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The Acquisition of the Tagalog Symmetrical Voice System: Evidence from Structural Priming

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ABSTRACT

We report on two experiments that investigated the acquisition of the Tagalog symmetrical voice system, a typologically rare feature of Western Austronesian languages in which there are more than one basic transitive construction and no preference for agents to be syntactic subjects. In the experiments, 3-, 5-, and 7-year-old Tagalog-speaking children and adults completed a structural priming task that manipulated voice and word order, with the uniqueness of Tagalog allowing us to tease apart priming of thematic role order from that of syntactic roles. Participants heard a description of a picture showing a transitive action, and were then asked to complete a sentence of an unrelated picture using a voice-marked verb provided by the experimenter. Our results show that children gradually acquire an agent-before-patient preference, instead of having a default mapping of the agent to the first noun position. We also found an earlier mastery of the patient voice verbal and nominal marker configuration (patient is the subject), suggesting that children do not initially map the agent to the subject. Children were primed by thematic role but not syntactic role order, suggesting that they prioritize mapping of the thematic roles to sentence positions.

Introduction

Most of our knowledge on language acquisition comes from studies on English and other Indo-European languages. In fact, only around 2% of the 6,000 to 7,000 languages of the world have been investigated at least once with respect to acquisition (Stoll, 2009). This bias toward English and other Indo-European languages means that they are taken as the prototype for language acquisition (Slobin, 1985; Stoll, 2009), even though the languages of the world show a remarkable amount of diversity (Dryer & Haspelmath, 2013; Evans & Levinson, 2009). The field's reliance on a small and unrepresentative sample of languages has no doubt skewed theoretical development, making research on under-studied languages an important priority (Kelly et al., 2015).

In the current paper, we present research on the acquisition of the Tagalog symmetrical voice system. Symmetrical voice is a typologically rare but theoretically important feature of grammar commonly associated with Western Austronesian languages (Foley, 2008; Riesberg et al., 2019). The languages are unique because they show no preference for the agent to be the subject (Foley, 2008; Riesberg, 2014). They have more than one basic transitive construction, and these are considered symmetrical because they are all equally marked by voice morphology and no argument is demoted to a lower grammatical position (e.g., oblique). Thus, they provide an important testing ground for theoretical approaches to the acquisition of verb argument structure.

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Notably, developmental research on sentence interpretation strategies shows that children acquiring languages like English regularly assign early appearing nouns an agent role (e.g., Bever, 1970; Slobin & Bever, 1982). One interpretation of the effect is that it reflects an early or innate mapping of the agent thematic role to the syntactic subject (e.g., Pinker, 1984). An alternative explanation deriving from functionalist approaches is that children attend to form-function correlations in their input and develop biases based on frequent mappings between sentence positions and functional roles (e.g., E. Bates & MacWhinney, 1989). Such a preference may emerge early: Jackendoff and Wittenberg (2014) proposed that the preference for the agent to be mentioned as the first noun phrase is present even in a two-word grammar stage, and that this link is between thematic roles and sentence positions without reference to syntactic structure. This mapping of an agent to the subject role or to the first noun phrase position is not a default in a symmetrical voice system, so it is crucial to investigate how children learn the verb argument structure of such languages.

Tagalog

Tagalog is a widely-spoken language of the Philippines, and is often cited as a representative of the symmetrical voice system (Foley, 2008; Riesberg et al., 2019). In Tagalog, verbal and nominal morphology are used for thematic role assignment. A voice affix on the verb assigns the thematic role of the subject¹ noun phrase, which is marked by *ang* (Himmelman, 2005). The agent voice (AV) infix *-um-* marks the *ang*-phrase as the agent (1, 3), while the patient voice (PV) infix *-in-* marks the *ang*-phrase as the patient (2, 4). The marker *ng* or *sa* precedes non-subject arguments and adjuncts.

The choice of voice is affected by factors such as definiteness (Himmelman, 2005; Reid & Liao, 2004), specificity (Rackowski & Richards, 2005), discourse topicality (Carrier-Duncan, 1985), and telicity (Saclot, 2011). For example, because the *ang*-phrase is always considered definite, the patient voice is used whenever the patient is definite. Studies have also shown that there is a general preference to use the patient voice whenever an action has a patient (Cooreman et al., 1984 based on a written corpus; Tanaka et al., 2015 based on the results of a picture description task). However, this patient voice preference is also modulated by animacy: the preference is weakened whenever the patient is indefinite and inanimate.

- | | | | | |
|-------------------------------------|------------|-------|------------|-------|
| (1) H<um>ahabol | ng | babae | ang | bata |
| <AV> ² chase | NSBJ | woman | SBJ | child |
| “The child is chasing a woman.” | | | | |
| (2) H<in>ahabol | ng | babae | ang | bata |
| <PV>chase | NSBJ | woman | SBJ | child |
| “The/A woman is chasing the child.” | | | | |
| (3) H<um>ahabol | ang | bata | ng | babae |
| <AV>chase | SBJ | child | NSBJ | woman |
| “The child is chasing a woman.” | | | | |
| (4) H<in>ahabol | ang | bata | ng | babae |
| <PV>chase | SBJ | child | NSBJ | woman |
| “The/A woman is chasing the child.” | | | | |

Tagalog is canonically verb-initial but the post-predicate arguments have a relatively free order (Schachter, 2015), and the basic order of the arguments is still debated (for a review, see Garcia et al.,

¹It must be noted that *ang* is not merely a subject marker, because it also marks predicates (Himmelman, 2005). More importantly, there has been a debate over the status of the *ang*-phrase. It has been considered as a subject (Guilfoyle et al., 1992), privileged syntactic argument (Van Valin, 2001), trigger (Schachter, 2015), sentence topic (Schachter & Otones, 1972), discourse topic (Cooreman et al., 1984), or absolutive (Aldridge, 2004).

²AV refers to the agent voice, PV to the patient voice, SBJ to subject, and NSBJ to non-subject.

2018). Experimental studies using picture description tasks and naturalness ratings have shown that the most preferred construction of Tagalog-speaking adults is the patient voice with an agent-initial or subject-last order (Ex. 2; Bondoc, O'Grady, Deen, & Tanaka, 2018; Hsieh, 2016; Sauppe et al., 2013; Tanaka, 2016). The next preferred construction (but far behind the first) is the agent voice patient-initial structure (Ex. 1; Sauppe et al., 2013; Tanaka, 2016); or both the agent voice agent-initial (Ex. 3) and patient-initial structures (Hsieh, 2016). To identify the preferred argument order in both voices, Garcia et al. (2018) controlled for voice and animacy in a picture description and sentence completion task. They provided the sentence-initial voice-marked verb prompts (e.g., *Hinahabol . . .*), which the participants were asked to use to describe action pictures between two animals. They found that adults had a strong agent-initial preference in the patient voice (Ex. 2), but that they showed no preference in the agent voice, in line with Hsieh's results.

An agent-before-patient preference has also been found in children, based on a corpus of spontaneous speech from children ages 1;2 to 4;11 (Marzan, 2013) and a picture description task with 2- to 4-year-old children (Bautista, 1983). Moreover, this word order preference holds for both the agent and patient voice in 5- and 7-year-old children, as observed in experimental studies where voice was modulated or analyzed separately (Garcia et al., 2018; Tanaka, 2016).

As regards children's mastery of the Tagalog voice-marking system, there is evidence of a patient voice advantage (Galang, 1982; Garcia et al., 2018). Galang (1982) gave 3- to 8-year-old children a picture description task and provided the sentence-initial subjects as prompts (e.g., *Ang bata ay . . .* "The child is . . ." or *Ang saging ay . . .* "The banana is" given a picture of a child eating a banana).³ She found that children were more accurate in producing verbs in the patient voice (but Segalowitz & Galang, 1978 found no difference using the same paradigm). Using the more basic verb-initial structure, Garcia et al. (2018) found that given agent voice verb prompts, 5- and 7-year-old children were more likely to reverse the *ang* and *ng* markers of nouns as if they had been given a patient voice prompt, than the other way around.

In summary, past research shows that the patient voice agent-initial argument frame is the most preferred and possibly earliest acquired in Tagalog. This finding suggests two important points. Firstly, unlike children acquiring Indo-European languages, children acquiring Tagalog make a canonical link between patients and syntactic subjects, which is inconsistent with theories that predict innate links between agents and subjects (Pinker, 1984). Secondly, although Tagalog-speaking children prefer to focus on patients as prominent arguments, they still map the agent role to early appearing nouns, suggesting the presence of an early functional bias where children map thematic roles to sentence positions (E. Bates & MacWhinney, 1989; Jackendoff & Wittenberg, 2014). However, it is still not clear when the agent-before-patient preference emerges or if the bias reflects a general and perhaps innate property of the system. Moreover, we do not yet know how children's acquisition of the voice-marking system of Tagalog unfolds, and the kind of cues that children use to master the system. In the next section, we discuss structural priming, a paradigm that can address these gaps in the literature.

Structural priming

Structural priming, the tendency to repeat a previously encountered syntactic structure, has been widely used as a tool to measure children's acquisition of syntax (for reviews, see Branigan & Pickering, 2017; Kidd, 2012; Pickering & Ferreira, 2008). Because priming does not depend on lexical similarities between prime and target (Bock, 1989), its occurrence is taken as an implicit measure of abstract knowledge (i.e., if priming occurs independent of the meaning of the sentence, the speaker can be said to have a mental representation of the structure that was primed). More recently, researchers have claimed that priming not only provides insight on abstract representations but that it also reflects implicit learning (Chang et al., 2006), thus demonstrating the mechanistic processes underlying

³The *ang-ay* verb-*ng* structure is also possible in Tagalog but it is considered formal, and is mostly found in written texts (Schachter & Otanes, 1972).

acquisition in which grammatical representations are acquired and slowly altered in response to experience (Dell & Chang, 2014).

Given the claim that priming provides insight into syntactic representations, determining the structural level that is primed can tell us about the kinds of information (e.g., syntactic or thematic) children use to learn the word order of their language. Several studies have shown priming of passive sentences in children (Bencini & Valian, 2008; Branigan & Messenger, 2016; Huttenlocher et al., 2004; Kidd, 2012; Messenger et al., 2012; Savage et al., 2003, 2006; Shimpi et al., 2007; Thatcher et al., 2008). However, the structural level at which priming occurs is still debated. On one hand, structural priming is usually described as a syntactic phenomenon that is not dependent on factors like thematic roles (Bock & Loebell, 1990). On the other hand, it can be argued, for instance, that speakers tend to produce more passives because the patient is primed to be in the subject or sentence-initial position, instead of being due to the priming of the passive structure per se (Pickering & Ferreira, 2008 for a discussion). More recent studies with adults provide support for the suggestion that non-syntactic features such as thematic roles can be primed (Cai et al., 2012; Chang et al., 2003; Köhne et al., 2014; Pappert & Pechmann, 2014; Salamoura & Williams, 2007; Vernice et al., 2012; Ziegler & Snedeker, 2018; see Ziegler et al., 2019 for a review).

Using English spray-load sentences in a repetition task, Chang et al. (2003) found that adult speakers produced more sentences with a goal-before-theme order (e.g., *The farmer heaped [the wagon] [with straw]*), after reading a goal-before-theme locative (e.g., *The maid rubbed [the table] [with polish]*) compared to a theme-before-goal locative (e.g., *The maid rubbed [polish] [onto the table]*), even though the two locative constructions have the same NP-VP-PP constituent order. These findings were replicated and extended by Ziegler and Snedeker (2018) using an event description task, who showed that priming of thematic roles occurs regardless of the animacy of the goal. Additional priming studies with German-speaking adults by Köhne et al. (2014) and Pappert and Pechmann (2014) suggest that speakers map thematic roles directly to linear sentence positions (see also Kidd, Tennant et al., 2015).

There is also evidence for thematic role order priming in children, based on a study on discourse emphasis in Russian. Vasilyeva and Waterfall (2012) reported that a participial passive sentence (analogous to the English passive) primed adults' and 6-year-olds' use of more common patient-initial utterances instead of the participial passive itself. In these patient-initial utterances, the patient is still an object but it is in the initial position, so these structures are object-initial; compared to the participial passive primes, which are subject-initial. Crucially, both the prime and the participants' productions emphasize the patient. The results therefore serve as evidence for priming of emphasis separate from syntactic priming, but it also suggests priming of thematic role order. However, the grammatical order in the primes they used were always subject-before-object, and the animacy of the arguments was not controlled (pictures with animate patients and inanimate agents elicited the majority of the passive alternatives), so further investigation is needed to determine the priming of thematic role order separate from grammatical role order.

