of a construction or occur to create a pattern (Bybee & Beckner, 2009; Ellis & Collins, 2009). In general sense, type frequency includes the number of different lexical items which are used in a specific pattern, i.e., a suffix. (Brandt et al., 2011; Bybee, 2007). Rispens & De Bree

(2014) further mentioned that morphological productivity is highly influenced by type frequency. In this study, an inflection that has been used with even one verb stem is considered as productive use of that inflection. Moreover, the researchers have tried to connect the findings of this research with the existing literature in the same field.

2.1. Participants

The participants of this research are 30 children from 3 government operated day care centres in Dhaka city who are aged from 24 months to 48 months (age 2 to 4). With the permission from the authority, this study has been conducted. Table 1 gives information about the participants.

Table 1

Age Profile of Children

Children Age (Months)	Mean (N= 30)	Standard Deviation	Age Range (Maximum Age-Minimum Age)
	36.33	7.82	48-24= 24

A 20-minute language sample is collected through elicited production method from each of the 30 children (Mean= 36.33, Standard Deviation= 7.82). The three-day care centres are identified as: X, Y, and Z. The ratio of number of participants from each day care, X: Y: Z = 10: 11: 9. All the participants are identified as typically developing children by the caregivers in the day care centres. The authority of the day care centres has confirmed that the participants included in this study have no reported speech and/or language delay.

2.2. Data collection and processing

To elicit children responses for this research, the researchers have created a set of questions (see Appendix B). Sultana (2016) in her study with Bangla speaking children found only administering structured probes is fruitless to elicit the target verb forms. She recommended a spontaneous conversation framework using structured probes with very young children. The questions thus have been designed to elicit responses from the children which contain the verb forms in the target 8 tenses. Similar to Sultana's (2016) study the questions included target morphological forms used with non-target finite verbs. The researchers are native Bangla-speakers themselves. Therefore, they have used their intuition and have chosen those verbs with which young children are familiar; such as, *kanna kora* (to cry), *boka deowa* (to scold), *katukutu deowa* (to tickle). However, during data collection children are also given scope for natural language production. At one end, the children are given the scope for natural production; on the other end, the researchers exert control by constraining questions. During elicited production procedure, to engage the children in conversation, the researcher has used a set of toys including a car, a stuffed elephant and a teddy bear. The researcher has given the toys gradually to the children to engage them in a play session. The pre-planned question included questions related with

the toys to capture the interest of the children. The conversations have been video recorded with a digital camera and a mobile phone.

The setting of this study is the three-day care centres. While conducting the study it is necessary that the recording of child language data takes place in a place which is familiar to the participants (Eisenbeiss, 2010). As the children stay in the day cares for a significant amount of time, it can be assumed that the place will be familiar to and comfortable for them. In a familiar surrounding the children will not be intimidated and will willingly take part in the study. Eisenbeiss (2010) also mentioned that observer effect will be stronger if the researcher remains a stranger to the participants of the research before the actual recording takes place. Therefore, the researcher who has collected the data has made herself familiar with the children in the place where the study has taken place. Otherwise, the language sample will be unreliable containing insignificant data as the children will be frightened to take part in the elicitation process.

Eisenbeiss (2010) explained that researchers can use orthographic transcriptions combined with additional conventions for capturing deviations from the target forms by also incorporating target like forms and the properties of the children's spoken speech sample, e.g., pauses, hesitations, gestures, etc. which can be sometimes relevant for its interpretation. For this study, a complete morphological transcription of the language data has been done.

2.3. Data analysis

The transcribed language data have been analysed following several steps. First of all, only simple verbs and conjunct verbs with Noun/Adjective+ do type (verb) have been included in the analysis. Then, to analyse the data the researchers have calculated frequencies. Eisenbeiss (2010) explained that type frequency includes the calculation of frequency of morphological verb inflections and token frequency includes the calculation of frequency of individual tense inflected verb forms which the children will produce. For this study, an inflection that has been used with even one verb stem is considered productive use of that inflection. While calculating frequency of productive inflections, same inflection produced with the same verb stem as well as different verb stems has been considered a different item in every single use. To measure the use of verb inflections, inflections are written in standard Bangla to keep the tense markers consistent throughout the paper. All the varieties (standard and colloquial) produced by the children are included in Appendix A. Production score of tense inflections has been generated by calculating mean score and standard deviation. Mackey & Gass (2005) mentioned that mean or arithmetic average is a commonly used measure of central tendency. Mean or arithmetic average despite being commonly used, is sensitive to extreme scores when the number of participants is small. Measure of central tendency can be useful to show the typical behaviour of a group, but it tends to ignore some vital information. Mean score does not show how the scores are dispersed around the mean. In order to measure variability or dispersion it is necessary to measure standard deviation. A smaller standard deviation means that in terms of a particular behaviour the groups is more homogenous, and vice versa. The

smaller the standard deviation, the better the mean indicates the behaviour of group. Thus, measures of dispersion serve as a quality control for measures of central tendency. Besides, comparison has been made between 4 age groups. These 30 children have been divided into 4 age groups (see Table 2). From group A to group D, the age of the children increases.

Table 2

Age groups

Group	Number of Children (N= 30)	Age range (Months)
A	8	24 - <30
B	6	30 - <36
C	6	36 - <42
D	10	42 - < 48

Graphical representation of the data collected from the sample has been done using Microsoft Excel.

3. Findings

In total, 29 different morphological verb inflections for 8 tenses are found to be productive in this study. For a better representation, they have been shown under their particular tense inflection (see Table 3). For example, four morphological verb inflections (-i, -o, -e, -en) represent simple present tense; and they are shown under that particular tense inflection.

Table 3

Productivity of Tense Inflections and Their Frequency of Use for Each Child

No.	Children's Age in Months	Tense Inflections							
		Simple Present	Present Progressive	Present Perfect	Simple Past	Past Progressive	Past Perfect	Past Habitual	Future
1	24	5	0	2	0	0	0	0	1
2	24	10	0	1	0	0	0	0	2
3	26	16	1	2	0	0	0	0	1
4	26	15	4	1	1	0	0	0	4
5	27	13	0	3	0	0	0	1	1
6	28	12	0	1	0	0	0	0	2
7	28	9	2	8	3	0	1	0	5
8	29	14	3	5	0	0	3	1	4
9	30	12	5	3	0	2	6	2	3
10	31	12	0	11	1	1	1	1	3
11	32	16	1	6	0	1	1	1	4
12	33	15	4	8	2	0	3	1	5

13	34	23	2	9	2	2	5	0	1
14	35	27	2	14	0	1	3	3	3
15	36	28	5	12	3	2	6	2	6
16	37	25	7	15	0	1	0	3	5
17	38	37	6	12	2	0	8	1	5
18	39	36	6	11	2	1	7	1	2
19	40	39	6	20	1	2	0	0	5
20	41	59	4	14	1	1	7	3	6
21	42	32	7	11	3	0	0	3	5
22	43	31	8	11	2	1	6	2	12
23	44	32	9	22	1	0	7	5	11
24	44	25	8	18	2	0	5	4	8
25	45	32	9	27	2	1	6	4	7
26	45	50	11	19	6	0	3	5	16
27	46	49	11	21	3	10	29	5	14
28	47	80	12	27	5	6	16	21	13
29	48	82	13	19	15	15	5	9	14
30	48	79	17	42	9	4	12	5	12

Apart from that, Table 4 represents the production scores of tense inflections across age groups. Here, mean score and standard deviation of productive tense inflections have been measured for each group.

Table 4

Mean Score and Standard Deviation of Tense Inflections Across Age Group

		Age Groups			
		A	B	C	D
Inflections of Simple Present Tense	Mean Score	11.75	17.50	37.33	49.20
	Standard Deviation	3.62	6.16	11.94	22.89
Inflections of Present Progressive Tense	Mean Score	1.25	2.33	5.67	10.50
	Standard Deviation	1.58	1.86	1.03	2.99
Inflections of Present Perfect Tense	Mean Score	2.88	8.50	14	21.70
	Standard Deviation	2.47	3.83	3.29	8.98
Inflections of Simple Past Tense	Mean Score	0.5	0.83	1.50	4.80
	Standard Deviation	1.07	0.98	1.05	4.32
Inflections of Past Progressive Tense	Mean Score	0	1.17	1.17	3.70
	Standard Deviation	0	0.75	0.75	5.19
Inflections of Past Perfect Tense	Mean Score	0.5	3.17	4.67	8.90
	Standard Deviation	1.07	2.04	3.67	8.36

Inflections of Past Habitual Tense	Mean Score	0.25	1.33	1.67	6.30
	Standard Deviation	0.46	1.03	1.21	5.48
Inflections of Future Tense	Mean Score	2.50	3.17	4.83	11.20
	Standard Deviation	1.60	1.33	1.47	3.49

From the group data (see Table 4), it is also shown that productivity increases as the age of the children increases.
Some of these productive morphological verb inflections of tenses have been more frequent and some of them have been less frequent. Below, the total number of productive morphological inflections of verb for tenses and the number of productive tenses for each child is shown (see Table 5).

Table 5

Productive Tenses and Productive Morphological Inflections of Verb for Bangla Tenses

Children	No. of Productive Tenses	No. of Productive Inflections of Verb	Children	No. of Productive Tenses	No. of Productive Inflections of Verb
1 (24 months)	3	3	16 (37 months)	6	11
2 (24 months)	3	5	17 (38 months)	7	14
3 (26 months)	4	5	18 (39 months)	8	13
4 (26 months)	5	7	19 (40 months)	6	15
5 (27 months)	4	7	20 (41 months)	8	18
6 (28 months)	3	4	21 (42 months)	6	14
7 (28 months)	6	10	22 (43 months)	8	20
8 (29 months)	6	11	23 (44 months)	7	18
9 (30 months)	7	12	24 (44 months)	7	16
10 (31 months)	7	10	25 (45 months)	8	19
11 (32 months)	7	11	26 (45 months)	7	18
12 (33 months)	7	13	27 (46 months)	8	23
13 (34 months)	7	13	28 (47 months)	8	22

14 (35 months)	7	13	29 (48 months)	8	20
15 (36 months)	8	18	30 (48 months)	8	26

Table 6 represents total number of produced productive inflections of verb for tense and productive tenses across age groups. Here, mean score and standard deviation of the produced inflections and tenses have been measured for each age group.

Table 6

Mean Score and Standard Deviation of the Total Number of Productive Tenses and Productive Morphological Inflections of Verb for Tense across Age Groups

Group	Number of Children	Age Range (Months)	No. of Tenses		No. of Productive Inflections of Verb	
			Mean Score	Standard Deviation	Mean Score	Standard Deviation
A	8	24 - <30	4.25	1.82	6.5	2.83
B	6	30 - <36	7	0	12	1.26
C	6	36 - <42	7. 17	0.98	14.83	2.79
D	10	42 - < 48	7.5	0.71	19.6	3.47

Table 7 provides information about frequency of total number of use of productive morphological verb inflections of Bangla tenses. For one verb inflection of tense, the number of children who have used that inflection productively during the elicitation task has been taken as frequency of total number of child use for that particular inflection.

Table 7

Usage of verb inflections among children

Verb Inflection of Tense	Total Number of Child Use	Percentage (%)	Verb Inflection of Tense	Total Number of Child Use	Percentage (%)
-i	29	96.67			
-o	16	53.33	-len	3	10.00
-e	29	96.67	-chilam	11	36.67
-en	2	6.67	-chilo	7	23.33
-chi	19	63.33	-chile	2	6.67
-cho	1	3.33	-echilam	19	63.33
-che	23	76.67	-echile	4	13.33
-chen	1	3.33	-echilo	12	40.00
-echi	28	93.33	-tam	15	50.00

-echo	11	36.67	-te	4	13.33
-eche	24	80.00	-to	15	50.00
-echen	3	10.00	-bo	28	93.33
-lam	11	36.67	-ba	9	30.00
-le	10	33.33	-be	16	53.33
-lo	12	40.00	-ben	1	3.33

4. Analysis

4.1. Productivity of tense inflections

4.1.1. Present and Future Tense

From the study, it is found that inflections of present simple tense, present perfect tense and future tense start to be used productively from the earliest period (24 months) by the children (see Table 3). Looking at the group data from Table 4, there is a gradual increase of mean score in the age groups. In case of age group D which includes the highest number of children, a significantly high standard deviation is observed for all the tenses. It suggests that the productive tense inflection scores fluctuated among the children. For example, in Table 3, in case of Simple Present, child 24 scores 25, whereas, the highest score in this age group is 82 (from Table 1). It can be due to individual personality trait (such as, shyness) or their preference to not engage during the data collection procedure. Some children have talked more whereas some have been reluctant to respond. Therefore, they may have not productively used some morphological forms which are present to them.

Four verb inflections (-i, -o, -e, en) of simple present tense, four verb inflections (-echi, -echo, -eche, -echen) of present perfect tense, and four verb inflections (-bo, -ba, -be, -ben) of future tense have been productive among the children in this study. However, inflections of present simple tense are found to be most productive in this study. Two of the simple present tense inflection (-i and -e) are used by 96.67% of the total sample in this study (see Table 7). On the contrary, *-cho, -chen, -ben* verb inflections have been used by only one child (3.33%). This is different than English language where children's early utterances include present progressive tense the most (Brown, 1973). The reason which makes it the "earliest developing form" is that the structure of this form is the simplest and requires the least complex tense and aspect markers (Sultana et al., 2016, p.14). The researchers also feel that cultural learning plays an important role in acquisition of productive tense inflections (Ghalebi & Sadighi, 2015). In the early years, children are exposed to these tense inflections more than other tense inflections in their social and linguistic environment.

