THEMATIC ROLE ASSIGNMENT AND WORD ORDER PREFERENCES IN THE CHILD LANGUAGE ACQUISITION OF TAGALOG

by

Rowena Santiago Garcia

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Under the supervision of

Professor Barbara Höhle, University of Potsdam

Professor Roelien Bastiaanse, University of Groningen

Reviewed by

Professor Barbara Höhle, University of Potsdam

Professor Jeffrey Lidz, University of Maryland

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Abstract

This dissertation is concerned with Tagalog-speaking children's use of word order and morphosyntactic markers for thematic role assignment. It aims to explain children's difficulties in interpreting non-canonical sentences (patient-before-agent), and to test the influence of a word order strategy in a language like Tagalog, where the thematic roles are always unambiguous in a sentence, due to its verb-initial order and its voice-marking system (verb inflection indicates the thematic role of the noun marked by *ang*). First, the possible basis for a word order strategy in Tagalog was established using a sentence completion experiment given to adults and 5- and 7-year-old children (Chapter 2) and a child-directed speech corpus analysis (Chapter 3). Children's comprehension was then examined through a self-paced listening and picture verification task (Chapter 3) and an eye-tracking and picture selection task (Chapter 4). Offline (i.e., accuracy) and online (i.e., listening times, looks to the target) measures revealed that 5- and 7-year-old Tagalog-speaking children have a bias to interpret the first noun as the agent. Additionally, the use of word order and morphosyntactic markers was found to be modulated by sentence voice. Findings are discussed within the context of accounts explaining the development of children's sentence processing abilities.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

In daily communications, one of our main tasks is to identify *who* did *what* to *whom* in the sentences that we hear. It then comes as no surprise that children's acquisition of this skill has garnered a lot of attention from researchers. In this dissertation, I aim to add to the growing body of literature on child language acquisition by looking at thematic role assignment in Tagalog, an understudied language which has features that are different from widely-researched languages. As previous research has shown that canonical argument orders influence comprehension strategies in adults and children, word order preferences of both Tagalog-speaking adults and children were also investigated in the present dissertation.

1.1 Thematic role assignment

Each argument in a sentence has a thematic role which marks how it affects or is affected by the event expressed by the verb (see Ackema, 2014 for an

overview; Gruber, 1976; Jackendoff, 1972). For example, the argument referring to the participant performing an action, or affecting another entity is assigned the *agent* thematic role while the affected participant is assigned the *patient* thematic role. There are several other proposed thematic roles such as experiencer, instrument, and location. Because thematic role classification is also debated, the agent and patient roles in this dissertation refer to Dowty's (1991) more encompassing proto-agent and proto-patient roles. A proto-agent is volitionally involved and able to feel or perceive things, causes an event change or change in state of another participant, moves in relation to another participant, and exists independently of the event. In contrast, a proto-patient has the following properties: causally affected by another participant, an incremental theme (involved in telic events, e.g., *He crossed the desert*), undergoes a change of state, stationary, and does not exist outside of the event (e.g., *John erased an error*).

Languages use a variety of features to convey thematic roles, including word order, case marking (such as affixes, adpositions, or articles), verb agreement, and intonation (MacWhinney, 2012). In the majority of languages in the world, the agent is usually mentioned before the patient (Dryer, 2013). In nominative-accusative languages with case marking, the agent argument is encoded in the nominative case, while the patient is in the accusative case (Comrie, 2013). For example, in German, singular masculine nouns are canonically marked by the article *der* if they are acting as agents, and *den* if they serve as patients. Since the agent is typically mapped to the subject (Siewierska, 1993), subject-verb agreement (e.g., number and gender) can also be used for assigning thematic roles. For example, a singular-marked

verb in English (marked by *–s* or *–es*) provides an additional cue that the singular argument is the sentence subject, and more likely, the agent of the action. Moreover, MacWhinney, Bates, and Kliegl (1984) also found that contrastive stress reduced the bias of Italian speakers to interpret the first noun phrase as the agent.