Overall, recent priming studies on adults and children show that priming can occur at the level of thematic roles. Moreover, it has been proposed that thematic roles directly map to word order. It could then be argued that in passive priming in children, the passive structure per se is not primed, but rather, the patient-before-agent order. Using Tagalog, we can tease these two possibilities apart as the language allows agents, subjects, and sentence-initial positions to be dissociated from each other. Therefore, we can determine whether priming occurs at the syntactic or thematic level. Our study differs from previous research on this topic as we tested not only adults, but also three different age groups of children to determine whether the locus of priming changes developmentally. Moreover, instead of priming the order of thematic roles such as themes and recipients, we manipulated the order of agents and patients, which are core arguments.

Current study

The current research had two aims. Firstly, we examined children's acquisition of a symmetrical voice language, particularly its flexible word order and complex voice-marking system. Given that the structural priming paradigm provides insights on syntactic representation and on the mechanistic processes underlying acquisition, it enabled us to observe the strength of children's bias toward a particular word order, and their mastery of the verbal and noun morphology for thematic role assignment. More importantly, because the paradigm provided models (i.e., primes), we were able to test younger children (3-year-olds) compared to Garcia et al.'s (2018) study. Secondly, we investigated the structural level at which priming occurs (syntactic vs. thematic). Focusing on Tagalog enabled us to address a core and as-yet unanswered question in the field concerning the locus of priming of core arguments. That is, when primed, do children follow the order of thematic roles or the order of the grammatical roles? Answering this question provides insight on children's use of semantic or syntactic information in word order acquisition.

Regarding the acquisition of a symmetrical voice language, if children have a general bias for agent-initial utterances (E. Bates & MacWhinney, 1989; Jackendoff & Wittenberg, 2014), we would expect 3- to 7-year-old Tagalog-speaking children to produce mostly agent-before-patient constructions, similar to previous findings on 5- to 7-year-old children (Garcia et al., 2018). If children also initially map the agent to the subject role (Pinker, 1984), then children should first acquire the verbal and nominal markings for the agent voice (agent is the subject) before the patient voice morphology (agent is not the subject). However, based on the previous findings on Tagalog that the patient voice is actually easier to acquire than the agent voice (Galang, 1982; Garcia et al., 2018), we would expect children to be more accurate in marking the nouns given a verb marked in the patient voice compared to a verb marked in the agent voice. Regardless of voice, we expected a developmental increase in the accuracy of marking the nouns according to the given voice-marked verb prompts (i.e., *ang*-marker for the agent and *ng*-marker for the patient given an agent voice verb; and *ng* for the agent and *ang* for the patient given a patient voice verb).

With regard to the locus of priming, we expected that children would produce more patient-initial sentences compared to agent-initial sentences given a patient-initial prime sentence regardless of the voice of the verb prompt for the target. However, if children use the grammatical roles to order their noun phrases, we would expect a different pattern of results depending on voice. Specifically, given an agent voice patient-initial prime (verb-*ng*-*ang*; Ex. 1), participants would produce more patient-initial sentences only when the target prompt is also an agent voice-marked verb (patient-initial has a verb-*ng*-*ang* order similar to the prime sentence). If the target is in the patient voice instead, an agent-initial structure would be primed (also verb-*ng*-*ang*; Ex. 2). Given a prime in the patient voice, the opposite results would be expected: a patient voice patient-initial prime (verb-*ang*-*ng*; Ex. 4) would lead to more patient-initial productions only when the target prompt is also a patient voice-marked verb. If the target is in the agent voice, an agent-initial structure would be primed (verb-*ang*-*ng*; Ex. 3). In Experiment 1, we provided agent- and patient-initial primes only in the agent voice. In Experiment 2, the prime sentences were only in the patient voice.

Experiment 1

Method

Participants

We recruited thirty-five 3-year-olds (mean age: 3;8, age range: 3;0–4;00, girls: 20), thirty-four 5-year-olds (mean age: 5;6, age range: 4;10–5;11, girls: 16), and thirty-three 7-year-olds (mean age: 7;7, age range: 7;0–7;11, girls: 16) from Metropolitan Manila, Philippines. We included 5- and 7-year-olds following Garcia et al. (2018), and also 3-year-olds since we aimed to track the emergence of priming. The 5-year-olds were Kindergarten students and the 7-year-olds were Grade 2 students from a public elementary school. The 3-year-olds were recruited from 10 different day care centers near the

elementary school. Their guardians provided written consent for the children to participate in the study.

These children were reported to be Tagalog-dominant and coming from Tagalog-speaking households. Children's language proficiency was tested using the Peabody Picture Vocabulary Test (4th edition, PPVT4, Dunn & Dunn, 2007), the first 12 sets of which were translated by the first author into Tagalog (following similar adaptations, e.g., Kidd, Chan et al., 2015; Kidd & Kirjavainen, 2011). When the equivalent Tagalog word was deemed inappropriate, another picture that was of an appropriate difficulty for that set was chosen from the item display to be the target. In the task, four pictures were shown at a time, and participants were asked to point to the item named by the experimenter. There were 12 items per set (with each set in increasing difficulty). Testing stopped when the participant made at least eight errors in a set. The raw score was calculated by subtracting the number of errors from the last number administered. The 3-year-old group scored an average of 32 points (range: 9–65 points). The 5-year-olds had an average of 71 points (range: 49–107), while the 7-year-olds had a mean score of 104 (range: 75–125). However, it must be noted that for some participants, testing had to stop before a ceiling was established, because the children were no longer cooperative (seventeen 3-year-olds) or because of experimenter error (two 7-year-olds). Nevertheless, the results imply that the different age groups also had varying proficiency in Tagalog that was related to age. Note that we did not use the PPVT scores in our analyses of the priming data.

Data from two 5-year-olds and one 7-year-old were not included for analysis, due to speech errors observed before and after the actual experiment which were not made by their peers (e.g., using only the base forms of verbs). In total, we analyzed data from thirty-five 3-year-olds, thirty-two 5-year-olds, and thirty-two 7-year-olds.

We also recruited 33 adult native speakers of Tagalog from a university in Metropolitan Manila (mean age: 22, range: 18–38, females: 17). The participants reported not having any history of language or speech delay, or neurologic or psychiatric disorders. The adults provided written consent. Data from one adult was not included in the analysis because it became apparent during testing that the participant was not a native Tagalog speaker.

Materials

Eight Tagalog transitive verbs (*hila* “pull”, *sipa* “kick”, *huli* “catch”, *palo* “hit”, *kagat* “bite”, *habol* “chase”, *gamot* “cure”, and *baril* “shoot”) were used in both the prime sentences and target prompts (see Appendix A for a complete list of the experimental items). Each verb appeared twice as a prime and twice as a target, each time with a different animal pair (a total of eight common animals were used). The verbs were paired with each other (prime and target for each trial) such that no prime-target verb pairs were repeated. Animals were assigned to the verbs, such that no animal in the prime also appeared in the target for the same trial. Each animal served as an agent and as a patient an equal number of times.

Thematic role order of the prime (agent-initial, patient-initial) and voice-marking of the target verb prompt (agent voice, patient voice) were crossed, resulting in four experimental sentence conditions (Table 1). Each prime-target verb pair appeared in all of the four conditions, resulting in a total of 64

Table 1. Sample experimental items for Experiment 1.

	Prime sentence				Target prompt	
1. Agent-initial prime	H<um>ihila	ang	baka	ng	baboy.	K<um>akagat
Agent voice target	<AV>pull	SBJ	cow	NSBJ	pig	<AV>bite
2. Agent-initial prime	H<um>ihila	ang	baka	ng	baboy.	K<in>akagat
Patient voice target	<AV>pull	SBJ	cow	NSBJ	pig	<PV>bite
3. Patient-initial prime	H<um>ihila	ng	baboy	ang	baka.	K<um>akagat
Agent voice target	<AV>pull	NSBJ	pig	SBJ	cow	<AV>bite
4. Patient-initial prime	H<um>ihila	ng	baboy	ang	baka.	K<in>akagat
Patient voice target	<AV>pull	NSBJ	pig	SBJ	cow	<PV>bite
	“The cow is pulling a pig.”					“biting”

experimental items. These 64 items were distributed using a Latin square design into four lists, each containing 16 experimental trials (four items per condition) or unique prime-target verb pairs. Each list also contained 16 fillers consisting of descriptions (e.g., Prime sentence: *Bali ang mga lapis* “The pencils are broken.” Target prompt: *Kulay dilaw ...* “Yellow ...” given a picture of a yellow mango). Four of these fillers served as the snap items (prime and target were the same).

Pictures depicting the 64 combinations of the verbs and the animal pairs for the experimental items, and the rest of the fillers and practice items were created by a professional artist (see Figure 1 for examples). The direction of the action in the pictures within trials and throughout the experiment was counterbalanced.

Within a list, the items were distributed in two blocks, such that in each block a verb appeared only once as a prime and once as a target. The order of presentation of the blocks was balanced across the lists. Within each block, the order of presentation of the items was pseudo-randomized such that there would be a minimum of three experimental items before the same verb was encountered again (as a prime or as a target). Fillers were also interspersed among experimental items, so no two experimental items followed each other. Filler items were randomly distributed across the experiment. Each participant was assigned to one list.

Procedure

The adult participants were individually tested in a quiet room at the university, while the 3-year-olds were tested at the back part of their day care classrooms. For the 5- and 7-year-olds, testing was done by two experimenters in a quiet room in the school. One experimenter administered the PPVT, while the other tested the children with the priming experiment.

Priming was assessed using the “Snap Game” (Branigan et al., 2005). The experimenter and participant sat side-by-side in front of a table. First, the experimenter presented individual picture cards of the animals and the actions that would appear in the experiment (four pictures at a time), and asked the participant to identify the item she named. In these pictures, the actions were between two boys, instead of two animals as in the priming experiment. Additionally, the experimenter used the base form of the verbs during this pre-experiment task.

Afterward, the experimenter explained the rules of the snap card game to the children and gave four practice trials. The experimenter and the participant each had a deck of cards, which were facing down. These cards were pre-arranged and the experimenter had the script (prime sentences and verb prompts) on Powerpoint slides on a smart phone. The experimenter started each game by turning her topmost card over, and describing it using a sentence in a specific experimental condition (prime sentence). Before the participant turned his/her topmost card over, the experimenter gave a voice-marked verbal prompt, which the participant should use to start a sentence describing the target picture. They both took turns until no card was left. Whenever the pictures were the same, the first one to call out “Snap!” would win the round. All of the items used for these Snap trials were fillers. The experiment lasted for an average of 6 minutes for the adults, 8 minutes for the 7-year-olds, 10 minutes for the 5-year-olds, and 12 minutes for the 3-year-olds. The experiment was recorded using Tascam DR-40 digital portable recorder.



Figure 1.

For the PPVT, pictures were presented on a 9.7 inch tablet, and the participants were asked to point to the item named by the experimenter. The incorrect responses were recorded on-line on paper or on an Excel sheet. Testing stopped when the participants have made eight or more errors within a set; or when they were no longer cooperative. Scores were then tallied.

Data analysis

The audio-recordings were transcribed by a native speaker of Tagalog (the first author). After the transcription, the first-mentioned animal was coded (also by the first author), as well as the accuracy of noun-marking, the specific noun markers used, the types of errors, and the number of arguments. Another native speaker coded 10% of the data set. The calculated Cohen's kappa scores are above 0.89, indicating almost perfect agreement between the two coders.

The experiment had a $2 \times 2 \times 4$ factorial design. The independent variables used were thematic role order in the prime sentence (agent-initial and patient-initial), voice-marking of the verb prompt (agent voice and patient voice), and age group (3-year-olds, 5-year-olds, 7-year-olds, and adults). The dependent variable was the frequency of patient-initial productions, which we chose to report instead of agent-initial productions (i.e., its inverse) to be consistent with the preference in priming studies to report priming as a function of the dispreferred structure (i.e., past studies have shown that 5- and 7-year-olds produce more agent-initial structures).