Inflections of present progressive tense become productive later than these 3 tenses; from around the age of 26 months with some exceptions (see Table 3). There is a gradual increase of mean score in the age groups as well (see Table 4). Four verb inflections (-chi, -cho, -che, -chen) of present progressive tense have been productive among the children in this study. It has been observed by the researchers that children have tended to use present perfect tense in the context of present progressive tense. Again, this may be due to the relative complexity of the present progressive tense inflections than the

perfect ones (-echi, -echo, -eche, -echen > -chi, -cho, -che, -chen). Although children start to use future tense inflections before tense inflections of present progressive tense (see Table 3), there production scores are quite similar. Again, this can be due to the children's avoidance of talking about incidents in the future in the study. Moreover, in the context of future tense children have tended to use present tenses.

4.1.2. Past Tenses

For elicited production, questions have been included to elicit inflections of simple past tense before the questions to elicit other past tenses as inflections of simple past tense have been expected to be productive before those inflections (see Appendix B; question f). However, it is seen that inflections of past perfect tense and past habitual (from the age of 28 months and 29 months respectively) are productive earlier than simple past tense inflection (see Table 3). There is a gradual increase of mean score in the age groups (see Table 4). Three verb inflections (-echilam, -echile, -echilo) of past perfect tense, and three verb inflections (-tam, -te, -to) of past habitual tense have been productive among the children in this study.

In most cases, children start to use inflections of simple past tense productively from around 33 months (see Table 3). There is a gradual increase of mean score in the age groups for these tenses as well (see Table 4). Four verb inflections (-lam, -le, -lo, -len) of simple past tense have been productive among the children in this study. As anticipated, inflections of past progressive tense become productive later than all the other tense inflections- from around 46 months (see Table 3). Before that age, there have been some limited productive use of the inflections of this tense. There is no reported use of this tense for age group A, and productivity increases for age group D, before being somewhat limited in both age group B and C (see Table 4). Three verb inflections (-chilam, -chilo, -chile) of past progressive tense have been productive. Sultana et al. (2016) explains that these forms can be cognitively challenging for the children and they often can be replaced by non-target forms. In Sultana's (2016) study, past progressive and past perfect verb forms were very low due to their structural and cognitive demands. In Chakraborty and Leonard's (2012) study past progressive forms were highly accurate. The researchers in this study have also found the accurate but very limited use of past progressive tense inflections by the children.

4.2. Comparative usage among children

From Table 5, it is found that there is an increase in the number of productive verb inflections for tense and productive tenses along with the increase of age in the children. There has been a strong positive correlation between children's age and their productive tenses, $r = .78$, $p < 0.000005$. A one-way ANOVA run with age groups as independent, and number of productive tense inflections as dependent variables further shows that the age groups have a significant effect on productivity of tense inflections ($F_{3,26} = 32.32$, $p < 0.00000005$). Children create categories and slots as they learn new inflections, and later test them in conversational context; finally form a generalisation about the semantic features. While doing so, they are bound

to make mistakes, which is why production of tense has gone through fluctuation from 37 months to 45 months. Thus, the findings in this research implies that linguistic acquisition and production of children involves consciously learning linguistic terms and their constructions in order to gradually reconstruct them to form more "abstract and word general" linguistic items. (Wittek & Tomasello, 2002, p.586). It is to be noted that the researchers have not explored other situational, cognitive and individual aspects which can affect the production of target tense forms. Therefore, from the current study it was not possible to propose an exact developmental trend in productive tense inflections. However, there is a certain pattern in the productive use of the tense inflections which is observed during this study. First of all, from Table 5 it can be seen that the number of productive verb inflections of tenses starts to increase as the age of the children increase. However, this increase in productive tense inflections does not necessarily mean that productive tense increases along with age. As seen from Table 5, there is a fluctuation of number of tenses produced by the children. From 37 months to 45 months, the number of tenses produced varied from 6 to 8. In group data (see Table 6), we can see these trends very clearly. The mean score of number of tenses and inflections produced increases along with age.

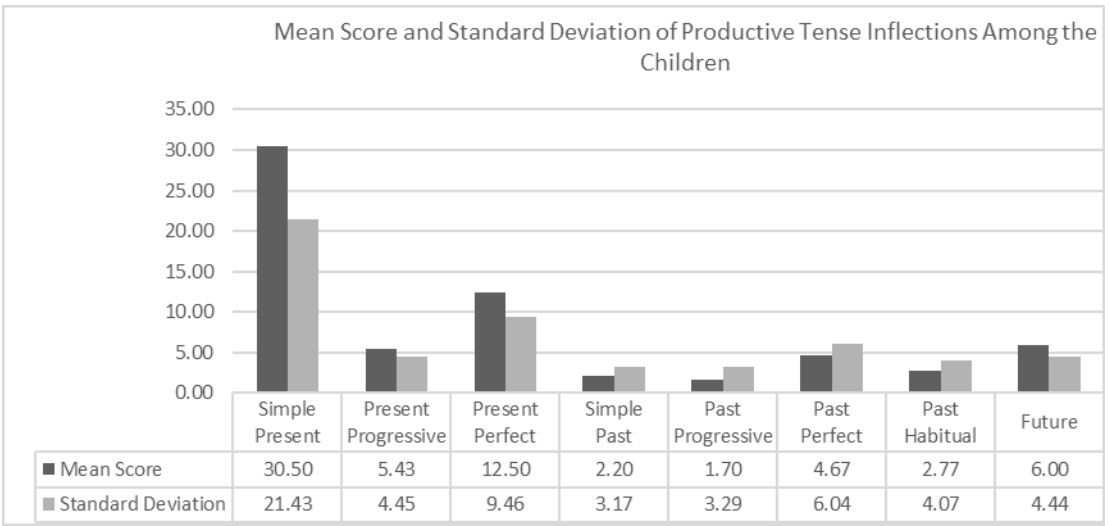
4.3. Order of use for productive tense inflections and tenses

Based on the number of child use from Table 7, the researchers can propose the following order of use for all the morphological verb inflections of different Bangla tenses: -i, -e> -echi, -bo> -eche> -che> -chi, -echilam> -o, -be> -tam, -to> -lo, -echilo> -echo, -lam, -chilam> -le> -ba> -chilo> -echile, -te> -echen, -len> -en, -chile> -cho, chen, ben

From the data of Table 3, the production scores (mean score and standard deviation) for the tense inflections have been graphically presented in Figure 1.

Figure 1

Production scores of tense inflections.



From the comparative analysis amongst the tense inflections it is found that present simple tense gets the highest production score (Mean Score= 30.50, Standard Deviation= 21.43). Past progressive tense gets the least production score in the study (Mean Score= 1.70, Standard Deviation= 3.29). Based on the production scores of the tense inflections, the following order of use of tense inflections can be proposed:
Simple Present Tense> Present Perfect Tense> Future Tense> Present Progressive Tense> Past Perfect Tense> Past Habitual Tense> Simple Past Tense> Past Progressive Tense
The researchers believe that younger children lack the cognitive skills and produce less productive verb inflections and tenses. Also, there is a chance that the children they may have not productively used some morphological form. In children's early years, their "stored linguistic experience" (Tomasello, 2000a, p.76) includes only those inflections and tenses which do not require complex linguistic understanding. However, as they age, and their cognitive skill starts to mature, they learn to create "utterance schemas" (Tomasello, 2000a, p.66). They create slots for the inflections they have learned from their linguistic experience to use with variety of range of verb stems. At first these use of new inflections are not appropriate as they seem cognitively challenging and difficult to produce for the children. However, as they gain experience, they begin to get more proficient in using the verb inflections and tenses more productively.

5. Conclusion

To conclude, the researchers employ the data collection methods- elicited production; to investigate the productive tense inflections in Bangla speaking pre-school children from 3-day care centres. In this study, the researchers have found that age of the children plays role in acquisition of tense inflections. Although, other variables, such as exposure to forms in environment, or processing capacity of children etc. have not been studied in this research, the finding of this study is helpful to create a developmental profile for typically developing children. This study can be used as an inventory by researcher as it includes real-life data from 30 typically developing Bangla speaking pre-school children. Moreover, this research will help other researchers who are interested to work on Bangla tense and inflection development in children. Therefore, conclusions derived from this study is noteworthy in the area of Bangla tense inflection acquisition, productivity and development.
Recommendations for future studies are given below:
a. Future studies can explore the other factors except age for tense inflection production
b. They can include complex and conjunct verb forms.
c. They can include aspectual and personal markers as well.
d. They can include larger sample to draw more generalisations.
e. They can use other data collection methods.

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Appendices

Appendix A: *Bangla tense-aspect paradigm*

TENSE	1st Person	2nd Person			3rd Person	
		Neg	Gen	Res	Gen	Res
Simple Present	-i Pori	-ish Porish	-o Poro	-en Poren	-e Pore	-en Poren
Present Progressive	-chi/-tesi Porchi/ Portesi	-chis/-tesis Porchish/ Portesis	-cho/-teso Porcho/ Porteso	-chen/-tesen Porchen/ Portesen	-che/-tese Porche/ portese	-chen/-tesen Porchen/ Portesen
Present Perfect	-echi/-si Porechi/ Porsi	-echis/ -sis Porechis/ Porsis	-echo/-so Porecho/ Porso	-echen/-sen Porechen/ Porsen	-eche/-se Poreche/ Porse	-echen/-sen Porechen/ Porsen
Simple Past	-lam Porlam	-li Porli	-le Porle	-len Porlen	-lo Porlo	-len Porlen
Past progressive	-chilam/-tesilam Porchilam/ Portesilam	-chilish/-tesilish Porchilish/ Portesilish	-chile/-tesila Porchile/ Portesila	-chilen/-tesilen Porchilen/ Portesilen	-chilo/-tesilo Porchilo/ Portesilo	-chilen/-tesilen Porchilen/ Portesilen
Past Perfect	-echilam/-silam Porechilam/ Porsilam	-echili/ -sili Porechili/ Poresli	-echile/-sila Porechile/ Porsila	-echilen/-silen Porechilen/ Porsilen	-echilo/-silo Porechilo/ Porsilo	-echilen/-silen Porechilen/ Porsilen
Past Habitual	-tam Portam	-ti Porti	-te Porte	-ten Porten	-to Porto	-ten Porten
Future	-bo/-mu Porbo/ Pormu	-bi Porbi	-ba Porba	-ben Porben	-be Porbe	-ben Porben

Here, Gen=General, Neg=Negligible and Res= Respect
Note: Adapted from Ali, Sarker, Ahmed & Das, 2010; Bhattacharya, Choudhury, Sarkar & Basu, 2005; Paramita, 2006; Sultana 2016.

Appendix B: *Elicited Production Questionnaire*

1. Basic introductory questions:
a. Tomar nam ki?
b. Kemon acho?
2. Questions focusing on tense:
a. Ki korcho?
b. Sokale ki korecho?
c. Dekho to eta ki? (showing the child a toy car).
d. Garita die ki koro?
e. Gari ta die ki ki kora jay amake ektu bolo toh?
f. Accha, tumi ei putul take bolo toh tumi kal ke ki ki korechile? (showing the child a doll)
g. Acting as if the doll is speaking: Hi amar nam bulu, amar kono bondhu nei. Ami ki korle tumi amar bondhu hoba?

h. Acting as if the doll is speaking: Ami Jodi kanna kortam tahole tumi ki korta?
i. Acting as if the doll is speaking: Tumi jokhon basay kanna koro tokhon tomar ammu ki korto?
j. Acting as if the doll is speaking: Ami Jodi tomake boka dei tahole ki korba tumi?
k. Acting as if the doll is speaking: Tomake abbu/ ammu boka dile ki koro?
l. Tickling the doll: Dekho putul tar onek katukutu ache. Tomake keu katukutu dite chaile ki korta?
m. (Giving the child the doll) Ektu age putuler sathe ki korla bolo toh amake?
n. Putula ta die ki koro?
o. (Dancing a teddy in front of the child) Bolo teddy ta ki korche?
p. Teddy ta jante chasse ajk basay jeye ki ki korba?
q. (Pinching the teddy) Teddyta ke etokkhon ki kortechilam?
r. (Giving the child the teddy) Teddyta r na onek mon kharap oke ektu bolo toh valo teddy hote hole ki ki korte hobe?
s. Tumi boro hoe ki ki korba?

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Bangla Tense Inflections Productivity among Pre-School Children[1]

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S. M. Sanzana Rahman[2]
Southeast University
Lubaba Sanjana[3]
Brac University

Abstract

Although there have been different types of studies regarding Bangla verbs, acquisition of Bangla verbs and different types of Bangla tenses; there is a lack of research on the relationship between age and productive tense inflections and development of these inflections for Bangla speaking children. This paper studies the relation between age and productivity of tense inflections of typically developing Bangla speaking pre-school children. The data have been collected from speech samples of 30 children aged 24 months to 48 months through elicited production method. The study finds out the different age range when different tense inflections become productive. It proposes an order of use of the morphological verb inflections of tense and tense inflections for the 30 children in this study. In addition, it explores the probability of a developmental sequence in these inflections in relation to *Tomasello's* (2008) *usage-based approach* for typically developing Bangla speaking pre-school children. The findings of this research can be used to help future studies in the field of Bangla Tense acquisition as well as to create a profile for typically developing children. Moreover, studies dealing with children with language impairments may benefit from the findings.