Studies have shown that extra-linguistic factors also affect adult sentence comprehension. Behavioral and event-related potentials (ERP) studies have presented evidence of the influence of animacy on thematic role assignment. Specifically, speakers of English, German, and Italian preferred to interpret animate entities as agents (Frisch & Schlesewsky, 2001; Kuperberg, Kreher, Sitnikova, Caplan, & Holcomb, 2007; MacWhinney et al., 1984). In addition, adults also use real-world probability as a guide in identifying thematic roles. Ferreira (2003) showed that adults correctly identified the agent in plausible passive sentences, e.g., *The man was bitten by the dog*, more accurately than in less plausible sentences, e.g., *The dog was bitten by the man.*

In order to investigate children's acquisition of thematic role assignment, researchers have used various sentence interpretation tasks. In several studies, children were presented with various orders of two nouns and a verb, and asked to act out these sentences or word sequences (e.g., Slobin & Bever, 1982). Other researchers used a sentence-picture matching task (e.g., Stromswold, Eisenband, Norland, & Ratzan, 2002), or a truth-value judgment task (e.g., Gordon & Chafetz, 1990). Recent experiments also made use of the visual world paradigm in eye-tracking (e.g., Abbot-Smith, Chang, Rowland, Ferguson, & Pine, 2017). Generally, researchers manipulated the following variables: word order, voice, case marking, subject/object-verb

agreement, real-world plausibility, and animacy of the arguments.

Decades of research have shown that children initially have difficulties in assigning thematic roles in sentences with non-canonical argument order (patient-before-agent, from here on referred to as *non-canonical sentences*). Children tend to interpret the first noun phrase as the agent, resulting in thematic role reversals, for example in passives. In sentences like *Mary was pushed by John*, children interpret *Mary* as the agent of the action. This word order strategy has been found not only in languages with a fixed word order such as English (Bever, 1970; de Villiers & de Villiers, 1973; Gertner, Fisher, & Eisengart, 2006; Tager-Flusberg, 1981; van der Lely, 1994), French (Sinclair & Bronckart, 1972) and Portuguese (Coelho de Barros Pereira Rubin, 2009), but also in flexible word order languages such as German (Dittmar, Abbot-Smith, Lieven, & Tomasello, 2008; Lindner, 2003), Hebrew (Frankel, Amir, Frenkel, & Arbel, 1980), Hungarian (MacWhinney, Pleh, & Bates, 1985), Italian (E. Bates et al., 1984), Japanese (Hakuta, 1977), and Serbo-Croatian and Turkish (Slobin & Bever, 1982).

Differences in the use of word order for thematic role assignment have also been found across languages. English-speaking children have been found to start using a word order strategy at around 2;0 (E. Bates et al., 1984; Gertner et al., 2006), while children speaking languages with more flexible word order start only around 3;0 or 5;0 (Chan, Lieven, & Tomasello, 2009 for German and Cantonese; Frankel et al., 1980 for Hebrew; MacWhinney et al., 1985 for Hungarian). In addition, researchers have found that children rely less on word order when the latter goes against the thematic roles designated by morphosyntactic markers like case marking in German (Dittmar et al.,

2008), object and gender markers in Hebrew (Frankel et al., 1980), postposed particles in Japanese (Hakuta, 1977). More importantly, studies have also shown that children use word order only when case marking is ambiguous (MacWhinney et al., 1985 for Hungarian; Slobin & Bever, 1982 for Turkish).

Children's use of word order for thematic role assignment has also been found to be influenced by real-world plausibility, stress, animacy, and agreement. For example, Italian-speaking children (age: 3;6) interpreted the first noun as the agent in noun-verb-noun sequences, but chose the stressed noun phrase as the agent when given less frequently occurring orders, namely, verb-noun-noun and noun-noun-verb (E. Bates et al., 1984). Three-year-old children also showed the use of real-world probability, such that in less plausible sentences like *The baby feeds the girl*, they chose *the girl* (second noun phrase) as the agent of the action (Strohner & Nelson, 1974). Additionally, children from the age of 3;0 to 8;11 have also been shown to assign the agent role to the animate argument, such that they were more accurate in interpreting non-reversible passives (only one argument is a potential agent, usually animate) than reversible passives (both arguments are potential agent or patient) (E. Bates et al., 1984; Chan et al., 2009; Lindner, 2003; Turner & Rommetveit, 1967). Lastly, 6-year-old German-speaking children used word order when case and gender and number agreement assigned different agents, but less when case and agreement pointed to the second noun phrase as the agent (Lindner, 2003).