We used R version 3.6.1 (R Development Core Team, 2016), and the R function `glmer` of the `lme4` package version 1.1-21 (D. Bates et al., 2015) to fit logistic mixed-effects models. The `emmeans` package (version 1.4.1) was used for pairwise comparisons in case of a significant interaction of variables. The models included the fixed effects and interactions of age (3-year-olds vs. 5-year-olds, 5-year-olds vs. 7-year-olds), thematic role order in the prime sentence, and the voice-marking of the verb prompt, and random subject and item intercepts. Due to a lack of variance, the models including the adult data did not converge. The logistic mixed-effects models we present in the Results section do not include the adult data. However, because we consider the adult performance as the developmental end-state, we also provide a descriptive analysis of this data set. Note that Figures 2 and 3 suggest that even 7-year-old children's performance is not yet adult-like.

We also fitted a logistic model to determine the effects of the independent variables on children's accuracy in marking the nouns. The model included the same fixed effects as enumerated above, but

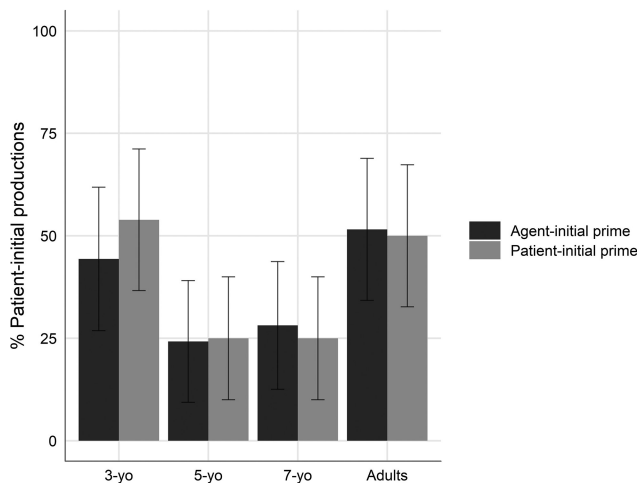


Figure 2. Mean percentage of patient-initial productions with 95% confidence intervals for each prime condition per age group given agent voice targets in Experiment 1.

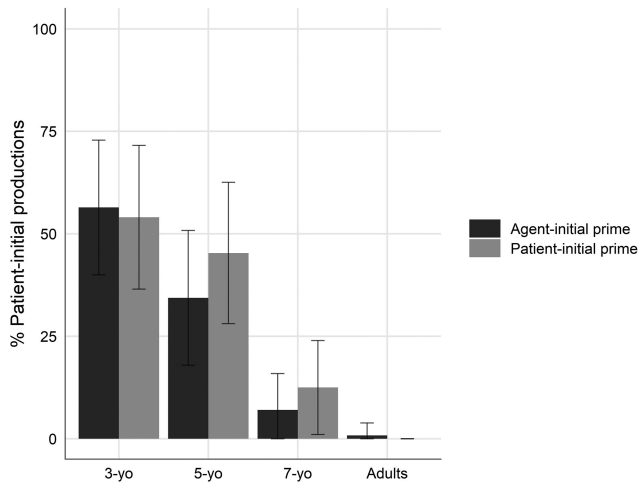


Figure 3. Mean percentage of patient-initial productions with 95% confidence intervals for each prime condition per age group given patient voice targets in Experiment 1.

only with a random subject intercept, as other models would not converge. We also computed the frequency of occurrence of the errors. The data and the code can be found at <https://osf.io/yz58c/>.

Results

We present the word order results followed by the children's accuracy in noun-marking.

Word order

We calculated the percentage of patient-initial utterances produced by the participants, irrespective of noun marking accuracy. The mean percentage of patient-initial productions and 95% confidence intervals for all prime conditions and age groups given agent voice targets are presented in Figure 2, and given patient voice targets in Figure 3. The results show that given a verb prompt in the agent voice, the adults had no word order preference and produced both agent-initial and patient-initial sentences regardless of the thematic role order in the prime sentence. However, in the patient voice, adults showed a strong agent-initial preference, and barely produced a patient-initial utterance even after hearing a patient-initial prime. In contrast, 5- and 7-year-old children produced more agent-initial than patient-initial constructions not only in the patient voice but also in the agent voice. Three-year-olds did not show a word order preference in either voice.

The logistic mixed-effects model shows main effects of age (3 vs. 5; 5 vs. 7), thematic role order in the prime, and two-way interactions of age (5 vs. 7) and voice-marking of the verb prompt (see Table 2).⁴ Overall, 3-year-olds produced more patient-initial utterances than the 5-year-olds. In addition, there were generally more patient-initial productions after participants heard a patient-initial prime compared to an agent-initial prime. The pairwise comparisons inspecting the two-way interaction show that the 5-year-olds produced more patient-initial utterances than the 7-year-olds but only given a patient voice target ($\beta = 2.32$, $SE = 0.39$, $p < .001$) and a difference was not observed in the agent voice ($\beta = -0.08$, $SE = 0.35$, $p > .99$).

⁴Analysis excluding single-argument productions and utterances with compound arguments (using *at* "and" between the nouns) shows similar results (see Table 9 in Appendix B).

Table 2. Summary of the fixed effects of age, thematic role order in the prime, voice-marking of the verb prompt and their interactions, on the frequency of children's patient-initial productions in Experiment 1.

Predictor	Estimate	SE	z value	p value
Intercept	-1.01	.21	-4.69	<.001
Age (3:5)	1.07	.29	3.71	<.001
Age (5:7)	1.12	.32	3.52	<.001
Thematic role order in the prime (TRO)	-0.13	.07	-2.01	.04
Voice-marking of the verb prompt (VM)	0.05	.07	0.73	.47
Age(3:5)*TRO	0.05	.14	0.32	.75
Age(5:7)*TRO	-0.03	.18	-0.17	.86
Age(3:5)*VM	0.25	.14	1.73	.08
Age(5:7)*VM	-1.20	.18	-6.66	<.001
TRO*VM	0.08	.07	1.13	.26
Age(3:5)*TRO*VM	-0.27	.14	-1.89	.06
Age(5:7)*TRO*VM	-0.10	.18	-0.58	.56

Table 3. Summary of the fixed effects of age, thematic role order in the prime, voice-marking of the verb prompt and their interactions, on children's accuracy in noun-marking in Experiment 1.

Predictor	Estimate	SE	z value	p value
Intercept	0.57	.17	3.28	.001
Age (3:5)	-2.33	.38	-6.06	<.001
Age (5:7)	-3.36	.46	-7.28	<.001
Thematic role order in the prime (TRO)	-0.07	.10	-0.75	.45
Voice-marking of the verb prompt (VM)	-0.42	.10	-4.33	<.001
Age(3:5)*TRO	-0.10	.16	-0.63	.53
Age(5:7)*TRO	0.18	.26	0.68	.50
Age(3:5)*VM	0.36	.16	2.07	.04
Age(5:7)*VM	0.64	.26	2.45	.01
TRO*VM	-0.01	.10	-0.15	.88
Age(3:5)*TRO*VM	0.03	.16	0.17	.87
Age(5:7)*TRO*VM	0.20	.26	0.76	.45

Noun-marking accuracy

Across the voice conditions, 3-year-olds had 17% accuracy in noun-marking, 5-year-olds had 55%, and 7-year-olds had 93%. The logistic mixed-effects model shows main effects and interactions of age (3 vs. 5; 5 vs. 7) and voice-marking of the target (see Table 3) on children's noun-marking accuracy. Seven-year-olds showed higher accuracy compared to the 5-year-olds, while 5-year-olds performed more accurately compared to the 3-year-old children. Inspecting the interactions revealed higher accuracy in the patient voice than in the agent voice for the 5-year-olds ($\beta = -0.63$, $SE = 0.21$, $p = .03$) and 7-year-olds ($\beta = -1.91$, $SE = 0.48$, $p < .001$), but no difference was found in the 3-year-olds ($\beta = 0.04$, $SE = 0.25$, $p > .99$).

The highest frequency error made by 3-year-olds was leaving at least one of the arguments uninflected, while most of the errors of the older children consisted of using an incorrect marker for at least one of the nouns (see Figure 4). The 5-year-olds sometimes used the same marker (either *ang* or *ng*) for both nouns, or reversed the *ang* and *ng* markers. The 7-year-olds' few errors were from reversals of the noun-markers. It must also be noted that both the 5- and the 7-year-olds made more reversal errors given an agent voice target compared to a patient voice target. Other noun-marking errors included using *at* "and" between the nouns.

Discussion

The results suggest that the development of word order preference and noun marking in Tagalog takes some time, and is significantly affected by voice. For word order, the adult data show that the children's target is uniform for the patient voice (i.e., agent-initial), but is highly variable for the agent voice, a result that is consistent with past research (Garcia et al., 2018; Hsieh, 2016). The

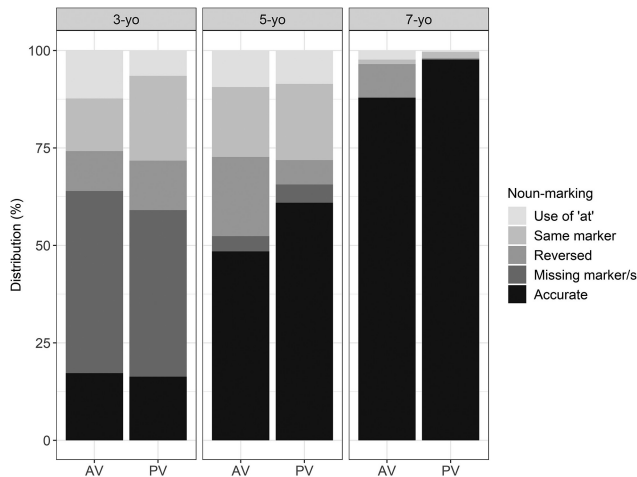


Figure 4. Percentage distribution of noun-marking types within each voice-marking condition per age group in Experiment 1. Note. AV refers to an agent voice-marked target prompt, and PV refers to a patient voice-marked target prompt.

developmental data reflected this difference. For the patient voice, age group-related effects suggested a gradual and linear convergence on the adult target, with an increasing number of agent-initial productions with age. In contrast, the agent voice showed a U-shaped developmental pattern, with 3-year-olds and adults showing no agent-initial preference, but the 5- and 7-year-olds showing one. Thus, across voice types, we see that the 3-year-olds had no agent-initial preference, which only emerged in the 5- and 7-year-olds, the latter consistent with past research (Garcia et al., 2018). The data thus suggest that the first-noun-as-agent bias emerges with experience. We return to the differences between word order preferences and voice in the General Discussion.

Noun-marking accuracy also increased developmentally and interacted with voice. The 3-year-olds struggled to mark both nouns, showing limited abstract knowledge of the nominal markers and how these correspond to the voice-marking on the verb. Noun-marking accuracy improved in the older children, but was most accurate for the more frequent patient voice. Their pattern of errors suggests that they may be using the patient voice as a canonical template for noun marking, as revealed most clearly by the tendency of the older children to make reversal errors of the *ang* and *ng* markers. More errors arose from using the patient voice marker configuration (*ang* for the patient, *ng* for the agent) given an agent voice verb prompt, than vice versa; similar to Garcia et al.'s (2018) findings. These results suggest that older children understand that noun-marking is obligatory, but they have not yet fully mastered the nominal and verbal marking system, even by 7-years.

As regards priming, the data showed that adults' productions did not seem to be influenced by the thematic role order nor by the grammatical role order in the prime sentence. In contrast, we found that children produced more patient-initial utterances after hearing a patient-initial prime, suggesting that children follow the thematic role order in the prime. Moreover, this effect was found across voice conditions, showing that the markings on the nouns or their grammatical roles do not matter. We discuss this effect further in the General Discussion.

Experiment 2

In Experiment 1, all primes were in the agent voice. However, our results and those of past studies suggest that children master the Tagalog patient voice first (e.g., Galang, 1982; Garcia et al., 2018). Thus, it is possible that there may be a different pattern of results depending on voice type. In terms of priming, if, as in Experiment 1, children follow the thematic role order in

the prime, they would produce more patient-initial utterances after hearing a patient-initial prime. However, if they follow the grammatical role order in the prime, they would produce more patient-initial utterances after hearing a patient-initial prime but only given patient voice targets (verb-*ang-ng*). If the target is in the agent voice, an agent-initial structure (also verb-*ang-ng*) would be primed instead.