Keywords Tense inflections; Bangla Tense; Productivity; Bangla Verbal Morphology; First Language Acquisition

1. Introduction

In Bangla language, different morphological inflections are used with bare verb stems to denote different types of tenses. As a result, Bangla tense system is extraordinarily complex including different range of morphological verb inflections. Sultana (2016) asserted that in Bangla language, an in-depth scenario of typical growth in language has not been established by analysing child language data. This research will measure typical Bangla speaking children's productive use of tense inflections in relation to age. It will conduct a comparative analysis of the usage of the productive morphological verb inflections of Bangla tense to propose a developmental

[1] The authors have made equal contributions to the paper

[2] S. M. Sanzana Rahman is a lecturer currently working in the Department of English, Southeast University, Dhaka, Bangladesh. Her areas of research interest include child language development, SLA, language and identity and CALL. She teaches EAP courses.

[3] Lubaba Sanjana is a lecturer in the Department of English & Humanities, Brac University, Dhaka, Bangladesh. Her areas of research interest include child language development, reading development and SLA. Currently, she is pursuing her PhD in the Faculty of Education at Mount Saint Vincent University, Nova Scotia, Canada.

Corresponding author: lubaba.sanjana273@gmail.com

trend in these inflections which can be later used to create assessments and interventions for children with language impairment. The researchers have tried to figure out the answers to these questions:

a. When do children start to use different tense inflections productively?
b. What is the comparative range of usage of the productive morphological verb inflections of Bangla tense among the children?
c. Is there any developmental trend in the productive verb inflections of tenses in relation to Tomasello's (2008) *usage-based approach*; for typically developing Bangla speaking pre-school children?

1.1. Bangla Tense

Rácová (2009) mentioned that there are eight tenses in Bangla language; simple present, present imperfect or present continuous or present progressive, present perfect, preterite or simple past, past imperfect or past continuous or past progressive, pluperfect or past perfect, past habitual, and future. In Bangla language, finite verb forms are marked for person, tense, aspect, and honour features, each attaching itself to the verb stem in a fixed order (Kar, 2009; Thompson, 2012). Unlike English, they are unmarked for plurality or gender. The markers attach to the verb in an incremental or agglutinative fashion (Kar, 2009). In Bangla language, the finite verb form not only includes the root morpheme which has the lexical meaning of the verb but also, tense marking grammatical morpheme + aspect marking grammatical morpheme + personal endings (Rácová, 2009; Sultana et al., 2016). Therefore, the designations of finite verbal forms include information about the aspect as well as the tense (e.g., present perfect, past imperfect or past continuous etc.) (Rácová, 2009). In case of present tense, verbs do not have overt tense markers. Also, aspect markers are seen in case of only two contexts; progressive and perfective. There are distinct person markers to indicate first, second, and third person agents (Sultana et al., 2016), and young children tend to acquire third person marker comparatively easily (Sanjana, 2018). Also, Paramita (2006) explained that in Bangla, each tense is incorporated with a set of five term person morphemes which include the honour features. They are, person 1 (p1), person 2. status 1 (p2sl), person 2 status 2 (p2s2), person 2 status 3 (p2s3) and person 3 (p3). It is possible for these tense-person morphemes to have some allomorphs that might be suffixed to the verb root. Bangla tense-aspect paradigm in all the three persons is included in Appendix A.

Chakraborty and Leonard's study (2012) found present progressive and past progressive forms to gain high accuracy. In her study, Sultana (2016) found that present perfect form is produced in the highest number (over 92%) by the children. Present progressive verb forms in Bangla obtains a moderate production score. Performance of the children has suggested that they frequently substitute past simple verb forms by the present perfect forms. The overall production of past progressive and past perfect verb forms is incredibly low due to their structural and cognitive demands. Another study by Sultana et al. (2016) stated that the highest accuracy of acquisition is in present simple forms (88%), then in present progressive forms (67%), and the lowest in past progressive forms (44%).

1.2. Bangla Verbal System

There are two types of verbs in Bangla verbal system; simple verbs and complex verbs which refer to both conjunct and compound verbs (Chatterjee, 2014). Complex verbs can be of several constrictions as well. For example; Noun/Adjective + do type, Noun/Adjective + do + Verb type and Verb + Verb type. N/A + do and N/A + do + V constructions are called conjunct verbs whereas, V+V constructions are called compound verbs (Thompson 2012). Bangla language has a limited use of simple verbs and abundant usage of conjunct verbs. In two-part conjunct verbs, noun or adjectives appear with a helping verb such as, *kora* (do). For example, *bhul kora* (to mistake). Here, the helping verb bears tense, person and aspect inflection. In three-part conjunct verbs, noun or adjectives appear with two verbs; a helping verb such as, *kora* (do) and a vector verb such, *neya* (to take). For example, *bhul kore niyechi* (to take mistakenly). Here, the helping verb is in the perfective participle form, whereas the vector verb bears tense, person and aspect inflection (Chatterjee, 2014). Ramchand (1990) viewed that the vector verb also affects the aktionsart or the lexical aspect, and provides semantic meaning (as cited in Chatterjee, 2014).

Compound verbs contain two verbs to express a single action. The first or the main verb is in nonfinite perfective participle form which is known as the pole. The second verb is a light verb which bears tense, aspect and person inflection is known as the vector verb (Butt, 2010). In these types of verbs, the pole always bears conjunctive participial form "-e" or infinitive form "-te" (Paul, 2003) despite the kind of aspect the vector has. For example, *pore giyeche* (have fallen). The vector verbs in compound verbs carry inflections and affects the aktionsart of the verbal construction (Chatterjee, 2014; Paul, 2003).

(1) Por-chi-l-am (Bangla)
/por-/ is the verb stem 'to read'; /-chi/ denotes the progressive aspect marker; /-l-/ is the past tense marker; and /-am/ is the first-person marker.
I was reading.

Hopper and Traugott (1993) explained that verbs which occur as a pole or simple verb contains its full meaning (as cited in Chatterjee, 2014). However, as vectors, these verbs tend to lose their inherent meanings and create slight difference in meaning (Chatterjee, 2014; Paul 2003). Bangla language has 16 vector verbs in total (Paul, 2003).

1.3. Usage-based Approach

According to Tomasello (2008), usage-based approach to language acquisition views that children acquire language structure from language use and frame language based on their general cognitive skills. Tomasello (2000a; 2008) viewed that instead of learning words directly, children try to understand adult utterances which results into comprehension of a word by deciding its functional role in the utterance and commonalities of this functional role across utterances (2008). Tomasello (2000a) further explained that when children want to communicate, they use these set expressions

which they have already mastered from their "stored linguistic experience" (p. 76). However, when there is no ready set expression, they modify their already mastered previous utterances or stored linguistic experiences to produce new utterances. This is known as "usage based syntactic operations" (Tomasello, 2000a, p.76); which explains that children create their new utterances by assorting or "cutting and pasting" their "pre-existing psycholinguistic units" according to the communicative situation; instead of building their utterances from scratch, morpheme by morpheme. According to usage-based model, children's early linguistic knowledge involves an "inventory of item-based constructions" which includes "utterance schemas" to structure new whole utterances (Tomasello, 2000a, p.77). These processes of continuous learning, chunking, making categories, and inferencing, in addition to fragmental or complete repetition later result into establishment of the language categories and structures (Bybee & Beckner, 2009).

1.4. Item Based Approach

According to Tomasello (2000b), in early language acquisition period children follow an item-based approach. Their early utterance includes particular words and phrases which lacks "system-wide syntactic categories or schemas" (p.156). Owens Jr. (2014) also mentioned that children observe the patterns of language in use in the environment around them and form a "hypothesis" about the rules of the patterns and test them in their own speech. As the child reaches cognitive and social maturity, he/she learns to use the "linguistic codes" with sophistication in his/her speech (p.294). MacWhinney (2005) went on stating that in each item-based construction there is a set of specific slots. In the initial phase, children's comprehension of the first words encountered in these slots assign the features of these slots. Thus, item-based learning is an ongoing process of generalisation of the semantic features of the arguments, where each item-based construction is related to a particular lexical item. This approach towards language acquisition inspired Tomasello (2000b) to propose a "usage based model" which argued that children learn new linguistic expressions naturally by imitating language around them and using cognitive and social-cognitive skills to "categorise, schematise and creatively combine" these new expressions in order to reach adult like competence (p.156).

1.5. Productivity

Yang (2005) explained that a structure or rule is productive when it can be automatically used with a set of lexical items having properties and can be used with novel items having similar properties. Brandt et al. (2011) explained that language acquisition, comprehension and production include three main processes which are segmentation, categorisation, and recombination. Children's productive acquisition takes place in rapid rate in a morphologically rich language (Xanthos et al., 2011). Hohenstein & Akhtar (2007) mentioned that children's vocabulary includes verbs only in the ways they have experienced them to be used around them as long as they do not experience other verbs. Here, Sultana (2016) mentioned that the children's early morphological production is strongly determined by the structural and the cognitive complexities of the target forms, where usually the structure of

substitute verb forms are simpler than the target forms. In case of Bangla, study shows that the productivity in early verb paradigm significantly increases with increasing age (Sanjana & Sultana, 2019). It is to be mentioned that simply adding inflections to verb stems does not mean that the child can use verbal inflections productively, since using appropriate inflection in the relevant syntactic context is important (Hohenstein & Akhter, 2007).

2. Methodology

Burns, Grove & Gray (2015) interpreted research design as, "a blueprint for conducting a study with maximum control over factors that may interfere with the validity of the findings" (p. 195). This research has been designed to understand the productive nature of tense inflections in relation to age, and to find a developmental pattern in these inflections. To investigate these issues, the researchers have collected language data from 30 typically developing Bangla speaking pre-school children aged 24 months to 48 months (age 2 to 4) from 3-day care centers in Dhaka. The language data is collected through elicited production. Elicited production or narrative is a data collection measure used for various numbers of purposes which includes eliciting particular structure or narrative from the participants by placing them in a discourse scenario where the target response is particularly appropriate (Ambridge, 2012; Mackey & Gass, 2005). Elicited production methods can lie along with a continuum from least to most structured. Moreover, sentence or stem completion technique can allow the researcher to exert more control (Ambridge & Rowland, 2013). Ambridge (2012) viewed that this paradigm is useful when the researcher wants to investigate children's acquisition of rarely used structures. Furthermore, the researchers have done a complete morphological transcription of the language data in order to analyse them to answer the research questions stated for this study. The data collected from the sample has been analysed following the *usage-based approach* proposed by Tomasello (2008). Frequency is one of the main factors in a usage based model to explain the productivity of language schemas, and structures as well as the abstractness of these language structures (Brandt et al., 2011; Bybee 2008). Frequency can be further divided into token and type frequency (Brandt et al., 2011; Bybee 2008). Yang (2005) mentioned that constitution of early vocabulary is directly related to token frequency, whereas productivity is depended on the type frequency of words in the early child vocabulary. Here, token frequency includes how many times a specific item is used in a specific pattern (Brandt et al., 2011; Ellis & Collins, 2009). It can refer to the number of times a lexical item occurs in child language data, i.e., a specific verb. Compared to low token frequency words, high token frequency items are strongly represented in memory, and are easily accessible (Rispens & De Bree, 2014). On the other hand, type frequency is a characteristic of patterns or constructions. It deals with a number of distinct items which either occur in the open slot of a construction or occur to create a pattern (Bybee & Beckner, 2009; Ellis & Collins, 2009). In general sense, type frequency includes the number of different lexical items which are used in a specific pattern, i.e., a suffix. (Brandt et al., 2011; Bybee, 2007). Rispens & De Bree

(2014) further mentioned that morphological productivity is highly influenced by type frequency. In this study, an inflection that has been used with even one verb stem is considered as productive use of that inflection. Moreover, the researchers have tried to connect the findings of this research with the existing literature in the same field.

2.1. Participants

The participants of this research are 30 children from 3 government operated day care centres in Dhaka city who are aged from 24 months to 48 months (age 2 to 4). With the permission from the authority, this study has been conducted. Table 1 gives information about the participants.

Table 1

Age Profile of Children

Children Age (Months)	Mean (N= 30)	Standard Deviation	Age Range (Maximum Age-Minimum Age)
	36.33	7.82	48-24= 24

A 20-minute language sample is collected through elicited production method from each of the 30 children (Mean= 36.33, Standard Deviation= 7.82). The three-day care centres are identified as: X, Y, and Z. The ratio of number of participants from each day care, X: Y: Z = 10: 11: 9. All the participants are identified as typically developing children by the caregivers in the day care centres. The authority of the day care centres has confirmed that the participants included in this study have no reported speech and/or language delay.