In this dissertation, non-canonical sentences are especially interesting because such structures can tease apart the factors that influence children's sentence processing strategies. The following sections introduce accounts that

aim to explain children's difficulty in interpreting non-canonical sentences.

The frequency account

Based on the frequency account, non-canonical sentences such as passives are difficult for children to interpret because these structures are infrequent in their linguistic input (Demuth, 1989; Gordon & Chafetz, 1990; Kline & Demuth, 2010). Corpus studies have shown that in languages where passives are acquired late, passives are rarely found in child-directed speech (e.g., Abbot-Smith & Behrens, 2006 for German; Gordon & Chafetz, 1990 for English). For example, in Gordon and Chafetz's (1990) English corpus, passives comprised only 0.04% of the total input.

The importance of frequency in comprehension is also exemplified by studies which have shown an earlier passive acquisition after experimentally increasing the passive input to children. For example, Brooks and Tomasello (1999) found that 3-year-old English-speaking children produced novel verbs in passive sentences after an extensive exposure to this construction. Instead of using single sentence models, Vasilyeva, Huttenlocher, and Waterfall (2006) used a more naturalistic context by increasing passives in stories. After 10 story sessions, they found that 4-year-old English-speaking children who heard more passives also produced more passives sentences and showed better comprehension of this structure. Furthermore, experiments using syntactic priming have also shown that children use passives more often when the experimenter has also produced this structure (Huttenlocher, Vasilyeva, & Shimpi, 2004; Savage, Lieven, Theakston, & Tomasello, 2003).

Even more convincing are field studies that have shown an earlier acqui-

sition of passives in languages wherein passives are frequent. For example, in Sesotho where passive constructions comprise 6% of the total utterances in the input and passive verbs make up 2.7% of non-copular verbs in the input, children showed production already at age 2;8 (Demuth, 1989; Kline & Demuth, 2010). Passive production has also been observed as early as 2;0 in Jakarta Indonesian (Gil, 2006); 2;1 in K'iche' Mayan (Pye & Poz, 1988), Inuktitut (Allen & Crago, 1996), Kiswahili and Kigiriama (Alcock, Rimba, & Newton, 2012); and 2;5 in Zulu (Suzman, 1987). Moreover, 3-year-old Sesotho-speaking children were found to comprehend and generalize the passive structure to novel verbs (Demuth, Moloi, & Machobane, 2010).

The Competition model

The *Competition model* is a functionalist model of language acquisition and performance. According to the model, sentence interpretation decisions are based not only on the frequency of thematic role assignment cues (e.g., word order and case-marking) in the input, but also on the reliability of these cues (MacWhinney, 1987, 2012; MacWhinney & Bates, 1989). All possible cues in the input, e.g., lexical, morphological, syntactic, or intonational, can be used to strengthen or weaken competing alternative sentence interpretations. For example, in the sentence *The girls kick the basket*, both *the girls* and *the basket* are competing candidates for the agent role. However, the noun phrase *the girls* has the advantage of animacy, preverbal positioning, and subject-verb agreement; therefore, it wins the competition. In a sentence like *The basket kick the girls*, preverbal positioning assigns *the basket* as the agent, while animacy and subject-verb agreement favor *the girls* as the

agents. Such a sentence results in competition between the cues. In the Competition model literature, thematic role assignment cues are usually put into conflict with each other to determine which cue will be relied on in case of conflict (MacWhinney, 2012).