Methods

Participants

We recruited another set of thirty-five 3-year-old children (mean age: 3;8, age range: 2;11–4;00, girls: 22), thirty-three 5-year-old children (mean age: 5;6, age range: 5;0–5;11, girls: 17), and thirty-two 7-year-old children (mean age: 7;7, age range: 7;0–7;11, girls: 16) from Metropolitan Manila, Philippines. Recruitment was similar to that of Experiment 1. Data from one 5-year-old was not included for analysis, due to speech errors observed before and after the actual experiment (e.g., using only the base forms of verbs), which were not made by other children in the same age group. We again administered the PPVT to determine the developmental levels of the sample. As in Experiment 1, we observed age-related differences: the 3-year-old group scored an average of 27 points (range: 14–43 points); 5-year-olds had an average of 76 points (range: 44–112); 7-year-olds had a mean score of 98 (range: 72–127). In some instances, testing stopped before a ceiling was established because the children were no longer cooperative (thirteen 3-year-olds, one 5-year-old), or due to experimenter error (one 7-year-old). These scores are comparable to those obtained from participants in Experiment 1.

A further 32 adult Tagalog native speakers were recruited as control participants (mean age: 22, age range: 18–46, females: 17). None of them participated in Experiment 1.

Materials

The verbs and pictures from Experiment 1 were used. The only difference between the experiments were the verbal and nominal markers in the prime sentences (see Appendix A Table 8 for a complete list of the experimental items). In Experiment 2, all of the verbs in the primes were marked with the patient voice, and therefore, the noun marker for the agent was *ng*, and it was *ang* for the patient (see Table 4), which is a reversal of the noun-marking in Experiment 1.

Procedure

The procedure was the same as in Experiment 1.

Data analysis

The analysis was the same as in Experiment 1.

Table 4. Sample experimental items for Experiment 2.

	Prime sentence					Target prompt
1. Agent-initial prime	H<in>ihila	ng	baka	ang	baboy.	K<um>akagat
Agent voice target	<PV>pull	NSBJ	cow	SBJ	pig	<AV>bite
2. Agent-initial prime	H<in>ihila	ng	baka	ang	baboy.	K<in>akagat
Patient voice target	<PV>pull	NSBJ	cow	SBJ	pig	<PV>bite
3. Patient-initial prime	H<in>ihila	ang	baboy	ng	baka.	K<um>akagat
Agent voice target	<PV>pull	SBJ	pig	NSBJ	cow	<AV>bite
4. Patient-initial prime	H<in>ihila	ang	baboy	ng	baka.	K<in>akagat
Patient voice target	<PV>pull	SBJ	pig	NSBJ	cow	<PV>bite
	"The/A cow is pulling the pig."					"biting"

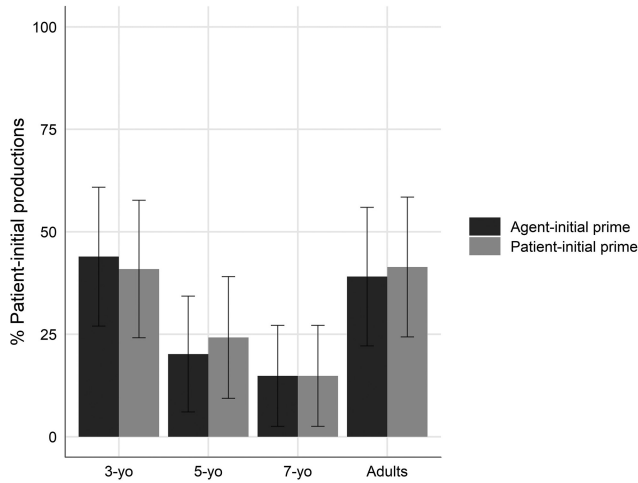


Figure 5. Mean percentage of patient-initial productions with 95% confidence intervals for each prime condition per age group given agent voice targets in Experiment 2.

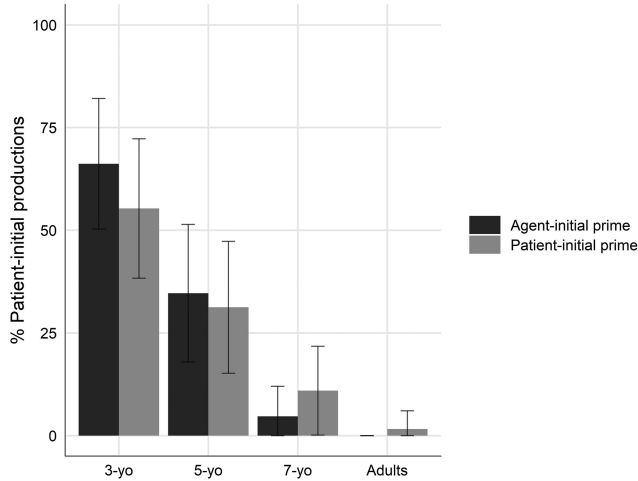


Figure 6. Mean percentage of patient-initial productions with 95% confidence intervals for each prime condition per age group given patient voice targets in Experiment 2.

Results

Word order

We calculated the percentage of patient-initial utterances produced by the participants. The mean percentage of patient-initial productions and 95% confidence intervals for all prime conditions and age groups given agent voice targets are presented in Figure 5, and given patient voice targets in Figure 6. Given a verb prompt in the agent voice, the adults produced both agent-initial and patient-initial sentences irrespective of the thematic role order in the prime sentence. However, adults showed a strong agent-initial preference in the patient voice, and produced very few patient-initial utterances after hearing a patient-initial prime. In contrast, 5- and 7-year-old children produced more agent-initial than patient-initial constructions in both voices. Three-year-olds did not show a word order preference in both voice conditions.

Table 5. Summary of the fixed effects of age, thematic role order in the prime, voice-marking of the verb prompt and their interactions, on the frequency of children's patient-initial productions in Experiment 2.

Predictor	Estimate	SE	z value	p value
Intercept	-1.34	.20	-6.69	<.001
Age (3:5)	1.35	.32	4.26	<.001
Age (5:7)	1.45	.36	4.04	<.001
Thematic role order in the prime (TRO)	-0.04	.07	-0.58	.57
Voice-marking of the verb prompt (VM)	-0.08	.07	-1.08	.28
Age(3:5)*TRO	0.19	.15	1.29	.20
Age(5:7)*TRO	0.22	.19	1.15	.25
Age(3:5)*VM	-0.06	.15	-0.43	.67
Age(5:7)*VM	-0.78	.20	-4.00	<.001
TRO*VM	0.02	.07	0.23	.82
Age(3:5)*TRO*VM	-0.02	.15	-0.13	.89
Age(5:7)*TRO*VM	-0.36	.19	-1.86	.06

The logistic mixed-effects model shows main effects of age (3 vs. 5; 5 vs. 7), and two-way interactions of age (5 vs. 7) and voice-marking of the verb prompt (see Table 5).⁵ Overall, 3-year-olds produced more patient-initial utterances than the 5-year-olds. The pairwise comparisons inspecting the two-way interaction show that the 5-year-olds produced more patient-initial utterances than the 7-year-olds but only given a patient voice target ($\beta = 2.23$, $SE = 0.43$, $p < .001$) and a difference was not observed in the agent voice ($\beta = 0.67$, $SE = 0.39$, $p = .52$).

Noun-marking accuracy

Across the voice conditions, 3-year-olds had 24% accuracy in noun-marking, 5-year-olds had 59%, and the 7-year-olds had 95%. The logistic mixed-effects model shows main effects of age (3 vs. 5; 5 vs. 7) and voice-marking of the target on children's noun-marking accuracy (see Table 6). Seven-year-olds showed higher accuracy compared to the 5-year-olds, while 5-year-olds performed more accurately compared to the 3-year-old children. Moreover, children marked the nouns more accurately given patient voice target prompts compared to agent voice targets.

As in Experiment 1, the majority of the errors that 3-year-olds made were due to leaving at least one of the arguments uninflected, while most of the errors of the older children comprised of the reversal of *ang* and *ng* markers, and using either *ang* or *ng* for both arguments (see Figure 7). The 3-year-olds and the 5-year-olds made more reversal errors given an agent voice target compared to a patient voice target. Other noun-marking errors included using *at* "and" between the nouns.

Table 6. Summary of the fixed effects of age, thematic role order in the prime, voice-marking of the verb prompt and their interactions, on children's accuracy in noun-marking in Experiment 2.

Predictor	Estimate	SE	z value	p value
Intercept	0.84	.17	4.81	<.001
Age (3:5)	-2.15	.39	-5.55	<.001
Age (5:7)	-3.19	.46	-6.99	<.001
Thematic role order in the prime (TRO)	0.04	.09	0.49	.62
Voice-marking of the verb prompt (VM)	-0.20	.09	-2.21	.03
Age(3:5)*TRO	-0.25	.15	-1.61	.11
Age(5:7)*TRO	0.18	.24	0.75	.45
Age(3:5)*VM	0.01	.15	0.08	.94
Age(5:7)*VM	0.29	.24	1.22	.22
TRO*VM	0.08	.09	0.94	.35
Age(3:5)*TRO*VM	0.01	.15	0.02	.99
Age(5:7)*TRO*VM	-0.07	.24	-0.28	.78

⁵Analysis excluding single-argument productions and utterances with compound arguments (using *at* "and" between the nouns) shows similar results (see Table 10 in Appendix B).

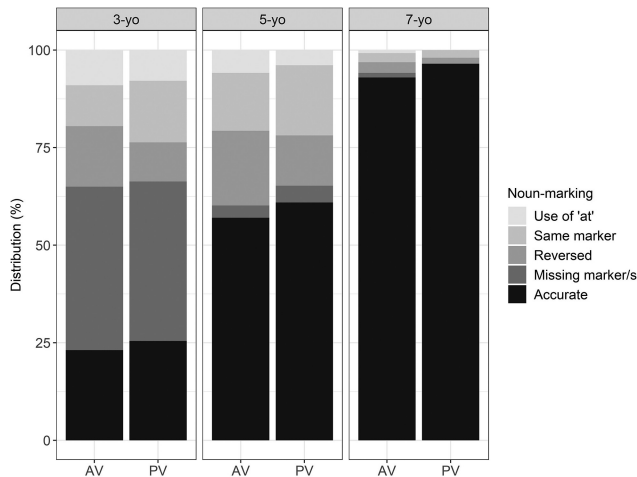


Figure 7. Percentage distribution of noun-marking types within each voice-marking condition per age group in Experiment 2. Note. AV refers to an agent voice-marked target prompt, and PV refers to a patient voice-marked target prompt.

Discussion

The word order preferences of adults and children in Experiment 2 are similar to those in Experiment 1. Notably, we see the same U-shaped use of agent-initial sentences for the agent voice, and a gradual increase in agent-initial utterances in the patient voice.

The accuracy in marking the nouns also increased developmentally, comparable to the results of Experiment 1. The 3-year-olds had difficulties in marking both the nouns, while the 5- and 7-year-olds showed awareness that noun-marking is obligatory but still reversed the use of the *ang* and *ng* markers. We also observed a patient voice advantage evidenced by higher accuracies in noun-marking and fewer reversal errors compared to the agent voice.

With regard to priming, the results of Experiment 2 differ from those of Experiment 1, because we did not observe priming of thematic role order in children, nor in adults. There was also no evidence for priming of grammatical role order.

General discussion

In this paper, we presented two experiments that used structural priming to investigate the acquisition of the Tagalog symmetrical voice system. Our focus on Tagalog enabled us to examine claims that children possess biases to map the agent to the subject role (Pinker, 1984) or to the initial noun phrase position (E. Bates & MacWhinney, 1989; Jackendoff & Wittenberg, 2014). Moreover, the properties of Tagalog allowed us to identify the structural level at which priming occurs, thereby providing insight on the kinds of information that children use for word order learning (e.g., thematic or syntactic). We discuss each of these issues in turn.

Children's acquisition of word order and voice-marking system

The data across both experiments suggest that the agent-initial preference observed in prior studies in 5- and 7-year-olds (e.g. Garcia et al., 2018) gradually emerges and strengthens across development, with children's word order preferences not being adult-like even at 7-years, most obviously when using the agent voice. The results are therefore not consistent with an early emerging agent-first strategy (Jackendoff & Wittenberg, 2014), but are more consistent with an account of acquisition where children gradually develop the strategy through analyses of the input (E. Bates & MacWhinney, 1989).