2.2. Data collection and processing

To elicit children responses for this research, the researchers have created a set of questions (see Appendix B). Sultana (2016) in her study with Bangla speaking children found only administering structured probes is fruitless to elicit the target verb forms. She recommended a spontaneous conversation framework using structured probes with very young children. The questions thus have been designed to elicit responses from the children which contain the verb forms in the target 8 tenses. Similar to Sultana's (2016) study the questions included target morphological forms used with non-target finite verbs. The researchers are native Bangla-speakers themselves. Therefore, they have used their intuition and have chosen those verbs with which young children are familiar; such as, *kanna kora* (to cry), *boka deowa* (to scold), *katukutu deowa* (to tickle). However, during data collection children are also given scope for natural language production. At one end, the children are given the scope for natural production; on the other end, the researchers exert control by constraining questions. During elicited production procedure, to engage the children in conversation, the researcher has used a set of toys including a car, a stuffed elephant and a teddy bear. The researcher has given the toys gradually to the children to engage them in a play session. The pre-planned question included questions related with

the toys to capture the interest of the children. The conversations have been video recorded with a digital camera and a mobile phone.

The setting of this study is the three-day care centres. While conducting the study it is necessary that the recording of child language data takes place in a place which is familiar to the participants (Eisenbeiss, 2010). As the children stay in the day cares for a significant amount of time, it can be assumed that the place will be familiar to and comfortable for them. In a familiar surrounding the children will not be intimidated and will willingly take part in the study. Eisenbeiss (2010) also mentioned that observer effect will be stronger if the researcher remains a stranger to the participants of the research before the actual recording takes place. Therefore, the researcher who has collected the data has made herself familiar with the children in the place where the study has taken place. Otherwise, the language sample will be unreliable containing insignificant data as the children will be frightened to take part in the elicitation process.

Eisenbeiss (2010) explained that researchers can use orthographic transcriptions combined with additional conventions for capturing deviations from the target forms by also incorporating target like forms and the properties of the children's spoken speech sample, e.g., pauses, hesitations, gestures, etc. which can be sometimes relevant for its interpretation. For this study, a complete morphological transcription of the language data has been done.

2.3. Data analysis

The transcribed language data have been analysed following several steps. First of all, only simple verbs and conjunct verbs with Noun/Adjective+ do type (verb) have been included in the analysis. Then, to analyse the data the researchers have calculated frequencies. Eisenbeiss (2010) explained that type frequency includes the calculation of frequency of morphological verb inflections and token frequency includes the calculation of frequency of individual tense inflected verb forms which the children will produce. For this study, an inflection that has been used with even one verb stem is considered productive use of that inflection. While calculating frequency of productive inflections, same inflection produced with the same verb stem as well as different verb stems has been considered a different item in every single use. To measure the use of verb inflections, inflections are written in standard Bangla to keep the tense markers consistent throughout the paper. All the varieties (standard and colloquial) produced by the children are included in Appendix A. Production score of tense inflections has been generated by calculating mean score and standard deviation. Mackey & Gass (2005) mentioned that mean or arithmetic average is a commonly used measure of central tendency. Mean or arithmetic average despite being commonly used, is sensitive to extreme scores when the number of participants is small. Measure of central tendency can be useful to show the typical behaviour of a group, but it tends to ignore some vital information. Mean score does not show how the scores are dispersed around the mean. In order to measure variability or dispersion it is necessary to measure standard deviation. A smaller standard deviation means that in terms of a particular behaviour the groups is more homogenous, and vice versa. The

smaller the standard deviation, the better the mean indicates the behaviour of group. Thus, measures of dispersion serve as a quality control for measures of central tendency. Besides, comparison has been made between 4 age groups. These 30 children have been divided into 4 age groups (see Table 2). From group A to group D, the age of the children increases.

Table 2

Age groups

Group	Number of Children (N= 30)	Age range (Months)
A	8	24 - <30
B	6	30 - <36
C	6	36 - <42
D	10	42 - < 48

Graphical representation of the data collected from the sample has been done using Microsoft Excel.

3. Findings

In total, 29 different morphological verb inflections for 8 tenses are found to be productive in this study. For a better representation, they have been shown under their particular tense inflection (see Table 3). For example, four morphological verb inflections (-i, -o, -e, -en) represent simple present tense; and they are shown under that particular tense inflection.

Table 3

Productivity of Tense Inflections and Their Frequency of Use for Each Child

No.	Children's Age in Months	Tense Inflections							
		Simple Present	Present Progressive	Present Perfect	Simple Past	Past Progressive	Past Perfect	Past Habitual	Future
1	24	5	0	2	0	0	0	0	1
2	24	10	0	1	0	0	0	0	2
3	26	16	1	2	0	0	0	0	1
4	26	15	4	1	1	0	0	0	4
5	27	13	0	3	0	0	0	1	1
6	28	12	0	1	0	0	0	0	2
7	28	9	2	8	3	0	1	0	5
8	29	14	3	5	0	0	3	1	4
9	30	12	5	3	0	2	6	2	3
10	31	12	0	11	1	1	1	1	3
11	32	16	1	6	0	1	1	1	4
12	33	15	4	8	2	0	3	1	5

13	34	23	2	9	2	2	5	0	1
14	35	27	2	14	0	1	3	3	3
15	36	28	5	12	3	2	6	2	6
16	37	25	7	15	0	1	0	3	5
17	38	37	6	12	2	0	8	1	5
18	39	36	6	11	2	1	7	1	2
19	40	39	6	20	1	2	0	0	5
20	41	59	4	14	1	1	7	3	6
21	42	32	7	11	3	0	0	3	5
22	43	31	8	11	2	1	6	2	12
23	44	32	9	22	1	0	7	5	11
24	44	25	8	18	2	0	5	4	8
25	45	32	9	27	2	1	6	4	7
26	45	50	11	19	6	0	3	5	16
27	46	49	11	21	3	10	29	5	14
28	47	80	12	27	5	6	16	21	13
29	48	82	13	19	15	15	5	9	14
30	48	79	17	42	9	4	12	5	12

Apart from that, Table 4 represents the production scores of tense inflections across age groups. Here, mean score and standard deviation of productive tense inflections have been measured for each group.

Table 4

Mean Score and Standard Deviation of Tense Inflections Across Age Group

		Age Groups			
		A	B	C	D
Inflections of Simple Present Tense	Mean Score	11.75	17.50	37.33	49.20
	Standard Deviation	3.62	6.16	11.94	22.89
Inflections of Present Progressive Tense	Mean Score	1.25	2.33	5.67	10.50
	Standard Deviation	1.58	1.86	1.03	2.99
Inflections of Present Perfect Tense	Mean Score	2.88	8.50	14	21.70
	Standard Deviation	2.47	3.83	3.29	8.98
Inflections of Simple Past Tense	Mean Score	0.5	0.83	1.50	4.80
	Standard Deviation	1.07	0.98	1.05	4.32
Inflections of Past Progressive Tense	Mean Score	0	1.17	1.17	3.70
	Standard Deviation	0	0.75	0.75	5.19
Inflections of Past Perfect Tense	Mean Score	0.5	3.17	4.67	8.90
	Standard Deviation	1.07	2.04	3.67	8.36

Inflections of Past Habitual Tense	Mean Score	0.25	1.33	1.67	6.30
	Standard Deviation	0.46	1.03	1.21	5.48
Inflections of Future Tense	Mean Score	2.50	3.17	4.83	11.20
	Standard Deviation	1.60	1.33	1.47	3.49

From the group data (see Table 4), it is also shown that productivity increases as the age of the children increases.
Some of these productive morphological verb inflections of tenses have been more frequent and some of them have been less frequent. Below, the total number of productive morphological inflections of verb for tenses and the number of productive tenses for each child is shown (see Table 5).

Table 5

Productive Tenses and Productive Morphological Inflections of Verb for Bangla Tenses

Children	No. of Productive Tenses	No. of Productive Inflections of Verb	Children	No. of Productive Tenses	No. of Productive Inflections of Verb
1 (24 months)	3	3	16 (37 months)	6	11
2 (24 months)	3	5	17 (38 months)	7	14
3 (26 months)	4	5	18 (39 months)	8	13
4 (26 months)	5	7	19 (40 months)	6	15
5 (27 months)	4	7	20 (41 months)	8	18
6 (28 months)	3	4	21 (42 months)	6	14
7 (28 months)	6	10	22 (43 months)	8	20
8 (29 months)	6	11	23 (44 months)	7	18
9 (30 months)	7	12	24 (44 months)	7	16
10 (31 months)	7	10	25 (45 months)	8	19
11 (32 months)	7	11	26 (45 months)	7	18
12 (33 months)	7	13	27 (46 months)	8	23
13 (34 months)	7	13	28 (47 months)	8	22

14 (35 months)	7	13	29 (48 months)	8	20
15 (36 months)	8	18	30 (48 months)	8	26

Table 6 represents total number of produced productive inflections of verb for tense and productive tenses across age groups. Here, mean score and standard deviation of the produced inflections and tenses have been measured for each age group.

Table 6

Mean Score and Standard Deviation of the Total Number of Productive Tenses and Productive Morphological Inflections of Verb for Tense across Age Groups

Group	Number of Children	Age Range (Months)	No. of Tenses		No. of Productive Inflections of Verb	
			Mean Score	Standard Deviation	Mean Score	Standard Deviation
A	8	24 - <30	4.25	1.82	6.5	2.83
B	6	30 - <36	7	0	12	1.26
C	6	36 - <42	7. 17	0.98	14.83	2.79
D	10	42 - < 48	7.5	0.71	19.6	3.47

Table 7 provides information about frequency of total number of use of productive morphological verb inflections of Bangla tenses. For one verb inflection of tense, the number of children who have used that inflection productively during the elicitation task has been taken as frequency of total number of child use for that particular inflection.

Table 7

Usage of verb inflections among children

Verb Inflection of Tense	Total Number of Child Use	Percentage (%)	Verb Inflection of Tense	Total Number of Child Use	Percentage (%)
-i	29	96.67			
-o	16	53.33	-len	3	10.00
-e	29	96.67	-chilam	11	36.67
-en	2	6.67	-chilo	7	23.33
-chi	19	63.33	-chile	2	6.67
-cho	1	3.33	-echilam	19	63.33
-che	23	76.67	-echile	4	13.33
-chen	1	3.33	-echilo	12	40.00
-echi	28	93.33	-tam	15	50.00

-echo	11	36.67	-te	4	13.33
-eche	24	80.00	-to	15	50.00
-echen	3	10.00	-bo	28	93.33
-lam	11	36.67	-ba	9	30.00
-le	10	33.33	-be	16	53.33
-lo	12	40.00	-ben	1	3.33

4. Analysis

4.1. Productivity of tense inflections

4.1.1. Present and Future Tense

From the study, it is found that inflections of present simple tense, present perfect tense and future tense start to be used productively from the earliest period (24 months) by the children (see Table 3). Looking at the group data from Table 4, there is a gradual increase of mean score in the age groups. In case of age group D which includes the highest number of children, a significantly high standard deviation is observed for all the tenses. It suggests that the productive tense inflection scores fluctuated among the children. For example, in Table 3, in case of Simple Present, child 24 scores 25, whereas, the highest score in this age group is 82 (from Table 1). It can be due to individual personality trait (such as, shyness) or their preference to not engage during the data collection procedure. Some children have talked more whereas some have been reluctant to respond. Therefore, they may have not productively used some morphological forms which are present to them.

Four verb inflections (-i, -o, -e, en) of simple present tense, four verb inflections (-echi, -echo, -eche, -echen) of present perfect tense, and four verb inflections (-bo, -ba, -be, -ben) of future tense have been productive among the children in this study. However, inflections of present simple tense are found to be most productive in this study. Two of the simple present tense inflection (-i and -e) are used by 96.67% of the total sample in this study (see Table 7). On the contrary, *-cho, -chen, -ben* verb inflections have been used by only one child (3.33%). This is different than English language where children's early utterances include present progressive tense the most (Brown, 1973). The reason which makes it the "earliest developing form" is that the structure of this form is the simplest and requires the least complex tense and aspect markers (Sultana et al., 2016, p.14). The researchers also feel that cultural learning plays an important role in acquisition of productive tense inflections (Ghalebi & Sadighi, 2015). In the early years, children are exposed to these tense inflections more than other tense inflections in their social and linguistic environment.

Inflections of present progressive tense become productive later than these 3 tenses; from around the age of 26 months with some exceptions (see Table 3). There is a gradual increase of mean score in the age groups as well (see Table 4). Four verb inflections (-chi, -cho, -che, -chen) of present progressive tense have been productive among the children in this study. It has been observed by the researchers that children have tended to use present perfect tense in the context of present progressive tense. Again, this may be due to the relative complexity of the present progressive tense inflections than the

perfect ones (-echi, -echo, -eche, -echen > -chi, -cho, -che, -chen). Although children start to use future tense inflections before tense inflections of present progressive tense (see Table 3), there production scores are quite similar. Again, this can be due to the children's avoidance of talking about incidents in the future in the study. Moreover, in the context of future tense children have tended to use present tenses.