The data provide a novel developmental perspective on current debates in linguistics regarding the existence of a universal agent-first principle. On face value, the existence of symmetrical voice languages like Tagalog challenges the existence of such a principle, since they do not privilege agents as prominent syntactic arguments and word order is flexible. However, Riesberg et al. (2019) reject this suggestion, and instead argue that even if symmetrical voice systems allow word order variations different from those of asymmetrical voice systems, these variations would still be biased toward an agent-initial order. Similarly, Primus (2006) proposed that there is a universal tendency for a thematically-independent role to precede a thematically-dependent one, and the agent is considered an independent role because there would have been no action nor patient without it. This agent-before-patient order is also said to reflect the natural flow of an event from the doer to the receiver of the action (Cohn & Paczynski, 2013; Kemmerer, 2012).

Moreover, Riesberg et al. (2019) argued that non-agent-initial structures still exist in languages because of other competing ordering biases which are not in the thematic domain. For example, agent voice patient-initial structures are also produced because the verb forms a constituent with the *ng*-argument, and this *ng*-argument regardless of the thematic role (which happens to be the patient in the agent voice) preferentially follows the verb. This claim is similar to Kroeger's (1993) proposal that, aside from an agent-initial principle, Tagalog's word order is guided by a subject-last/*ang*-last principle, resulting in no word order preference in the agent voice. That is, an agent-initial order satisfies the thematic role order principle but is also subject-initial. Our adult results support these claims, adding crucial psycholinguistic data to a debate that has largely relied on isolated examples.

The competing forces of the agent-first and subject-last principles usefully frame our developmental data. The 5- and 7-year-old children's agent-initial preference seems to show that they follow only the thematic role order principle (agent-initial), and not the grammatical role order principle (subject-last), whereas the 3-year-olds did not show any preference in both voices. The developmental timing of the effect suggests that the principles develop in response to experience, and that children attend primarily to functional over syntactic roles.

An important question then is why 5- and 7-year-old children show an agent-initial preference across both voice types when the adults show an agent-initial preference only in the patient voice. One likely explanation concerns the availability of evidence in the input (Ambridge et al., 2015; E. Bates & MacWhinney, 1989; Lieven, 2010). As much as the adult participants showed no preference for the agent voice in both Experiments 1 and 2, spontaneous speech data actually reveal that most of child-directed speech in the agent voice are agent-initial (Garcia et al., 2018, 2019 based on Marzan, 2013). Instead of having two full noun phrases like in Experiments 1 and 2, most of these utterances in the corpus are with at least one pronoun (which are usually agents), and pronouns obligatorily occur after the verb in Tagalog (Billings, 2005), leading to agent-initial constructions. Additionally, the majority of the utterances in the corpus are in the patient voice, so children may also generalize the prevailing word order in the patient voice to agent voice constructions (Garcia et al., 2018). Overall, it seems that children start without any word order preference, and over the course of development, an agent-initial preference emerges, most probably due to its dominance in the input. Mastery of the subject-last principle must occur sometime later, since we do not have overwhelming evidence in our data to suggest that even our 7-year-olds know it.

As regards the acquisition of the voice-marking system in Tagalog, children's accuracy on marking the nouns based on the given voice-marked verb, increased with age. Most of the errors made by the 3-year-olds consisted of leaving at least one noun unmarked, while older children inflected both nouns, but sometimes used the same marker for both or reversed the *ang* and *ng* markers. These results show that children start from having limited or no knowledge of the markers, to being aware that noun marking is obligatory, until fully mastering the assignment of the markers.

Our results also showed that children made more noun-marking errors given a verb that was marked for the agent voice compared to a patient voice-marked verb. Moreover, children were more likely to reverse the *ang* and *ng* markers from the agent voice configuration to that of the patient voice, than vice versa. These findings show that children master the patient voice earlier than the agent voice,

similar to Galang's (1982) claim. This early mapping of the patient to the *ang*-phrase is inconsistent with the proposal that children initially map the agent to the subject (Pinker, 1984). However, the earlier mastery of the patient voice is in line with findings of an earlier production of passive in languages where it is frequent in the input, such as in Jakarta Indonesian (Gil, 2006), Inuktitut (Allen & Crago, 1996), and Sesotho (Demuth, 1989; Kline & Demuth, 2010). Tagalog corpus studies have shown that the patient voice is more frequent given transitive sentences (Cooreman et al., 1984; Garcia et al., 2018 based on data from; Marzan, 2013), so it is likely that the higher exposure to the patient voice leads to its earlier mastery.

To summarize, evidence from Tagalog shows that children do have a tendency to produce agents before patients, but this bias seems to be gradually attained instead of being initially present, as it was observed only in the older age groups. Additionally, we did not find support for the claim that children map the agent to the subject role by default. Instead, Tagalog-speaking children showed better mastery of the patient voice (the patient is the subject), reflecting the higher frequency of the patient voice compared to the agent voice in the input. Overall, the voice-marking system of Tagalog takes a long time to be acquired, possibly because of the complex interplay of verbal and nominal markings.

The locus of priming

Our results in Experiment 1 show that children produced more patient-initial sentences in both the agent and patient voice, after hearing patient-initial primes. This finding provides evidence that priming can occur on the thematic role level, similar to claims from adult studies on English and German locative and dative alternations (Chang et al., 2003; Köhne et al., 2014; Pappert & Pechmann, 2014; Ziegler & Snedeker, 2018) and children's production of Russian passive alternatives (Vasilyeva & Waterfall, 2012). Additionally, we did not find evidence for priming of the grammatical role order. Therefore, our results support Köhne et al.'s (2014) claim that the priming effect is not due to the mapping of thematic roles to particular grammatical functions; rather thematic roles map directly to the surface word order. These findings show that thematic roles have an important role in language production and acquisition, and that they are present in children's abstract representations.

However, the effect we found is weaker compared to studies showing priming of passives in children (Bencini & Valian, 2008; Branigan & Messenger, 2016; Kidd, 2012; Messenger et al., 2012). It could be the case that the priming of thematic role order is weak because it is in conflict with the structure that can potentially be primed by the grammatical role order. Unlike in active-passive alternation in other languages, there is no overlap between the two possible sources of priming. Previous studies have shown that the priming effect is enhanced with an increasing number of features that align from the prime sentence to the target sentence (e.g., animacy, thematic roles, and constituent structure), and diminished when the number of shared features decrease (Gamez & Vasilyeva, 2015; Vernice et al., 2012; Ziegler & Snedeker, 2018). It has also been suggested that the influence of thematic roles is weak, such that it cannot bring about the production of another syntactic structure (Chang et al., 2003; Pickering & Ferreira, 2008). Its effect is only observed whenever there is no syntactic difference between the two alternatives, such as in locative alternations studied by (Chang et al., 2003) (e.g., *The maid rubbed [the table] [with polish]* compared to *The maid rubbed [polish] [onto the table]*). Because both the agent voice and patient voice are considered basic transitive sentences, we can argue that there is no syntactic distinction between the two (Foley, 2008; Riesberg, 2014), so we still observe the effect of thematic role order in Tagalog, albeit weakly.

We also found priming of thematic role order only in Experiment 1 where all of the primes were in the agent voice, but not in Experiment 2 where the primes were in the patient voice. The result can be attributed to the *inverse frequency* effect, whereby less frequent structures are more "primeable" (Ferreira, 2003), since the agent voice occurs less frequently in the input compared to the patient voice (Cooreman et al., 1984; Garcia et al., 2018, 2019).

Whereas there was no priming for children in the patient voice, the adult participants showed no priming at all, a finding that is inconsistent with the body of literature showing priming of passives or

patient-initial sentences in adult native speakers of Indo-European languages (Bock, 1986; Branigan & Messenger, 2016; Messenger et al., 2012; Thatcher et al., 2008). This null finding may be due to methodological issues, as our method was designed to work best with children. We could possibly observe priming in adults if there had been more experimental items and fillers in the study. However, another possible reason is the observation from previous studies that less-skilled speakers, like children, present larger priming effects compared to highly-proficient ones (Bencini & Valian, 2008 for children compared to adults; Hartsuiker & Kolk, 1998 for adults with aphasia compared to non-brain-damaged individuals; Leonard et al., 2000 for children with specific language impairment compared to typically-developing peers), possibly because they have fewer structural alternatives (Hartsuiker & Kolk, 1998), or because children's representations are weaker than those of adults' and are more vulnerable to change (Chang et al., 2006).

The small priming effects in children and the null effects in adults thus require further attention. The proposed mechanisms underlying priming, such as error-based learning (Chang et al., 2006; Dell & Chang, 2014), have been argued to play a crucial role in acquisition, and so the seemingly weak priming effects in Tagalog are on face value inconsistent with an account of acquisition in which error-based learning is a driving force. It could be that language-specific properties of Tagalog grammar combined with our experimental paradigm contribute to the weak effects. Notably, the language is verb-initial, the prominent syntactic roles are marked in relation to the voice-marking on the verb, and the core arguments can in principle be scrambled. Thus, unlike the typical languages in which priming has been assessed, Tagalog does not require word order to emphasize or mark participant roles. Instead, where the priming effect may be stronger is in voice-marking, since the choice of voice has significant consequences for the assignment of syntactic roles. We did not assess this because we provided participants with a voice-marked verbal prompt. This is a matter for future research, but underlies the importance of studying typologically diverse languages to test our current theories of language acquisition.

To conclude, our study shows that research on non-Indo-European languages such as those with a symmetrical voice-marking system provides insight on the language universal and language-specific aspects of acquisition. Our results show that it takes time to acquire the complex voice-marking system and word order flexibility of Tagalog. Tagalog-speaking children do not map the agent to the subject by the default, and they gradually acquire an agent-initial preference. Lastly, we provide evidence for priming of thematic role order, separate from syntactic order.

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No potential conflict of interest was reported by the authors.

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References

- Aldridge, E. (2004). *Ergativity and verb-initial word order in Austronesian languages* [Unpublished doctoral dissertation]. Cornell University.
- Allen, S. E. M., & Crago, M. B. (1996). Early passive acquisition in Inuktitut. *Journal of Child Language*, 23(1), 129–155. <https://doi.org/10.1017/S0305000900010126>
- Ambridge, B., Kidd, E., Rowland, C. F., & Theakston, A. L. (2015). The ubiquity of frequency effects in first language acquisition. *Journal of Child Language*, 42(2), 239–273. <https://doi.org/10.1017/S030500091400049X>
- Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, 67(1), 1–48. <https://doi.org/10.18637/jss.v067.i01>
- Bates, E., & MacWhinney, B. (1989). Functionalism and the competition model. In B. MacWhinney & E. Bates (Eds.), *The cross-linguistic study of sentence processing* (pp. 3–73). Cambridge University Press.
- Bautista, M. L. S. (1983). Word order in Tagalog child language. *Philippine Journal of Linguistics*, 14(1), 25–44
- Bencini, G. M. L., & Valian, V. V. (2008). Abstract sentence representations in 3-year-olds: Evidence from language production and comprehension. *Journal of Memory and Language*, 59(1), 97–113. <https://doi.org/10.1016/j.jml.2007.12.007>
- Bever, T. G. (1970). The cognitive basis for linguistic structures. In R. Hayes (Ed.), *Cognition and language development* (pp. 279–362). Wiley & Sons, Inc.
- Billings, L. (2005). Ordering clitics and postverbal R-expressions in Tagalog: A unified analysis? In A. Carnie, H. Harley, & S. A. Dooley (Eds.), *Verb first: On the syntax of verb initial languages* (pp. 303–339). John Benjamins.
- Bock, K. (1989). Closed-class immanence in sentence production. *Cognition*, 31(2), 163–186. [https://doi.org/10.1016/0010-0277\(89\)90022-X](https://doi.org/10.1016/0010-0277(89)90022-X)
- Bock, K., & Loebell, H. (1990). Framing sentences. *Cognition*, 35(1), 1–39. [https://doi.org/10.1016/0010-0277\(90\)90035-I](https://doi.org/10.1016/0010-0277(90)90035-I)
- Bondoc, I. P., O'Grady, W., Deen, K., & Tanaka, N. (2018). Agrammatism in Tagalog: Voice and relativisation. *Aphasiology*, 32(5), 598–617. <https://doi.org/10.1177/0142723719859090>
- Branigan, H. P., McLean, J. F., & Jones, M. (2005). A Blue cat or a cat that is blue? Evidence for abstract syntax in young children's noun phrases. In A. Brugos, M. Clark-Cotton, & S. Ha (Eds.), *The Proceedings of the Twenty-Ninth Boston University Conference on Language Development* (pp. 109–121). Cascadilla Press.
- Branigan, H. P., & Messenger, K. (2016). Consistent and cumulative effects of syntactic experience in children's sentence production: Evidence for error-based implicit learning. *Cognition*, 157, 250–256. <https://doi.org/10.1016/j.cognition.2016.09.004>
- Branigan, H. P., & Pickering, M. J. (2017). An experimental approach to linguistic representation. *Behavioral and Brain Sciences*, 40, 1–61. <https://doi.org/10.1017/S0140525X16002028>
- Cai, Z. G., Pickering, M. J., & Branigan, H. P. (2012). Mapping concepts to syntax: Evidence from structural priming in Mandarin Chinese. *Journal of Memory and Language*, 66(4), 833–849. <https://doi.org/10.1016/j.jml.2012.03.009>
- Carrier-Duncan, J. (1985). Linking of thematic roles in derivational word formation. *Linguistic Inquiry*, 16(1), 1–34.
- Chang, F., Bock, K., & Goldberg, A. E. (2003). Can thematic roles leave traces of their places? *Cognition*, 90(1), 29–49. [https://doi.org/10.1016/S0010-0277\(03\)00123-9](https://doi.org/10.1016/S0010-0277(03)00123-9)
- Chang, F., Dell, G. S., & Bock, K. (2006). Becoming syntactic. *Psychological Review*, 113(2), 234–272. <https://doi.org/10.1037/0033-295X.113.2.234>
- Cohn, N., & Paczynski, M. (2013). Prediction, events, and the advantage of Agents: The processing of semantic roles in visual narrative. *Cognitive Psychology*, 67(3), 73–97. <https://doi.org/10.1016/j.cogpsych.2013.07.002>
- Cooreman, A., Fox, B., & Givón, T. (1984). The discourse definition of ergativity. *Studies in Language*, 8(1), 1–34. <https://doi.org/10.1075/sl.8.1.02coo>
- Dell, G. S., & Chang, F. (2014). The P-chain: Relating sentence production and its disorders to comprehension and acquisition. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 369(1634), 20120394. <https://doi.org/10.1098/rstb.2012.0394>
- Demuth, K. (1989). Maturation and the acquisition of the Sesotho passive. *Linguistic Society of America*, 65(1), 56–80. <https://doi.org/10.2307/414842>
- Dryer, M. S., & Haspelmath, M. (2013). *The World Atlas of language structures Online*. Max Planck Institute for Evolutionary Anthropology. Retrieved October 4, 2019, from <http://wals.info>
- Dunn, L. M., & Dunn, D. M. (2007). *PPVT-4: Peabody picture vocabulary test*. Pearson Assessments.
- Evans, N., & Levinson, S. C. (2009). The myth of language universals: Language diversity and its importance for cognitive science. *Behavioral and Brain Sciences*, 32(5), 429–448. <https://doi.org/10.1017/S0140525X0999094X>
- Ferreira, V. S. (2003). The persistence of optional complementizer production: Why saying “that” is not saying “that” at all. *Journal of Memory and Language*, 48(2), 379–398. [https://doi.org/10.1016/S0749-596X\(02\)00523-5](https://doi.org/10.1016/S0749-596X(02)00523-5)
- Foley, W. (2008). The place of Philippine languages in a typology of voice systems. In P. K. Austin & S. Musgrave (Eds.), *Voice and grammatical relations in Austronesian languages* (pp. 22–44). CSLI Publications.
- Galang, R. G. (1982). Acquisition of Tagalog verb morphology: Linguistic and cognitive factors. *Philippine Journal of Linguistics*, 13(2), 1–15.

- Gamez, P. B., & Vasilyeva, M. (2015). Exploring interactions between semantic and syntactic processes: The role of animacy in syntactic priming. *Journal of Experimental Child Psychology*, 138, 15–30. <https://doi.org/10.1016/j.jecp.2015.04.009>
- Garcia, R., Dery, J. E., Roeser, J., & Höhle, B. (2018). Word order preferences of Tagalog-speaking adults and children. *First Language*, 38(6), 617–640. <https://doi.org/10.1177/0142723718790317>
- Garcia, R., Roeser, J., & Höhle, B. (2019). Thematic role assignment in the L1 acquisition of Tagalog: Use of word order and morphosyntactic markers. *Language Acquisition*, 26(3), 235–261. <https://doi.org/10.1080/10489223.2018.1525613>
- Gil, D. (2006). The acquisition of verbs and their grammar: The effect of particular languages. In N. Gagarina & I. Glzow (Eds.), *The acquisition of voice morphology in Jakarta Indonesian* (pp. 201–227). Springer.
- Guilfoyle, E., Hung, H., & Travis, L. (1992). SPEC of IP and SPEC of VP: Two subjects in Austronesian languages. *Natural Language & Linguistic Theory*, 10(3), 375–414. <https://doi.org/10.1007/BF00133368>
- Hartsuiker, R. J., & Kolk, H. H. (1998). Syntactic facilitation in agrammatic sentence production. *Brain and Language*, 62(2), 221–254. <https://doi.org/10.1006/brln.1997.1905>
- Himmelman, N. P. (2005). Tagalog. In A. Adelaar & N. P. Himmelman (Eds.), *The Austronesian languages of Asia and Madagascar* (pp. 350–376). Routledge.
- Hsieh, H. (2016). Prosodic indicators of phrase structure in Tagalog transitive sentences. In H. Nomoto, T. Miyauchi, & A. Shiohara (Eds.), *AFLA 23: The Proceedings of the 23rd meeting of the Austronesian Formal Linguistics Association* (pp. 111–122). A.C.T. Asia-Pacific Linguistics.
- Huttenlocher, J., Vasilyeva, M., & Shimpi, P. (2004). Syntactic priming in young children. *Journal of Memory and Language*, 50(2), 182–195. <https://doi.org/10.1016/j.jml.2003.09.003>
- Jackendoff, R., & Wittenberg, E. (2014). What you can say without syntax: A hierarchy of grammatical complexity. In F. Newmeyer & L. Preston (Eds.), *Measuring linguistic complexity* (pp. 65–82). Oxford University Press.
- Kelly, B. F., Kidd, E., & Wigglesworth, G. (2015). Indigenous children's language: Acquisition, preservation and evolution of language in minority contexts. *First Language*, 35(4–5), 279–285. <https://doi.org/10.1177/0142723715618056>
- Kemmerer, D. (2012). The cross-linguistic prevalence of SOV and SVO word orders reflects the sequential and hierarchical representation of action in Broca's area. *Linguistics and Language Compass*, 6(1), 50–66. <https://doi.org/10.1002/lnc3.322>
- Kidd, E. (2012). Individual differences in syntactic priming in language acquisition. *Applied Psycholinguistics*, 33(2), 393–418. <https://doi.org/10.1017/S0142716411000415>
- Kidd, E., Chan, A., & Chiu, J. (2015). Cross-linguistic influence in simultaneous Cantonese–English bilingual children's comprehension of relative clauses. *Bilingualism: Language and Cognition*, 18(3), 438–452. <https://doi.org/10.1017/S1366728914000649>
- Kidd, E., & Kirjavainen, M. (2011). Investigating the contribution of procedural and declarative memory to the acquisition of past tense morphology: Evidence from Finnish. *Language and Cognitive Processes*, 26(4–6), 794–829. <https://doi.org/10.1080/01690965.2010.493735>
- Kidd, E., Tennant, E., & Nitschke, S. (2015). Shared abstract representation of linguistic structure in bilingual sentence comprehension. *Psychonomic Bulletin & Review*, 22(4), 1062–1067. <https://doi.org/10.3758/s13423-014-0775-2>
- Kline, M., & Demuth, K. (2010). Factors facilitating implicit learning: The case of the Sesotho passive. *Language Acquisition*, 17(4), 220–234. <https://doi.org/10.1080/10489223.2010.509268>
- Köhne, J., Pickering, M. J., & Branigan, H. P. (2014). The relationship between sentence meaning and word order: Evidence from structural priming in German. *The Quarterly Journal of Experimental Psychology*, 67(2), 304–318. <https://doi.org/10.1080/17470218.2013.807855>
- Kroeger, P. R. (1993). *Phrase structure and grammatical relations in Tagalog*. CSLI Publications.
- Leonard, L. B., Miller, C. A., Grela, B., Holland, A. L., Gerber, E., & Petucci, M. (2000). Production operations contribute to the grammatical morpheme limitations of children with specific language impairment. *Journal of Memory and Language*, 43(2), 362–378. <https://doi.org/10.1006/jmla.1999.2689>
- Lieven, E. (2010). Input and first language acquisition: Evaluating the role of frequency. *Lingua*, 120(11), 2546–2556. <https://doi.org/10.1016/j.lingua.2010.06.005>
- Marzan, J. C. (2013). *Spoken language patterns of selected Filipino toddlers and pre-school Children* [Unpublished doctoral dissertation]. University of the Philippines.
- Messenger, K., Branigan, H. P., McLean, J. F., & Sorace, A. (2012). Is young children's passive syntax semantically constrained? Evidence from syntactic priming. *Journal of Memory and Language*, 66(4), 568–587. <https://doi.org/10.1016/j.jml.2012.03.008>
- Pappert, S., & Pechmann, T. (2014). Priming word order by thematic roles: No evidence for an additional involvement of phrase structure. *The Quarterly Journal of Experimental Psychology*, 67(11), 2260–2278. <https://doi.org/10.1080/17470218.2014.918632>
- Pickering, M. J., & Ferreira, V. S. (2008). Structural priming: A critical review. *Psychological Bulletin*, 134(3), 427–459. <https://doi.org/10.1037/0033-2909.134.3.427>
- Pinker, S. (1984). *Language learnability and language development*. Harvard University Press.