4.1.2. Past Tenses

For elicited production, questions have been included to elicit inflections of simple past tense before the questions to elicit other past tenses as inflections of simple past tense have been expected to be productive before those inflections (see Appendix B; question f). However, it is seen that inflections of past perfect tense and past habitual (from the age of 28 months and 29 months respectively) are productive earlier than simple past tense inflection (see Table 3). There is a gradual increase of mean score in the age groups (see Table 4). Three verb inflections (-echilam, -echile, -echilo) of past perfect tense, and three verb inflections (-tam, -te, -to) of past habitual tense have been productive among the children in this study.

In most cases, children start to use inflections of simple past tense productively from around 33 months (see Table 3). There is a gradual increase of mean score in the age groups for these tenses as well (see Table 4). Four verb inflections (-lam, -le, -lo, -len) of simple past tense have been productive among the children in this study. As anticipated, inflections of past progressive tense become productive later than all the other tense inflections- from around 46 months (see Table 3). Before that age, there have been some limited productive use of the inflections of this tense. There is no reported use of this tense for age group A, and productivity increases for age group D, before being somewhat limited in both age group B and C (see Table 4). Three verb inflections (-chilam, -chilo, -chile) of past progressive tense have been productive. Sultana et al. (2016) explains that these forms can be cognitively challenging for the children and they often can be replaced by non-target forms. In Sultana's (2016) study, past progressive and past perfect verb forms were very low due to their structural and cognitive demands. In Chakraborty and Leonard's (2012) study past progressive forms were highly accurate. The researchers in this study have also found the accurate but very limited use of past progressive tense inflections by the children.

4.2. Comparative usage among children

From Table 5, it is found that there is an increase in the number of productive verb inflections for tense and productive tenses along with the increase of age in the children. There has been a strong positive correlation between children's age and their productive tenses, $r = .78$, $p < 0.000005$. A one-way ANOVA run with age groups as independent, and number of productive tense inflections as dependent variables further shows that the age groups have a significant effect on productivity of tense inflections ($F_{3,26} = 32.32$, $p < 0.00000005$). Children create categories and slots as they learn new inflections, and later test them in conversational context; finally form a generalisation about the semantic features. While doing so, they are bound

to make mistakes, which is why production of tense has gone through fluctuation from 37 months to 45 months. Thus, the findings in this research implies that linguistic acquisition and production of children involves consciously learning linguistic terms and their constructions in order to gradually reconstruct them to form more "abstract and word general" linguistic items. (Wittek & Tomasello, 2002, p.586). It is to be noted that the researchers have not explored other situational, cognitive and individual aspects which can affect the production of target tense forms. Therefore, from the current study it was not possible to propose an exact developmental trend in productive tense inflections. However, there is a certain pattern in the productive use of the tense inflections which is observed during this study. First of all, from Table 5 it can be seen that the number of productive verb inflections of tenses starts to increase as the age of the children increase. However, this increase in productive tense inflections does not necessarily mean that productive tense increases along with age. As seen from Table 5, there is a fluctuation of number of tenses produced by the children. From 37 months to 45 months, the number of tenses produced varied from 6 to 8. In group data (see Table 6), we can see these trends very clearly. The mean score of number of tenses and inflections produced increases along with age.

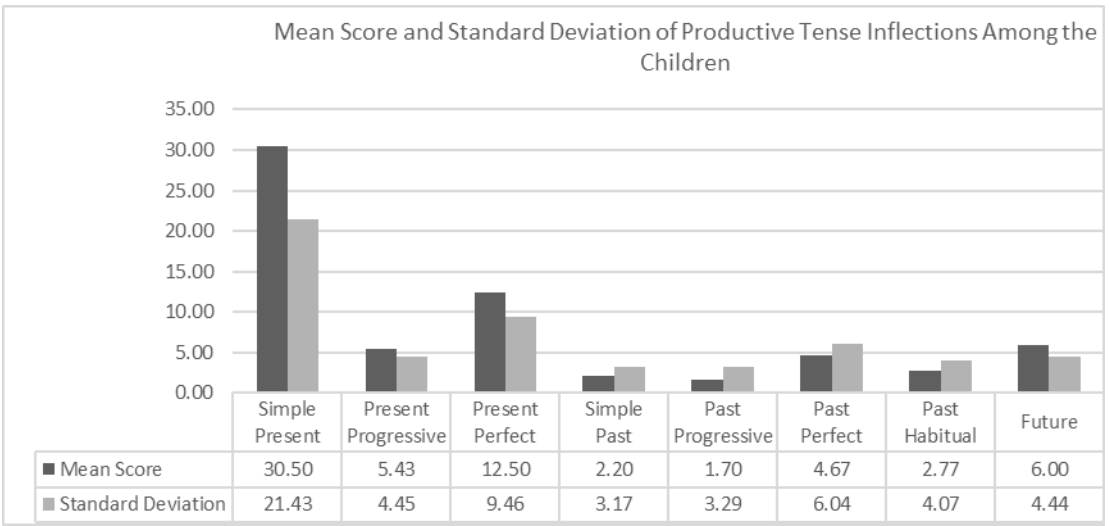
4.3. Order of use for productive tense inflections and tenses

Based on the number of child use from Table 7, the researchers can propose the following order of use for all the morphological verb inflections of different Bangla tenses: -i, -e> -echi, -bo> -eche> -che> -chi, -echilam> -o, -be> -tam, -to> -lo, -echilo> -echo, -lam, -chilam> -le> -ba> -chilo> -echile, -te> -echen, -len> -en, -chile> -cho, chen, ben

From the data of Table 3, the production scores (mean score and standard deviation) for the tense inflections have been graphically presented in Figure 1.

Figure 1

Production scores of tense inflections.



From the comparative analysis amongst the tense inflections it is found that present simple tense gets the highest production score (Mean Score= 30.50, Standard Deviation= 21.43). Past progressive tense gets the least production score in the study (Mean Score= 1.70, Standard Deviation= 3.29). Based on the production scores of the tense inflections, the following order of use of tense inflections can be proposed:
Simple Present Tense> Present Perfect Tense> Future Tense> Present Progressive Tense> Past Perfect Tense> Past Habitual Tense> Simple Past Tense> Past Progressive Tense
The researchers believe that younger children lack the cognitive skills and produce less productive verb inflections and tenses. Also, there is a chance that the children they may have not productively used some morphological form. In children's early years, their "stored linguistic experience" (Tomasello, 2000a, p.76) includes only those inflections and tenses which do not require complex linguistic understanding. However, as they age, and their cognitive skill starts to mature, they learn to create "utterance schemas" (Tomasello, 2000a, p.66). They create slots for the inflections they have learned from their linguistic experience to use with variety of range of verb stems. At first these use of new inflections are not appropriate as they seem cognitively challenging and difficult to produce for the children. However, as they gain experience, they begin to get more proficient in using the verb inflections and tenses more productively.

5. Conclusion

To conclude, the researchers employ the data collection methods- elicited production; to investigate the productive tense inflections in Bangla speaking pre-school children from 3-day care centres. In this study, the researchers have found that age of the children plays role in acquisition of tense inflections. Although, other variables, such as exposure to forms in environment, or processing capacity of children etc. have not been studied in this research, the finding of this study is helpful to create a developmental profile for typically developing children. This study can be used as an inventory by researcher as it includes real-life data from 30 typically developing Bangla speaking pre-school children. Moreover, this research will help other researchers who are interested to work on Bangla tense and inflection development in children. Therefore, conclusions derived from this study is noteworthy in the area of Bangla tense inflection acquisition, productivity and development.
Recommendations for future studies are given below:
a. Future studies can explore the other factors except age for tense inflection production
b. They can include complex and conjunct verb forms.
c. They can include aspectual and personal markers as well.
d. They can include larger sample to draw more generalisations.
e. They can use other data collection methods.

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Appendices

Appendix A: *Bangla tense-aspect paradigm*

TENSE	1st Person	2nd Person			3rd Person	
		Neg	Gen	Res	Gen	Res
Simple Present	-i Pori	-ish Porish	-o Poro	-en Poren	-e Pore	-en Poren
Present Progressive	-chi/-tesi Porchi/ Portesi	-chis/-tesis Porchish/ Portesis	-cho/-teso Porcho/ Porteso	-chen/-tesen Porchen/ Portesen	-che/-tese Porche/ portese	-chen/-tesen Porchen/ Portesen
Present Perfect	-echi/-si Porechi/ Porsi	-echis/ -sis Porechis/ Porsis	-echo/-so Porecho/ Porso	-echen/-sen Porechen/ Porsen	-eche/-se Poreche/ Porse	-echen/-sen Porechen/ Porsen
Simple Past	-lam Porlam	-li Porli	-le Porle	-len Porlen	-lo Porlo	-len Porlen
Past progressive	-chilam/-tesilam Porchilam/ Portesilam	-chilish/-tesilish Porchilish/ Portesilish	-chile/-tesila Porchile/ Portesila	-chilen/-tesilen Porchilen/ Portesilen	-chilo/-tesilo Porchilo/ Portesilo	-chilen/-tesilen Porchilen/ Portesilen
Past Perfect	-echilam/-silam Porechilam/ Porsilam	-echili/ -sili Porechili/ Poresli	-echile/-sila Porechile/ Porsila	-echilen/-silen Porechilen/ Porsilen	-echilo/-silo Porechilo/ Porsilo	-echilen/-silen Porechilen/ Porsilen
Past Habitual	-tam Portam	-ti Porti	-te Porte	-ten Porten	-to Porto	-ten Porten
Future	-bo/-mu Porbo/ Pormu	-bi Porbi	-ba Porba	-ben Porben	-be Porbe	-ben Porben

Here, Gen=General, Neg=Negligible and Res= Respect
Note: Adapted from Ali, Sarker, Ahmed & Das, 2010; Bhattacharya, Choudhury, Sarkar & Basu, 2005; Paramita, 2006; Sultana 2016.

Appendix B: *Elicited Production Questionnaire*

1. Basic introductory questions:
a. Tomar nam ki?
b. Kemon acho?
2. Questions focusing on tense:
a. Ki korcho?
b. Sokale ki korecho?
c. Dekho to eta ki? (showing the child a toy car).
d. Garita die ki koro?
e. Gari ta die ki ki kora jay amake ektu bolo toh?
f. Accha, tumi ei putul take bolo toh tumi kal ke ki ki korechile? (showing the child a doll)
g. Acting as if the doll is speaking: Hi amar nam bulu, amar kono bondhu nei. Ami ki korle tumi amar bondhu hoba?

h. Acting as if the doll is speaking: Ami Jodi kanna kortam tahole tumi ki korta?
i. Acting as if the doll is speaking: Tumi jokhon basay kanna koro tokhon tomar ammu ki korto?
j. Acting as if the doll is speaking: Ami Jodi tomake boka dei tahole ki korba tumi?
k. Acting as if the doll is speaking: Tomake abbu/ ammu boka dile ki koro?
l. Tickling the doll: Dekho putul tar onek katukutu ache. Tomake keu katukutu dite chaile ki korta?
m. (Giving the child the doll) Ektu age putuler sathe ki korla bolo toh amake?
n. Putula ta die ki koro?
o. (Dancing a teddy in front of the child) Bolo teddy ta ki korche?
p. Teddy ta jante chasse ajk basay jeye ki ki korba?
q. (Pinching the teddy) Teddyta ke etokkhon ki kortechilam?
r. (Giving the child the teddy) Teddyta r na onek mon kharap oke ektu bolo toh valo teddy hote hole ki ki korte hobe?
s. Tumi boro hoe ki ki korba?

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Acquisition of complex coda and sonority among selected bilingual Nigerian children

Grace Boluwatife Olarewaju[1]
University of Ibadan
Adesina B. Sunday[2]
University of Ibadan

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Abstract

This study examined the role of sonority in the acquisition of complex coda by Yoruba-English bilingual children with a view to determining the way children rank constraints to arrive at their outputs. The study adopted Optimality Theory as the theoretical framework. A wordlist of about 100 words, complemented by relevant pictures, was used to collect the data for analysis. Spontaneous speeches were also collected. Ten Yoruba-English bilingual children made up the population. The data got were phonologically and acoustically analyzed. The children's grammar showed a preference for less sonorous consonants over highly sonorous consonants in coda clusters through deletion and substitution of segments. They also showed a preference for single consonants that are not highly sonorous at the coda. They violated *COMPLEX-CODA and sometimes NOCODA. The grammar of the Yoruba-English bilingual child does not allow for the formation of coda clusters. This may be as a result of the influence of the indigenous language.

Keywords: Sonorous consonants, Coda clusters, Yoruba-English bilingual child, Optimality Theory, Children's grammar

1. Introduction

Effective communication, which is a necessity in any human society, is made possible through the use of language. Language cannot be divorced from human interaction and society. This necessitates the need to acquire language. Human beings have the innate ability to acquire language as proposed by Noam Chomsky (Chomsky, 1975; Sunday, 2020). This inborn ability has made the process of language acquisition easy for normally developing children. Human beings acquire language at various stages of life but this study focused on bilingual first language acquisition.

Language acquisition deals with the processes involved in language development. It refers to a natural process whereby children develop language ability in their first language effortlessly, as they do not need to

[1] Bio: Grace Boluwatife Olarewaju is a PhD student in the Department of English, University of Ibadan, Ibadan, Nigeria. Her research interests cover Child Language Acquisition and English Phonology and Phonetics.

[2] Bio: Adesina Bukunmi Sunday is a Senior Lecturer in the Department of English at University of Ibadan, Ibadan, Nigeria. He specializes in Neurolinguistics, English Phonology and Phonetics, and Pragmatics. He has published in reputable journals, like *English Today*, *Journal of Pragmatics*, *HUMOUR: International Journal of Humor Research,* and *SKASE Journal of Theoretical Linguistics*. Corr. author: sinadaybuk@gmail.com

deliberately learn the grammar of the language (Adegbite, 2009; Meisel, 2011). In the study of language acquisition, children have been discovered to be able to learn as many languages as they are exposed to. As a result of this, children become bilinguals/multilinguals at a very young age. This produces what is called Bilingual First Language Acquisition (BFLA). This is the subconscious simultaneous acquisition of two languages by children who have been consistently exposed to both languages (Itani-Adams, 2007; Ramirez and Kuhl, 2016). The phonological repertoire of bilingual children is determined by the languages that they are exposed to (Gildersleeve-Neumann et al., 2008). There is no limit to this repertoire.

In discussing the phonology of any language, the syllable is germane, particularly when speech is the focus. This is because it gives insights into the phonotactics of the language. Syllables are made up of speech sounds or phonemes; the arrangement of the phonemes is determined by the language. Languages vary as to which type of speech sounds are allowed to occur in which position of the syllable. The syllable is made up of onset, nucleus/peak and coda. Only the nucleus/peak is obligatory. At times, the nucleus/peak and coda are collapsed to form rhyme, in which case, the syllable now has two components, namely onset and rhyme (Gussenhoven and Jacobs, 2005; Clark, Yallop, and Fletcher, 2007; Gut, 2009).

To determine how bilingual children acquire a language that permits the production of complex coda, this study investigated the production of complex coda by Yoruba-English bilingual children. The Yoruba syllable does not permit consonant cluster. Conversely, English permits optional consonants of up to four in the coda position. The way a Yoruba child acquires English coda will reveal some insights on cluster acquisition and the manipulation of two different syllable systems by a child. The purpose of this study is to unravel how children rank and re-rank constraints in their production of complex coda and their judgement of sounds based on the level of sonority.

For ease of understanding, there is a need to briefly examine the English and Yoruba phonological systems.

1.1. Phonology of Yoruba

Yoruba phonology has been greatly studied by language scholars over time (Oyebade, 2010). Yoruba, like every other language, has its sound system. The Yoruba sound system contains eighteen consonants, seven oral vowels, and five nasal vowels. The consonant sounds in Yoruba are /b, t, d, k, ɡ, kp, ɡb, f, s, ṣ, h, m, n, r, l, w, j/. The Yoruba vowel system consists of seven oral vowels and five nasal vowels. The oral vowels are /i, e, ẹ, a, ọ, o, u/. The nasal vowels are /ĩ, ɛ̃, ã̀, õ, ũ/ (Oyebade, 2010; Arokoyo, 2012; Ogundepo, 2015). Yoruba does not distinguish between long and short vowels. The Yoruba sound system does not permit clusters (Ogundepo, 2015).

According to Wachuku (2008:131), “the syllable structure refers to the way vowels and consonants are arranged to form a syllable.” That is the specific arrangement of consonants and vowels to form a syllable with adherence to what is permissible in the language. The grammar of Yoruba permits only open syllables. This means that it does not permit syllables to have codas.

By implication, Yoruba disallows consonant clusters. The Yoruba syllable structure permits V, VCV, CV, and CVN structures. The syllable bears the tone in the language. The language has monosyllabic, disyllabic and polysyllabic words (Abiodun, 2010; Orie, 2012; Arokoyo, 2012).

1.2. Phonology of English

The English language has twenty-four consonants and vowels. The vowels comprise twelve monophthongs, eight diphthongs and five triphthongs (Ladefoged, 2001; Osisanwo, 2012). The consonant sounds in English are /p, t, k, b, d, g, f, v, ɵ, ð, s, z, ʃ, ʒ, h, m, n, ŋ, r, l, w, ʧ, ʤ, j/. The English vowel system consists of twelve monophthongs /i, i:, e, u, u:, a, æ, ɔ, ɔ:, ʌ, ɜ:, ə/. These monophthongs are further classified into long and short vowels. It also contains eight diphthongs /ei, iə, eə, ai, au, əu, uə, ɔi/ and five triphthongs /eiə, aiə, ɔiə, əuə, auə/ (Roach, 1997; McCully, 2009).

1.3. Syllable and Sonority

As noted by Gut (2009), the phonotactic structure of syllables is usually described with reference to the sonority of the phonemes involved. The sonority of a sound refers to the relative loudness of one sound in comparison to other sounds and speech sounds are often described in terms of their degree of sonority (Giegerich, 1992; Ladefoged, 1993). The sonority of English speech sounds is represented on a sonority scale (Gut, 2009). In the formation of syllables, speech sounds are organized based on two criteria, which are Sonority Sequencing Principle and Sonority Distance. The arrangement of segments on the sonority scale ranges from the sounds with a high degree of sonority to sounds that are less sonorous.

Oral stops		Fricatives		Nasals	Liquids		Semi-Vowels	Vowels	
Voiceless	Voiced	Voiceless	Voiced					High	Low
p	b	f	v	m					
t	d	t	ð	n			j	ɪ	a
k	g	s	z	ŋ	l	r	w	u	ɑ

s o n o r i t y

Figure1. Sonority scale

Source: Adapted from Giegerich (1992:133)

The sonority scale presented above reveals the role of natural classes in the description of sonority. These natural classes have distinctive features that make it easy to describe them in any phonological analysis. According to Chomsky and Halle (1968), distinctive features are the minimal elements of which phonetic, lexical, and phonological transcription are composed, by combination and concatenation (Sunday, 2014). Some of the distinctive features relevant to this study are examined here. The classification is based

on the works of scholars such as Chomsky and Halle (1968), and Schane (1973) and Giegerich (1992):

i. SONORANT: Vowels, nasals, liquids and semi-vowel are [+sonorant] while stops, fricatives, affricates and laryngeal glides are [-sonorant].

ii. CONTINUANT: [+continuant] are approximants and fricatives while stops and affricates (oral and nasal) are [-continuant].

iii. CONSONANTAL: The sounds that are [+consonantal] are stops, fricatives, affricates, nasals and liquids while laryngeal glides, vowels, and semi-vowels are [-consonantal].

iv. SYLLABIC: This feature is needed to differentiate syllabic nasals and liquids from their non-syllabic counterparts. Vowels, syllabic nasals, and syllabic liquids are [+ syllabic] while obstruents, non-syllabic nasals, glides, and non-syllabic liquids are [-syllabic].

v. VOCALIC: [+vocalic] are vowels and liquids while [-vocalic] are glides, nasal, obstruents, devoiced vowels and devoiced liquids.

vi. NASAL: Nasal consonants are [+nasal] while oral consonants are [-nasal].

1.4. Theoretical Framework: Optimality Theory

Optimality Theory (OT) is a theory that accounts for the workings of every language. It assumes that constraints, which are violable, are essentially universal; as such, are present in every language. In other words, constraints are universal. However, the point of divergence in languages is the order in which the constraints are ranked in each language. This theory, as proposed by Alan Prince and Paul Smolensky (1993), reflects the resolution of conflicts among competing constraints (Kager, 1999; Oyebade, 2008; Sunday, 2013a; 2013b; 2013c; Sunday and Oyatokun, 2016; Sunday and Olarewaju, 2020).

There are core mechanisms in OT. These are Generator (GEN) and Evaluator (EVAL). GEN generates output forms based on the linguistic input. EVAL evaluates the candidates generated by GEN to choose the most harmonic candidate. It selects the optimal candidate by considering a set of ranked, violable constraints. The role of EVAL is to assess the harmony of outputs with respect to a given ranking of constraints. Some constraints are considered to be more important than others as a result of domination (dominance relation). These mechanisms are interrelated (McCarthy and Prince, 1995; Kager, 1999).

Constraints (CON) are used to test the well-formedness of the set of candidates in relation to what is acceptable in the grammar of each language. Constraints are hierarchically ordered from the highest to the lowest and they can be violated. There are two major types of constraints: faithfulness and markedness. Faithfulness constraints require the mapping of the input form to the output form, while markedness constraints forbid grammatically ill-formed structures (McCarthy, 2002).

2. Methodology

The methodology of the research should be detailed very clearly referring to relevant theories.

2.1. Participants

The data used for analysis were collected from ten Yoruba-English bilingual children between the ages of one year, seven months (1;7) and five years (5;0) at the start of the data collection. Yoruba is predominantly spoken in the south-western part of Nigeria. The participants were selected from different schools across different local government areas in Ibadan, the capital of Oyo State, south-western, Nigeria.

2.2. Socio-demographic Analysis of the Participants

The participants were three males and seven females. They were in the age range of 1 year, 7 months and five years. All of them were Yoruba-English bilinguals. The participants were put in five groups, made up of two participants each (1; 7, 2, 3, 4, and 5). The first group was for children that were one year, seven months old. The second group was for the respondents who were two years old. The third group catered for the respondents who were three years old. Those children who were four years old formed the fourth group. The last group consisted of the children who were five years old. Each of the groups comprised two children.

Table 1
Demography of the Participants

Subject	Age (at the outset)	Languages	Group
S1	1 year, 7 months	English and Yoruba	1
S2	1 year, 7 months	English and Yoruba	
S3	2 years, 3 months	English and Yoruba	2
S4	2 years, 1 month	English and Yoruba	
S5	3 years, 1 month	English and Yoruba	3
S6	3 years	English and Yoruba	
S7	4 years	English and Yoruba	4
S8	4 years	English and Yoruba	
S9	5 years	English and Yoruba	5
S10	5 years	English and Yoruba	

2.3. Data collection and processing

The respondents were visited three times a week for data collection. The entire study lasted eight weeks. Age and simultaneous bilingualism were the criteria employed in grouping the participants. For accuracy and reliability of data, strictly simultaneous bilingual children were sampled; they were bilingual in Yoruba and English before the age of three years. The study employed both longitudinal and cross-sectional designs. A wordlist of about 100 words, complemented by relevant pictures, was used to elicit the data for analysis from the participants. Additional data were collected from spontaneous speech of the respondents. The words were tested across the different age groups to know the structures that each group had acquired at

their different ages. For each word, two tokens were got from two subjects across all age groups. The forms presented were chosen based on the age of the subject who produced it and the similarity between the two tokens got from the subjects who represented a particular group. The subjects' renditions are generally presented under each tableau to show the progressive nature of the grammar of the children.

2.4. Data analysis

Perceptual and acoustic analyses were carried out, with Optimality Theory used for explanation of the observable patterns. The syllable patterns made by the children were grouped into stages in line with to the available age groups. Instances of occurrences of each syllable were then identified. The items that were repeated by the participants were not considered for analysis, except if there was variation in their renditions. Phonetic transcription was done for the sake of accurate description.

2.5. Realization of Coda Clusters

This section captures the analysis and interpretation of the data collected. Both regular patterns and variations in the renditions of the participants were identified. Nineteen English words were used to test the acquisition of coda clusters by the children: *drink, translation, instruct, aspect, point, hand, thank, jump, translation, strange, want, socks, round, front, branch, flask, plant, task,* and *strength.* Only one category of coda clusters was tested: two-consonant clusters. Different structures were considered in order to test if onset clusters affect the production of coda clusters in words that have coda clusters.

For the OT analysis, the following constraints were deployed:

a) ONSET: This constraint was suggested by Prince and Smolensky (1993) and it stipulates that every syllable must have an onset. A syllable must begin with a consonant. This constraint captures the universal preference of language for CV syllables (McCarthy, 2008).

b) NOCODA: This constraint was also proposed by Prince and Smolensky (1993) and it prohibits closed syllables while maximizing open syllables. A syllable must not end with a consonant sound. It stipulates that syllables do not have codas.

c) MAX (or MAX-IO): This requires the input segments to appear in the output. It forbids deletion of segments (Kager, 1999).

d) *COMPLEX-ONSET: It does not permit clusters at onset (McCarthy, 2008).

e) *COMPLEX-CODA: It forbids complex stringing of sounds at coda (McCarthy, 2008).

3. Findings

3.1. CC-Clusters

The section presents the analysis of English words with two final-consonant clusters. The analyses of four of these words are presented below.

3.2. Analysis of 'jump'

Jump is phonemically represented as /ʤʌmp/. It is graphically represented based on the hierarchy of the sounds on the sonority scale as:

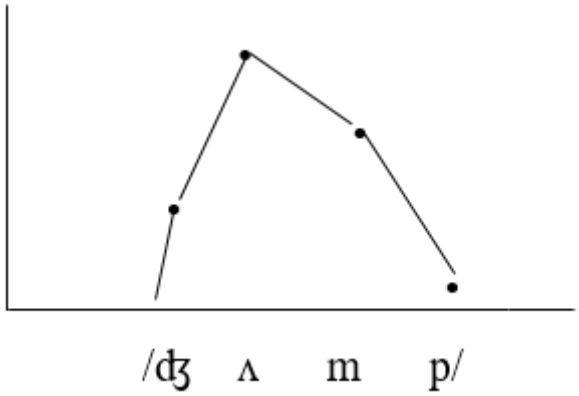


Figure 2. Sonority Scale of *jump*

The sonority scale shows that /ʤ/ is less sonorous than /ʌ/, which is more sonorous than /m/ and /p/.