- R Development Core Team. (2016). *R: A language and environment for statistical computing* (Version 3.6.1). R Foundation for Statistical Computing. <http://www.R-project.org/>
- Rackowski, A., & Richards, N. (2005). Phase edge and extraction: A Tagalog case study. *Linguistic Inquiry*, 36(4), 565–599. <https://doi.org/10.1162/002438905774464368>
- Reid, L. A., & Liao, H.-C. (2004). A brief syntactic typology of Philippine languages. *Language and Linguistics*, 5(2), 433–490.
- Riesberg, S. (2014). *Symmetrical voice and linking in Western Austronesian languages (Pacific linguistics 646)*. De Gruyter Mouton.
- Riesberg, S., Malcher, K., & Himmelmann, N. P. (2019). How universal is agent-first? Evidence from symmetrical voice languages. *Language*, 95(3), 523–561. <https://doi.org/10.1353/lan.2019.0055>
- Saclot, M. J. (2011). *Event Structure in Tagalog* [Unpublished doctoral dissertation]. The University of Melbourne.
- Salamoura, A., & Williams, J. N. (2007). Processing verb argument structure across languages: Evidence for shared representations in the bilingual lexicon. *Applied Psycholinguistics*, 28(4), 627–660. <https://doi.org/10.1017/S0142716407070348>
- Sauppe, S., Norcliffe, E., Konopka, A. E., Van Valin, R. D., Jr., & Levinson, S. C. (2013). Dependencies first: Eye tracking evidence from sentence production in Tagalog. In *Proceedings of the 35th annual meeting of the Cognitive Science Society (CogSci 2013)*. Cognitive Science Society.
- Savage, C., Lieven, E., Theakston, A., & Tomasello, M. (2003). Testing the abstractness of children's linguistic representations: Lexical and structural priming of syntactic constructions in young children. *Developmental Science*, 6(5), 557–567. <https://doi.org/10.1111/1467-7687.00312>
- Savage, C., Lieven, E., Theakston, A., & Tomasello, M. (2006). Structural priming as implicit learning in language acquisition: The persistence of lexical and structural priming in 4-year-olds. *Language Learning and Development*, 2(1), 27–49. https://doi.org/10.1207/s15473341l1d0201_2
- Schachter, P. (2015). Tagalog. In T. Kiss & A. Alexiadou (Eds.), *Syntax theory and analysis: An international handbook (Handbooks of linguistics and communication science (Vol. 42/3, pp. 1658–1676)*. Mouton de Gruyter.
- Schachter, P., & Otones, F. T. (1972). *Tagalog reference grammar*. University of California Press.
- Segalowitz, N. S., & Galang, R. G. (1978). Agent-patient word-order preference in the acquisition of Tagalog. *Journal of Child Language*, 5(1), 47–64. <https://doi.org/10.1017/S0305000900001938>
- Shimpi, P. M., Gamez, P. B., Huttenlocher, J., & Vasilyeva, M. (2007). Syntactic priming in 3- and 4-year-old children: Evidence for abstract representations of transitive and dative forms. *Developmental Psychology*, 43(6), 1334–1346. <https://doi.org/10.1037/0012-1649.43.6.1334>
- Slobin, D. I. (1985). *The crosslinguistic study of language acquisition: Vol. 1. The data*. Lawrence Erlbaum Associates.
- Slobin, D. I., & Bever, T. G. (1982). Children use canonical sentence schemas: A crosslinguistic study of word order and inflections. *Cognition*, 12(3), 229–265. [https://doi.org/10.1016/0010-0277\(82\)90033-6](https://doi.org/10.1016/0010-0277(82)90033-6)
- Stoll, S. (2009). Crosslinguistic approaches to language acquisition. In E. L. Bavin (Ed.), *The Cambridge handbook of child language* (pp. 89–104). Cambridge University Press.
- Tanaka, N., O'Grady, W., Deen, K., Kim, C.-E., Hattori, R., Bondoc, I. P. M., & Soriano, J. U. (2015). Split focus preferences in Tagalog: Evidence from child language. In A. Camp, Y. Otsuka, C. Stabile, & N. Tanaka (Eds.), *AFLA 21: The Proceedings of the 21st annual meeting of the Austronesian Formal Linguistics Association* (pp. 279–288). Asia-Pacific Linguistics.
- Tanaka, N. (2016). *An asymmetry in the acquisition of Tagalog relative clauses* [Unpublished doctoral dissertation]. University of Hawaii at Manoa.
- Thatcher, K., Branigan, H. P., McLean, J. F., & Sorace, A. (2008). Children's early acquisition of the passive: Evidence from syntactic priming. In *Proceedings of the Child Language Seminar 2007* (pp. 195–205). University of Reading.
- Van Valin, R. D., Jr. (2001). *An Introduction to Syntax*. Cambridge University Press.
- Vasilyeva, M., & Waterfall, H. (2012). Beyond syntactic priming: Evidence for activation of alternative syntactic structures. *Journal of Child Language*, 39(2), 258–283. <https://doi.org/10.1017/S0305000911000055>
- Vernice, M., Pickering, M. J., & Hartsuiker, R. J. (2012). Thematic emphasis in language production. *Language and Cognitive Processes*, 27(5), 631–664. <https://doi.org/10.1080/01690965.2011.572468>
- Ziegler, J., Bencini, G., Goldberg, A., & Snedeker, J. (2019). How abstract is syntax? Evidence from structural priming. *Cognition*, 193, 104045. <https://doi.org/10.1016/j.cognition.2019.104045>
- Ziegler, J., & Snedeker, J. (2018). How broad are thematic roles? Evidence from structural priming. *Cognition*, 179, 221–240. <https://doi.org/10.1016/j.cognition.2018.06.019>

Appendices

Appendix A

The complete list of experimental items in Experiment 1 can be found on Table 7. The experimental items in Experiment 2 are listed on Table 8.

Table 7. The complete list of experimental items in Experiment 1. All of the verbs in the prime sentences were in the agent voice. AI refers to agent-initial, PI to patient-initial, AV to agent voice, and PV to patient voice.

Item	Prime condition	Target condition	Prime sentence	Prime sentence translation	Target prompt	Target picture
1	AI	AV	Humihila ang baka ng baboy.	The cow is pulling a pig.	Kumakagat	The mouse is biting a dog.
2	AI	PV	Humihila ang baka ng baboy.	The cow is pulling a pig.	Kinakagat	The mouse is biting a dog.
3	PI	AV	Humihila ng baboy ang baka.	The cow is pulling a pig.	Kumakagat	The mouse is biting a dog.
4	PI	PV	Humihila ng baboy ang baka.	The cow is pulling a pig.	Kinakagat	The mouse is biting a dog.
5	AI	AV	Humihila ang aso ng daga.	The dog is pulling a mouse.	Bumabariil	The pig is shooting a cow.
6	AI	PV	Humihila ang aso ng daga.	The dog is pulling a mouse.	Binabariil	The pig is shooting a cow.
7	PI	AV	Humihila ng daga ang aso.	The dog is pulling a mouse.	Bumabariil	The pig is shooting a cow.
8	PI	PV	Humihila ng daga ang aso.	The dog is pulling a mouse.	Binabariil	The pig is shooting a cow.
9	AI	AV	Sumisipa ang unggoy ng aso.	The monkey is kicking a dog.	Humahabol	The cow is chasing a turtle.
10	AI	PV	Sumisipa ang unggoy ng aso.	The monkey is kicking a dog.	Hinahabol	The cow is chasing a turtle.
11	PI	AV	Sumisipa ng aso ang unggoy.	The monkey is kicking a dog.	Humahabol	The cow is chasing a turtle.
12	PI	PV	Sumisipa ng aso ang unggoy.	The monkey is kicking a dog.	Hinahabol	The cow is chasing a turtle.
13	AI	AV	Sumisipa ang pagong ng baka.	The turtle is kicking a cow.	Tumutulak	The dog is pushing a monkey.
14	AI	PV	Sumisipa ang pagong ng baka.	The turtle is kicking a cow.	Tinutulak	The dog is pushing a monkey.
15	PI	AV	Sumisipa ng baka ang pagong.	The turtle is kicking a cow.	Tumutulak	The dog is pushing a monkey.
16	PI	PV	Sumisipa ng baka ang pagong.	The turtle is kicking a cow.	Tinutulak	The dog is pushing a monkey.
17	AI	AV	Humuhuli ang daga ng manok.	The mouse is catching a chicken.	Tumutulak	The cat is pushing a pig.
18	AI	PV	Humuhuli ang daga ng manok.	The mouse is catching a chicken.	Tinutulak	The cat is pushing a pig.
19	PI	AV	Humuhuli ng manok ang daga.	The mouse is catching a chicken.	Tumutulak	The cat is pushing a pig.
20	PI	PV	Humuhuli ng manok ang daga.	The mouse is catching a chicken.	Tinutulak	The cat is pushing a pig.
21	AI	AV	Humuhuli ang baboy ng pusa.	The pig is catching a cat.	Humahabol	The chicken is chasing a mouse.
22	AI	PV	Humuhuli ang baboy ng pusa.	The pig is catching a cat.	Hinahabol	The chicken is chasing a mouse.
23	PI	AV	Humuhuli ng pusa ang baboy.	The pig is catching a cat.	Humahabol	The chicken is chasing a mouse.
24	PI	PV	Humuhuli ng pusa ang baboy.	The pig is catching a cat.	Hinahabol	The chicken is chasing a mouse.
25	AI	AV	Pumapalo ang pusa ng pagong.	The cat is hitting a turtle.	Bumabariil	The monkey is shooting a chicken.
26	AI	PV	Pumapalo ang pusa ng pagong.	The cat is hitting a turtle.	Binabariil	The monkey is shooting a chicken.

(Continued)

Table 7. (Continued).

Item	Prime condition	Target condition	Prime sentence	Prime sentence translation	Target prompt	Target picture
27	PI	AV	Pumapalo ng pagong ang pusa.	The cat is hitting a turtle.	Bumabariil	The monkey is shooting a chicken.
28	PI	PV	Pumapalo ng pagong ang pusa.	The cat is hitting a turtle.	Binabariil	The monkey is shooting a chicken.
29	AI	AV	Pumapalo ang manok ng unggoy.	The chicken is hitting a monkey.	Kumakagat	The turtle is biting a cat.
30	AI	PV	Pumapalo ang manok ng unggoy.	The chicken is hitting a monkey.	Kinakagat	The turtle is biting a cat.
31	PI	AV	Pumapalo ng unggoy ang manok.	The chicken is hitting a monkey.	Kumakagat	The turtle is biting a cat.
32	PI	PV	Pumapalo ng unggoy ang manok.	The chicken is hitting a monkey.	Kinakagat	The turtle is biting a cat.
33	AI	AV	Tumutulak ang pagong ng manok.	The turtle is pushing a chicken.	Humihila	The cat is pulling a monkey.
34	AI	PV	Tumutulak ang pagong ng manok.	The turtle is pushing a chicken.	Hinihila	The cat is pulling a monkey.
35	PI	AV	Tumutulak ng manok ang pagong.	The turtle is pushing a chicken.	Humihila	The cat is pulling a monkey.
36	PI	PV	Tumutulak ng manok ang pagong.	The turtle is pushing a chicken.	Hinihila	The cat is pulling a monkey.
37	AI	AV	Tumutulak ang daga ng baka.	The mouse is pushing a cow.	Pumapalo	The dog is hitting a pig.
38	AI	PV	Tumutulak ang daga ng baka.	The mouse is pushing a cow.	Pinapalo	The dog is hitting a pig.
39	PI	AV	Tumutulak ng baka ang daga.	The mouse is pushing a cow.	Pumapalo	The dog is hitting a pig.
40	PI	PV	Tumutulak ng baka ang daga.	The mouse is pushing a cow.	Pinapalo	The dog is hitting a pig.
41	AI	AV	Bumabariil ang pusa ng daga.	The cat is shooting a mouse.	Sumisipa	The pig is kicking a chicken.
42	AI	PV	Bumabariil ang pusa ng daga.	The cat is shooting a mouse.	Sinisipa	The pig is kicking a chicken.
43	PI	AV	Bumabariil ng daga ang pusa.	The cat is shooting a mouse.	Sumisipa	The pig is kicking a chicken.
44	PI	PV	Bumabariil ng daga ang pusa.	The cat is shooting a mouse.	Sinisipa	The pig is kicking a chicken.
45	AI	AV	Bumabariil ang aso ng pagong.	The dog is shooting a turtle.	Humuhuli	The monkey is catching a cow.
46	AI	PV	Bumabariil ang aso ng pagong.	The dog is shooting a turtle.	Hinuhuli	The monkey is catching a cow.
47	PI	AV	Bumabariil ng pagong ang aso.	The dog is shooting a turtle.	Humuhuli	The monkey is catching a cow.
48	PI	PV	Bumabariil ng pagong ang aso.	The dog is shooting a turtle.	Hinuhuli	The monkey is catching a cow.
49	AI	AV	Kumakagat ang baka ng unggoy.	The cow is biting a monkey.	Humuhuli	The turtle is catching a dog.
50	AI	PV	Kumakagat ang baka ng unggoy.	The cow is biting a monkey.	Hinuhuli	The turtle is catching a dog.
51	PI	AV	Kumakagat ng unggoy ang baka.	The cow is biting a monkey.	Humuhuli	The turtle is catching a dog.
52	PI	PV	Kumakagat ng unggoy ang baka.	The cow is biting a monkey.	Hinuhuli	The turtle is catching a dog.
53	AI	AV	Kumakagat ang manok ng baboy.	The chicken is biting a pig.	Sumisipa	The mouse is kicking a cat.
54	AI	PV	Kumakagat ang manok ng baboy.	The chicken is biting a pig.	Sinisipa	The mouse is kicking a cat.
55	PI	AV	Kumakagat ng baboy ang manok.	The chicken is biting a pig.	Sumisipa	The mouse is kicking a cat.
56	PI	PV	Kumakagat ng baboy ang manok.	The chicken is biting a pig.	Sinisipa	The mouse is kicking a cat.
57	AI	AV	Humahabol ang baboy ng aso.	The pig is chasing a dog.	Pumapalo	The cow is hitting a mouse

(Continued)

Table 7. (Continued).

Item	Prime condition	Target condition	Prime sentence	Prime sentence translation	Target prompt	Target picture
58	AI	PV	Humahabol ang baboy ng aso.	The pig is chasing a dog.	Pinapalo	The cow is hitting a mouse
59	PI	AV	Humahabol ng aso ang baboy.	The pig is chasing a dog.	Pumapalo	The cow is hitting a mouse
60	PI	PV	Humahabol ng aso ang baboy.	The pig is chasing a dog.	Pinapalo	The cow is hitting a mouse
61	AI	AV	Humahabol ang unggoy ng pusa.	The monkey is chasing a cat.	Humihila	The chicken is pulling a turtle.
62	AI	PV	Humahabol ang unggoy ng pusa.	The monkey is chasing a cat.	Hinihila	The chicken is pulling a turtle.
63	PI	AV	Humahabol ng pusa ang unggoy.	The monkey is chasing a cat.	Humihila	The chicken is pulling a turtle.
64	PI	PV	Humahabol ng pusa ang unggoy.	The monkey is chasing a cat.	Hinihila	The chicken is pulling a turtle.