With respect to the acquisition of the CVCC-cluster, the children in groups 1, 2, and 3 (60% of the participants) could not properly articulate *jump* as [ʤʌmp] but as [ɛʃ] while the other four subjects pronounced it as [ʤɔmp]. Those who pronounced /ʤʌmp/ as [ɛʃ] reduced the entire syllable into something different from the input, thereby reducing it from its original CVCC structure to a CV type. The syllable was replaced with two new sounds: the open-mid front unrounded vowel /ɛ/ and the voiceless postalveolar fricative /ʃ/. The latter sounds are sonorous sounds; as such, this may be responsible for the replacement. It also shows that only the subjects who were between ages three and five have acquired the CVCC syllable type. The OT account of *jump* as pronounced by the participants is shown below:

Tableau 1
The emergence of /ɛʃ/

Input / ʤʌmp/ → Output / ɛʃ/

/ ʤʌmp/	*COMPLEX-CODA	*MAX	ONSET	NOCODA
(i) ʤɔmp	*!	*!		
(ii) ʤʌmp	*!	*!		
☞(iii) ɛʃ			*	*

Constraint ranking: *COMPLEX-CODA>> *MAX >> ONSET >> NOCODA

Optimal candidate: /ɛʃ/

Tableau 1 above presents the analysis for the production of /ʤʌmp/ with respect to the emergence of the optimal candidate for the majority of the participants. The constraints involved in the analysis are *COMPLEX-CODA, *MAX, ONSET, and NOCODA. The grammar showed a preference for non-clusters over clusters. And this is essentially the same in Levelt, Schiller, and Levelt's (2000) study. The participants also simplified the word using both deletion and substitution. There is actually no correlation between the output form and the input form. The constituents are entirely replaced with other sounds. Candidate (i) and candidate (ii) are similar except for difference in the vowel used. They violate the highest ranked constraints, thus incurring a fatal violation for each of the constraints. However, they both obey ONSET and NOCODA. Candidate (iii), which is the optimal candidate, obeys the two highly ranked constraints and violates the two constraints that are lowly ranked. The voiced palato-alveolar affricate /ʤ/ in the onset position and the open central neutral vowel /ʌ/ are replaced with the half-open front spread vowel /ɛ/ with the features [+ vocalic, + sonorant, - consonantal], while the bilabial nasal /m/, with features [-continuant, + sonorant], and the voiceless bilabial plosive /p/, with features [+obstruent, - continuant, +consonantal, -voice], that made up the /-mp/ cluster were replaced with the voiceless palatal-alveolar fricative /ʃ/ with features [+ continuant, -sonorant]. The production shows the constraint ranking as: *COMPLEX-CODA >> *MAX >> {ONSET >> NOCODA}.

Below is the Praat image of /ɛʃ/:

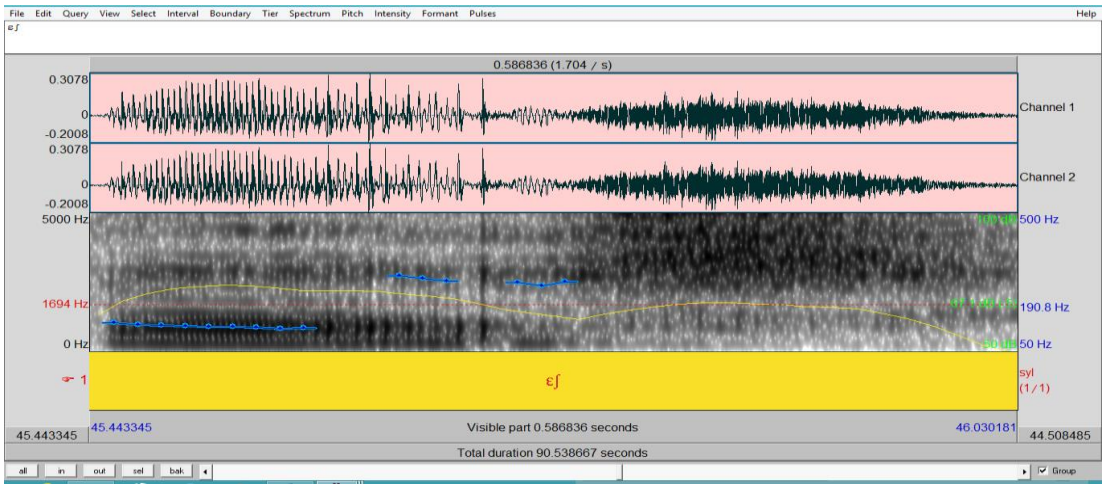


Figure 3. Praat image of jump

This Praat image shows the frequency and intensity values for jump as pronounced by a year, seven months old subject which is a representation of the production of the subjects in groups 1, 2, and partly 3. This monosyllabic word has an intensity value of 67.1 dB and a frequency of 190.8 Hz. The values are given to guide in the interpretation of the spectrogram.

3.3. Analysis of 'translation'

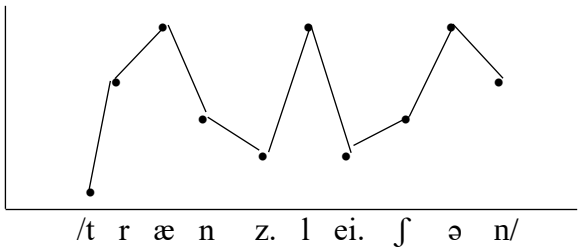


Figure 4. Sonority scale of *translation*

The scale is a graphical representation of the level of sonority of each of the speech sounds that make up the syllables in *translation*. The sonority scale reveals that /t/ is less sonorous than /r/, which is less sonorous than /æ/, which is more sonorous than /n/ and /z/. In the second syllable, /l/ is less sonorous than /ei/. In the third syllable, /ʃ/ is less sonorous than /ə/, which is more sonorous than /n/. It can be deduced that plosives and fricatives are lowly ranked on the sonority hierarchy, nasals are ranked higher than plosives and fricatives, while glides and vowels are highly ranked.

The first syllable in the word *translation* has the CCVCC structure. In the production of *translation,* five (50%) participants realised it as [tʰæleɪʃən], one (10%) participant pronounced it as [tʰænleɪʃən] and four (40%) participants produced it as [tʰrænzleɪʃən].

Tableau 2
The emergence of /tʰæ.lei. ʃən /

Input /trænz.lei. ʃən/ → Output /tʰæ.lei. ʃən /

/trænz.lei. ʃən/	*COMPLEX-ONSET	*COMPLEX-CODA	NOCODA	MAX
☞ (i) tʰæ.lei. ʃən			*	*
(ii) trænz.lei. ʃən	*!	*!	**	

Constraint ranking: *COMPLEX-ONSET >> *COMPLEX-CODA >> NOCODA >> MAX
Optimal candidate: /tʰæ.lei. ʃən /

Tableau 2 above shows the constraint ranking for the production of *translation* by the majority of the participants. Particular focus is on the first syllable, which has a complex coda. The constraints involved are *COMPLEX-ONSET, *COMPLEX-CODA, NOCODA, and MAX. They are hierarchically ranked as: *COMPLEX-ONSET >> *COMPLEX-CODA >> NOCODA >> MAX.

These participants prefer unmarked structure in the onset position. Candidate (i) violates highly ranked constraints: *COMPLEX-ONSET and *COMPLEX-CODA. The former forbids clusters in the onset, while the former bans clusters from appearing in the coda position. The first syllable in translation has an initial CCVCC structure which is simplified in the optimal output form to a CV structure. In onset position, the voiced alveolar trill /r/ is deleted, while the voiceless alveolar stop, which is the least sonorous of the pair, is retained. Similarly, the alveolar nasal /n/, with features [-continuant, +sonorant], and the voiced alveolar fricative /z/, with features [+ continuant, -sonorant, +voice], were deleted in coda position. Candidate (i) emerged as the optimal candidate despite its violation of NOCODA and MAX. Candidate (ii) fatally violates highly ranked constraints *COMPLEX-ONSET and *COMPLEX-CODA. Consequently, it is outright eliminated from further evaluations.

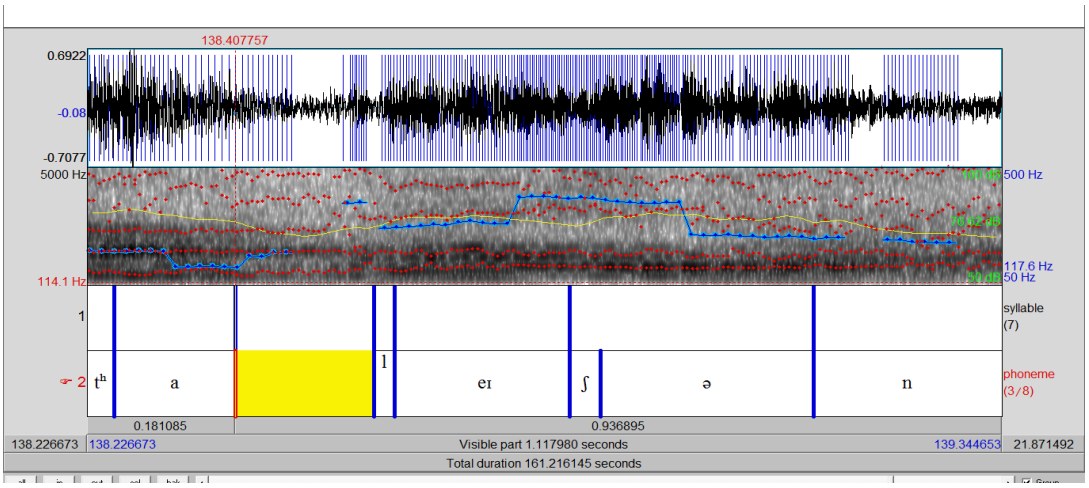
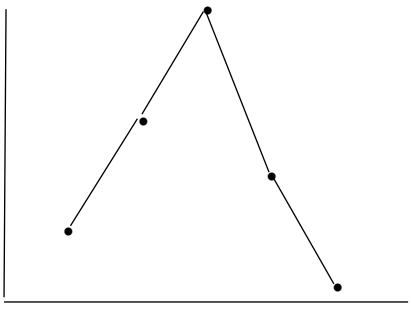


Figure 5. The spectrogram of translation

This image above is a spectrogram of translation as produced by a participant in group 1 and it is a representation of most of the children's rendition of the word.

3.4. Analysis of 'front'

Front is phonemically represented as /frʌnt/ and it is graphically represented on the sonority scale as:



/f r ʌ n t/

Figure 6. Sonority Scale of *front*

The sonority scale shows that /f/ is less sonorous than /r/, which is less sonorous than /ʌ /. While /n/ is less sonorous than /ʌ/, it is more sonorous than /t/. /ʌ/ has the highest degree of sonority.
Four (40%) out of the children used for this research pronounced *front* as [tʰɔt], while another two (20%) pronounced it as [frɔt] and others (40%), who were older, with almost adult proficiency, pronounced it as [frɔnt]. Those who pronounced it as [tʰɔt] were between ages of 1 years, 7 months and 2 years, 3 months at the time of data. Those who pronounced the word as [tʰɔt] reduced the entire syllable into something different from the input, thereby reducing it from its original CCVCC structure to a CVC type. The syllable was replaced with new sounds at onset and coda. For the complex coda [-nt], the voiceless alveolar stop /t/, with features [+obstruent, +consonantal, -sonorant], which is the less sonorous sound, is retained while the alveolar nasal /n/, with features [-obstruent, +consonantal, +sonorant, +continuant, +nasal], is deleted. The OT account of *front* is shown below:

Tableau 3
The emergence of [tʰɔt]

Input / frʌnt / → Output [tʰɔt]

/ frʌnt /	*COMPLEX-ONSET	*COMPLEX-CODA	ONSET	NOCODA	MAX
☞ (i) tʰɔt				*	**
(ii) frʌnt	*!	*!		*	
(iii) frɔnt	*!	*!		*	*

Constraint ranking: *COMPLEX-ONSET >> *COMPLEX-CODA >>ONSET>> NOCODA >> MAX
Optimal candidate: [tʰɔt]

Tableau 3 above presents the constraint ranking for the emergence of [tʰɔt] as the optimal candidate. The constraints involved are *COMPLEX-ONSET, *COMPLEX-CODA, ONSET, NOCODA, and MAX. The subjects, in simplifying the coda cluster /-nt/, deleted the sound with high sonority /n/ while retaining the one that is less sonorous /t/. This nasal-stop cluster obeys the sonority condition which prescribes that the first consonant in a complex coda must be less sonorous than the second. The grammar of the children in these age groups (1; 7 - 2; 3) selects the sound that is least sonorous in a cluster situation at coda position. This phenomenon is observed in the works of Levelt et al. (2000) and Kappa (2002). The subjects' preferred means of satisfying *COMPLEX-CODA is through deletion. In the bid to obey *COMPLEX-CODA, the production is unfaithful to the input form and, as such, violates MAX. Any attempt by the subjects to preserve both consonants at the coda position will result in the violation of the highest ranked constraint *COMPLEX-CODA, which will lead to the disqualification of the candidate. This is the case with candidates (ii) and (iii). By violating *COMPLEX-CODA, candidates (ii) and (iii) are knocked out of the competition. Candidate (i) emerges as the optimal candidate, having obeyed

the highest ranked constraint, but violates constraints *NOCODA, ONSET, and MAX.

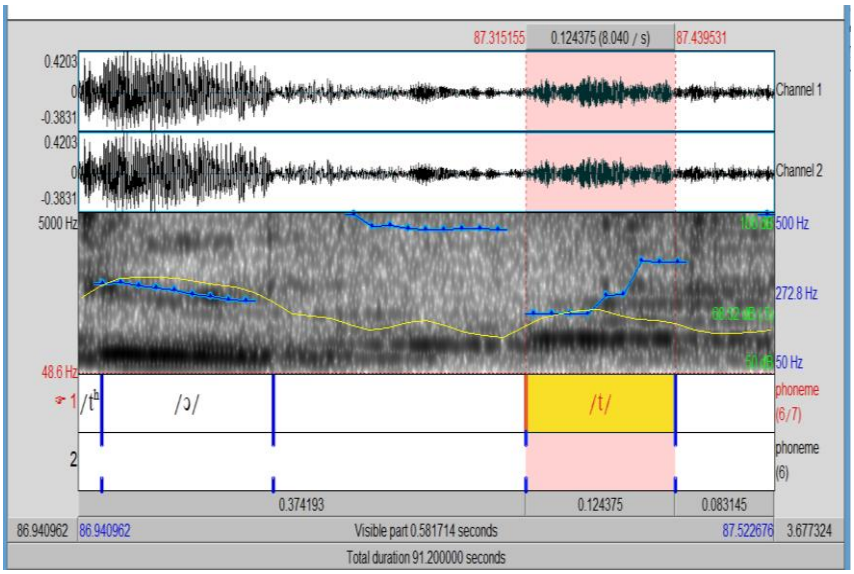


Figure 7. Praat image of *front*

The waveform illustrates the production of *front* as enunciated by one of the subjects and it represents the production of the majority of the participants, especially those in groups 1, 2, and 3.

3.5. Analysis of 'branch'

This is the phonemic representation of /brɑːnʧ/ and it is graphically represented on the sonority scale as:

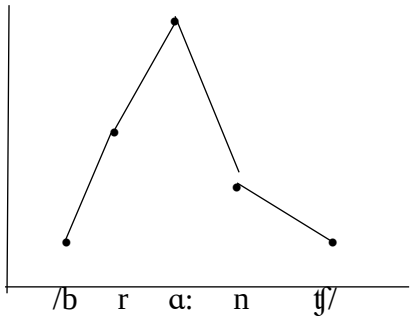


Figure 8. Sonority Scale of *branch*

The sonority scale shows that /b/ is less sonorous than /r/, which is less sonorous than /ɑ:/. While /n/ is less sonorous than /ɑ:/, it is more sonorous than /ʧ/.

In the rendition of *branch*, two of the groups (40%) pronounced it as [tʰA:t], while the production of the word by those in the third group (20%) was not clear, thus could not be presented. The other two groups (40%) pronounced it as [brɑːnʧ] because they can be said to have attained adult-like use of the language. Those who pronounced it as [tʰɑ:t] reduced the entire syllable into something different from the input form, thereby reducing it from its original

CCVCC structure to a CVC type. They simplified the structure through deletion and substitution. For the complex coda [-nʧ], the alveolar nasal /n/ with features [+consonantal, +sonorant, +nasal], which is the more sonorous sound, is deleted, while the post-alveolar affricate /ʧ/, with features [+obstruent, +consonantal, -continuant, +coronal, -voice], is deleted and replaced with /t/, with features [+obstruent, +consonantal, -voice]. The subjects' grammar shows a preference for less sonorous sounds over sounds that are highly sonorous. The OT account of *branch* is shown below:

Tableau 4
The emergence of [tʰɑ:t]

Input /brɑ:nʧ/ → Output [tʰɑ:t]

/brɑ:nʧ/	*COMPLEX-CODA	*COMPLEX-ONSET	ONSET	NOCODA	MAX
☞ (i) tʰɑ:t				*	**
(ii) brɑ:nʧ	*!	*!		*	

Constraint ranking: *COMPLEX- CODA >> *COMPLEX-ONSET >>ONSET>> NOCODA >> MAX
Optimal candidate: [**tʰɑ:t**]

Tableau 4 above shows how [tʰɑ:t] emerged as the optimal candidate. The constraints involved are *COMPLEX-CODA, *COMPLEX-ONSET, ONSET, NOCODA, and MAX. In order to simplify the cluster /-nʧ/, the alveolar nasal /n/, with features [+consonantal, +sonorant, +continuant, +nasal], and the voiceless post-alveolar affricate /ʧ/, with features [+obstruent, +consonantal, -sonorant, -continuant, +coronal, -voice], were deleted and replaced with a less sonorous sound /t/, with features [+obstruent, -continuant, -voice]. This is in accordance with the sonority condition, which states that the first consonant in a complex coda must be less sonorous than the second. In the bid to obey *COMPLEX-CODA, the subjects' output is unfaithful to the input form, thereby violating MAX.

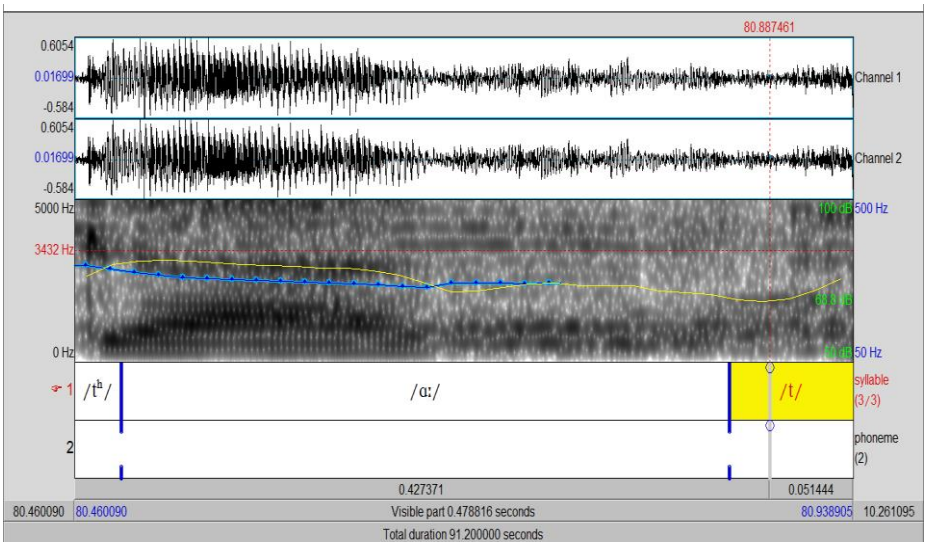


Figure 9. Praat image of *branch*

The image in Figure 9 is a waveform of branch as produced by the subjects in group 1 and group 2, which is a reflection of the children's speech production.

3.6. Analysis of 'socks'

The phonemic representation of socks is /sɔks/; it is graphically illustrated on the sonority scale as:

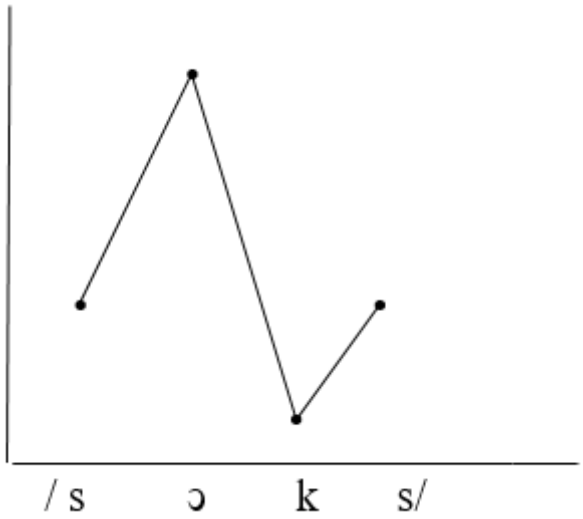


Figure 10. Sonority Scale of *socks*

The sonority scale shows the sonority hierarchy of each sound that make up the word. Going by the graphical representation above, the voiceless alveolar fricative /s/ is less sonorous than /ɔ/, which is often described as open back rounded vowel. The voiceless velar stop /k/ is lowly ranked on the sonority scale.

Socks was pronounced as [tʰɔk] rather than /sɔks/. The participants who pronounced it as [tʰɔk] simplified the word by deleting one of the sounds that make up the cluster at coda [-ks]. The voiceless velar stop /k/, with features [+obstruent, +consonantal, -sonorant, -voice], which is the less sonorous sound of the two, is retained, while the voiceless alveolar fricative /s/, with features [+consonantal, -sonorant, +continuant, -voice], is deleted and replaced with /t/, which has features [+obstruent, +consonantal, -sonorant, -voice]. The subject's grammar shows a preference for less sonorous sounds over highly sonorous sounds. The OT account of *socks* is shown below:

Tableau 5
The emergence of [tʰɔk]

Input /sɔks/ → Output [tʰɔk]

/sɔks/	*COMPLEX-CODA	*COMPLEX-ONSET	ONSET	NOCODA	MAX
(i) sɔks/	*!			*	
☞ (ii) tʰɔk				*	**

Constraint ranking: *COMPLEX- CODA>>*COMPLEX-ONSET>>ONSET>> NOCODA >> MAX
Optimal candidate: [tʰɔk]

As seen in Tableau 5, candidate (i) violates the highest ranked constraint, thereby incurring a fatal violation. Conversely, candidate (ii) violates two lowly ranked constraints, NOCODA and MAX, but did not violate the highly ranked constraints. However, in spite of the violation of two constraints, candidate (ii) emerges as the optimal candidate. In the bid to simplify the coda cluster /-ks/, the voiceless velar stop /k/, with features [+obstruent, +consonantal, -sonorant, -voice], was retained, while the voiceless alveolar fricative /s/, with features [+consonantal, +continuant, -voice], was deleted. This is in tandem with Salami's (2004) study that establishes the fact that children employ different phonological processes, such as deletion, to reduce existing structures into their preferred structures. In the bid to obey *COMPLEX-CODA, the subject's output is unfaithful to the input form, thereby violating MAX. Below is the spectrograph of *socks*:

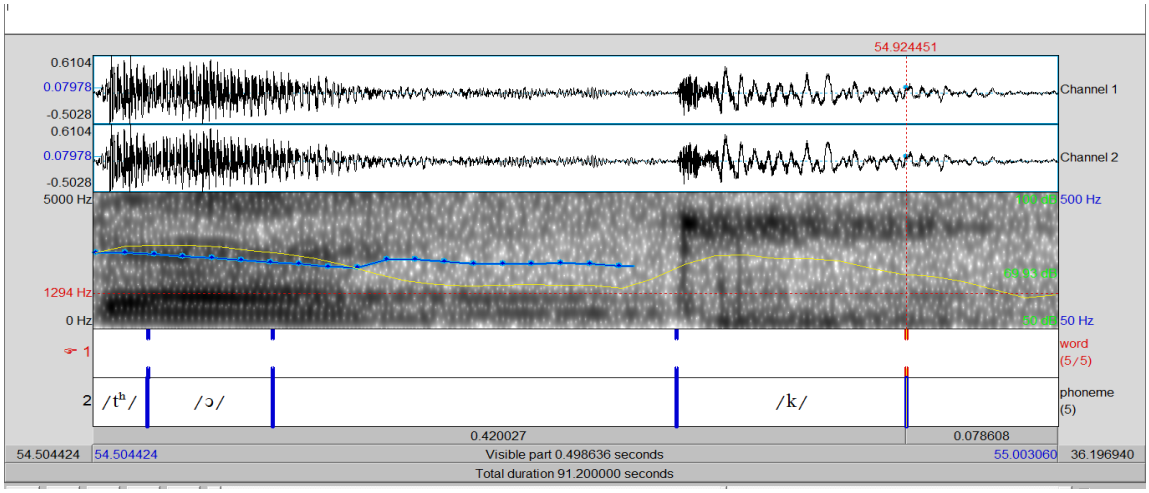


Figure 11. Praat image of *socks*

The waveform indicates that each segment is produced with a different degree of prominence with the nucleus of the syllable having the highest degree of prominence.

4. Conclusion

This paper examined the production of consonant clusters at the coda position in relation to sonority by Yoruba-English bilingual Nigerian children. The analysis revealed that the grammar of the children is quite different from that of adults, in that it does not permit complex stringing of consonants at the coda position. The children showed a preference for single consonants at the coda. This choice is made based on the levels of sonority of the sounds. The children constantly violated *COMPLEX-CODA, which forbids the existence of more than one consonant at the coda (Kager, 1999), and sometimes violated NOCODA. They were able to do this through constraint re-ranking. The subjects also showed a preference for less sonorous consonants over highly sonorous ones. The observed pattern changes as the children mature physiologically. However, some differences may occur as a result of other factors, like speech deficiency, interference and lack of exposure to novel words in English. The findings of this study have implications for early childhood education, as they reveal the kinds of words that are suitable for teaching bilingual children, the findings could also assist speech therapists in designing rehabilitation materials suitable for addressing speech disorders that affect consonant clusters.

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