Table 8. The complete list of experimental items in Experiment 2. All of the verbs in the prime sentences were in the patient voice. AI refers to agent-initial, PI to patient-initial, AV to agent voice, and PV to patient voice.

Item	Prime condition	Target condition	Prime sentence	Prime sentence translation	Target prompt	Target picture
1	AI	AV	Hinihila ng baka ang baboy.	The cow is pulling a pig.	Kumakagat	The mouse is biting a dog.
2	AI	PV	Hinihila ng baka ang baboy.	The cow is pulling a pig.	Kinakagat	The mouse is biting a dog.
3	PI	AV	Hinihila ang baboy ng baka.	The cow is pulling a pig.	Kumakagat	The mouse is biting a dog.
4	PI	PV	Hinihila ang baboy ng baka.	The cow is pulling a pig.	Kinakagat	The mouse is biting a dog.
5	AI	AV	Hinihila ng aso ang daga.	The dog is pulling a mouse.	Bumabaryl	The pig is shooting a cow.
6	AI	PV	Hinihila ng aso ang daga.	The dog is pulling a mouse.	Binabaryl	The pig is shooting a cow.
7	PI	AV	Hinihila ang daga ng aso.	The dog is pulling a mouse.	Bumabaryl	The pig is shooting a cow.
8	PI	PV	Hinihila ang daga ng aso.	The dog is pulling a mouse.	Binabaryl	The pig is shooting a cow.
9	AI	AV	Sinisipa ng unggoy ang aso.	The monkey is kicking a dog.	Humahabol	The cow is chasing a turtle.
10	AI	PV	Sinisipa ng unggoy ang aso.	The monkey is kicking a dog.	Hinahabol	The cow is chasing a turtle.
11	PI	AV	Sinisipa ang aso ng unggoy.	The monkey is kicking a dog.	Humahabol	The cow is chasing a turtle.
12	PI	PV	Sinisipa ang aso ng unggoy.	The monkey is kicking a dog.	Hinahabol	The cow is chasing a turtle.
13	AI	AV	Sinisipa ng pagong ang baka.	The turtle is kicking a cow.	Tumutulak	The dog is pushing a monkey.
14	AI	PV	Sinisipa ng pagong ang baka.	The turtle is kicking a cow.	Tinutulak	The dog is pushing a monkey.
15	PI	AV	Sinisipa ang baka ng pagong.	The turtle is kicking a cow.	Tumutulak	The dog is pushing a monkey.
16	PI	PV	Sinisipa ang baka ng pagong.	The turtle is kicking a cow.	Tinutulak	The dog is pushing a monkey.
17	AI	AV	Hinuhuli ng daga ang manok.	The mouse is catching a chicken.	Tumutulak	The cat is pushing a pig.
18	AI	PV	Hinuhuli ng daga ang manok.	The mouse is catching a chicken.	Tinutulak	The cat is pushing a pig.
19	PI	AV	Hinuhuli ang manok ng daga.	The mouse is catching a chicken.	Tumutulak	The cat is pushing a pig.
20	PI	PV	Hinuhuli ang manok ng daga.	The mouse is catching a chicken.	Tinutulak	The cat is pushing a pig.

(Continued)

Table 8. (Continued).

Item	Prime condition	Target condition	Prime sentence	Prime sentence translation	Target prompt	Target picture
21	AI	AV	Hinuhuli ng baboy ang pusa.	The pig is catching a cat.	Humahabol	The chicken is chasing a mouse.
22	AI	PV	Hinuhuli ng baboy ang pusa.	The pig is catching a cat.	Hinahabol	The chicken is chasing a mouse.
23	PI	AV	Hinuhuli ang pusa ng baboy.	The pig is catching a cat.	Humahabol	The chicken is chasing a mouse.
24	PI	PV	Hinuhuli ang pusa ng baboy.	The pig is catching a cat.	Hinahabol	The chicken is chasing a mouse.
25	AI	AV	Pinapalo ng pusa ang pagong.	The cat is hitting a turtle.	Bumabaryl	The monkey is shooting a chicken.
26	AI	PV	Pinapalo ng pusa ang pagong.	The cat is hitting a turtle.	Binabaryl	The monkey is shooting a chicken.
27	PI	AV	Pinapalo ang pagong ng pusa.	The cat is hitting a turtle.	Bumabaryl	The monkey is shooting a chicken.
28	PI	PV	Pinapalo ang pagong ng pusa.	The cat is hitting a turtle.	Binabaryl	The monkey is shooting a chicken.
29	AI	AV	Pinapalo ng manok ang unggoy.	The chicken is hitting a monkey.	Kumakagat	The turtle is biting a cat.
30	AI	PV	Pinapalo ng manok ang unggoy.	The chicken is hitting a monkey.	Kinakagat	The turtle is biting a cat.
31	PI	AV	Pinapalo ang unggoy ng manok.	The chicken is hitting a monkey.	Kumakagat	The turtle is biting a cat.
32	PI	PV	Pinapalo ang unggoy ng manok.	The chicken is hitting a monkey.	Kinakagat	The turtle is biting a cat.
33	AI	AV	Tinutulak ng pagong ang manok.	The turtle is pushing a chicken.	Humihila	The cat is pulling a monkey.
34	AI	PV	Tinutulak ng pagong ang manok.	The turtle is pushing a chicken.	Hinihila	The cat is pulling a monkey.
35	PI	AV	Tinutulak ang manok ng pagong.	The turtle is pushing a chicken.	Humihila	The cat is pulling a monkey.
36	PI	PV	Tinutulak ang manok ng pagong.	The turtle is pushing a chicken.	Hinihila	The cat is pulling a monkey.
37	AI	AV	Tinutulak ng daga ang baka.	The mouse is pushing a cow.	Pumapalo	The dog is hitting a pig.
38	AI	PV	Tinutulak ng daga ang baka.	The mouse is pushing a cow.	Pinapalo	The dog is hitting a pig.
39	PI	AV	Tinutulak ang baka ng daga.	The mouse is pushing a cow.	Pumapalo	The dog is hitting a pig.
40	PI	PV	Tinutulak ang baka ng daga.	The mouse is pushing a cow.	Pinapalo	The dog is hitting a pig.
41	AI	AV	Binabaryl ng pusa ang daga.	The cat is shooting a mouse.	Sumisipa	The pig is kicking a chicken.
42	AI	PV	Binabaryl ng pusa ang daga.	The cat is shooting a mouse.	Sinisipa	The pig is kicking a chicken.
43	PI	AV	Binabaryl ang daga ng pusa.	The cat is shooting a mouse.	Sumisipa	The pig is kicking a chicken.
44	PI	PV	Binabaryl ang daga ng pusa.	The cat is shooting a mouse.	Sinisipa	The pig is kicking a chicken.
45	AI	AV	Binabaryl ng aso ang pagong.	The dog is shooting a turtle.	Humuhuli	The monkey is catching a cow.
46	AI	PV	Binabaryl ng aso ang pagong.	The dog is shooting a turtle.	Hinuhuli	The monkey is catching a cow.
47	PI	AV	Binabaryl ang pagong ng aso.	The dog is shooting a turtle.	Humuhuli	The monkey is catching a cow.
48	PI	PV	Binabaryl ang pagong ng aso.	The dog is shooting a turtle.	Hinuhuli	The monkey is catching a cow.
49	AI	AV	Kinakagat ng baka ang unggoy.	The cow is biting a monkey.	Humuhuli	The turtle is catching a dog.
50	AI	PV	Kinakagat ng baka ang unggoy.	The cow is biting a monkey.	Hinuhuli	The turtle is catching a dog.
51	PI	AV	Kinakagat ang unggoy ng baka.	The cow is biting a monkey.	Humuhuli	The turtle is catching a dog.
52	PI	PV	Kinakagat ang unggoy ng baka.	The cow is biting a monkey.	Hinuhuli	The turtle is catching a dog.

(Continued)

Table 8. (Continued).

Item	Prime condition	Target condition	Prime sentence	Prime sentence translation	Target prompt	Target picture
53	AI	AV	Kinakagat ng manok ang baboy.	The chicken is biting a pig.	Sumisipa	The mouse is kicking a cat.
54	AI	PV	Kinakagat ng manok ang baboy.	The chicken is biting a pig.	Sinisipa	The mouse is kicking a cat.
55	PI	AV	Kinakagat ang baboy ng manok.	The chicken is biting a pig.	Sumisipa	The mouse is kicking a cat.
56	PI	PV	Kinakagat ang baboy ng manok.	The chicken is biting a pig.	Sinisipa	The mouse is kicking a cat.
57	AI	AV	Hinahabol ng baboy ang aso.	The pig is chasing a dog.	Pumapalo	The cow is hitting a mouse
58	AI	PV	Hinahabol ng baboy ang aso.	The pig is chasing a dog.	Pinapalo	The cow is hitting a mouse
59	PI	AV	Hinahabol ang aso ng baboy.	The pig is chasing a dog.	Pumapalo	The cow is hitting a mouse
60	PI	PV	Hinahabol ang aso ng baboy.	The pig is chasing a dog.	Pinapalo	The cow is hitting a mouse
61	AI	AV	Hinahabol ng unggoy ang pusa.	The monkey is chasing a cat.	Humihila	The chicken is pulling a turtle.
62	AI	PV	Hinahabol ng unggoy ang pusa.	The monkey is chasing a cat.	Hinihila	The chicken is pulling a turtle.
63	PI	AV	Hinahabol ang pusa ng unggoy.	The monkey is chasing a cat.	Humihila	The chicken is pulling a turtle.
64	PI	PV	Hinahabol ang pusa ng unggoy.	The monkey is chasing a cat.	Hinihila	The chicken is pulling a turtle.

Appendix B

The summary of the fixed effects of age, thematic role order in the prime, voice-marking of the verb prompt and their interactions, on the frequency of children's patient-initial productions in Experiment 1 after excluding single arguments and compound arguments (using *at* "and" between the nouns) can be found on Table 9. The summary for Experiment 2 can be found on Table 10.

Table 9. Summary of the fixed effects of age, thematic role order in the prime, voice-marking of the verb prompt and their interactions, on the frequency of children's patient-initial productions in Experiment 1 after excluding single arguments and compound arguments (using *at* "and" between the nouns).

Predictor	Estimate	SE	z value	p value
Intercept	-1.20	.22	-5.51	<.001
Age (3:5)	1.25	.36	3.44	<.001
Age (5:7)	1.09	.38	2.87	.004
Thematic role order in the prime (TRO)	-0.16	.08	-2.01	.04
Voice-marking of the verb prompt (VM)	0.12	.08	1.51	.13
Age(3:5)*TRO	0.05	.18	0.28	.78
Age(5:7)*TRO	-0.25	.20	-1.26	.21
Age(3:5)*VM	0.24	.18	1.34	.18
Age(5:7)*VM	-1.34	.20	-6.57	<.001
TRO*VM	0.01	.08	0.19	.85
Age(3:5)*TRO*VM	-0.28	.18	-1.57	.12
Age(5:7)*TRO*VM	-0.03	.20	-0.14	.89

Table 10. Summary of the fixed effects of age, thematic role order in the prime, voice-marking of the verb prompt and their interactions, on the frequency of children's patient-initial productions in Experiment 2 after excluding single arguments and compound arguments (using *at* "and" between the nouns).

Predictor	Estimate	SE	z value	p value
Intercept	-1.49	.22	-6.91	<.001
Age (3:5)	1.49	.39	3.77	<.001
Age (5:7)	1.36	.42	3.28	.001
Thematic role order in the prime (TRO)	-0.04	.09	-0.43	.67
Voice-marking of the verb prompt (VM)	-0.04	.09	-0.49	.63
Age(3:5)*TRO	0.23	.20	1.18	.24
Age(5:7)*TRO	0.28	.22	1.29	.20
Age(3:5)*VM	-0.16	.20	-0.81	.42
Age(5:7)*VM	-0.74	.22	-3.40	<.001
TRO*VM	0.03	.09	0.33	.74
Age(3:5)*TRO*VM	0.09	.20	0.47	.64
Age(5:7)*TRO*VM	-0.47	.22	-2.15	.03