The model predicts that children find sentences wherein the cues designate the same noun phrase as the agent easier to comprehend compared to sentences wherein the cues indicate different agents, and this claim is supported by experimental studies in different languages (Abbot-Smith et al., 2017 for English; Abbot-Smith & Serratrice, 2015 for Italian; Chan et al., 2009 for English, German, and Cantonese; Dittmar et al., 2008 for German; Hakuta, 1982 for Japanese; Janssen, Meir, Baker, & Armon-lotem, 2015 for Russian; Staroń & Kail, 2004 for Polish). For example, in German, Dittmar et al. (2008) found that 2-year-olds could correctly interpret only sentences in which word order and case-marking pointed to the same argument as agent. In addition, 5-year-olds showed the most difficulty in interpreting sentences wherein word order and case-marking competed with each other, and assigned the agent role to different arguments.

In case of conflict between the cues, the Competition model predicts that the cue with the highest validity is relied on and used for thematic role assignment. Moreover, this cue is acquired the earliest. Cue validity depends on how frequent the cue occurs in the input (cue availability) and how often the cue correctly assigns the thematic roles (cue reliability). These measures are quantified from the corpus data. Based on McDonald (1986), cue availability is calculated by dividing the number of occurrences of a cue in the input by the total number of possible occurrences; while cue reliability

is the number of times that the cue led to the correct interpretation divided by the number of times it occurred. Cue validity is then the product of cue availability and cue reliability.

As these cue validity measures are language-specific, the model predicts cross-linguistic differences in children's cue use when the cues compete with each other and assign agency to different arguments. For instance, Chan et al. (2009) crossed word order and animacy, and found that when these two cues indicated different agents, English-speaking children (age: 3;6) relied more on word order and interpreted the first noun phrase as the agent more often than German- and Cantonese-speaking children of the same age. This result was also observed when the children were given sentences without an animacy contrast between the noun phrases, such that only word order was an available cue. The authors argued that this heavier reliance of English-speaking children on word order reflects the higher validity of word order in English compared to the other languages.

The incremental processing account

Like the Competition model, the incremental processing account claims that listeners use all kinds of information (e.g., lexical, morphological, syntactic, prosodic) for sentence interpretation. However, the account also incorporates the importance of timing or when information is given. Based on the account, listeners process incoming information immediately and incrementally (Altmann & Steedman, 1988; Kamide, Altmann, & Haywood, 2003; Kamide, Scheepers, & Altmann, 2003; Marslen-Wilson & Tyler, 1987). Listeners do not wait for the sentence to finish before they interpret its meaning.

Therefore, revision is needed when a late-arriving cue in the sentence is in conflict with the interpretation of previously given information, just like in sentences with non-canonical word order. For example, again in a passive sentence in English, such as *Mary was pushed by John*, upon hearing *Mary*, it is immediately assigned the agent role based on word order and animacy. However, upon encountering *was pushed*, the original interpretation needs to be revised because the verb inflection indicates that *Mary* is instead the patient of the action.

It has been claimed that like adults, children incrementally process sentences, however, they have difficulties in revising their initial interpretation (Trueswell & Gleitman, 2004, 2007). For example, Trueswell, Sekerina, Hill, and Logrip (1999) showed that when listening to temporary ambiguous sentences such as *Put the frog on the napkin in the box*, both adults and 5-year-old children first looked at the frog on the napkin (destination interpretation). After hearing the second prepositional phrase *in the box*, adults correctly moved the frog which was on the napkin into the box. However, children did not revise their destination interpretation, and still moved the frog to the napkin. This difficulty in revision has been found not only in resolving ambiguities in prepositional phrase attachment, but also in interpreting long-distance dependencies (Omaki, Davidson White, Goro, Lidz, & Phillips, 2014) and quantified noun phrases (Musolino & Lidz, 2006).

To date, studies on children's incremental assignment of thematic roles remain scarce. Abbot-Smith et al. (2017) claimed that English-speaking children (ages: 2;1–3;5) incrementally map the first noun to the agent role as their eye-tracking data showed more looks to the clip which had the first noun

as the agent once the initial noun was played. However, once it became clear from the verb inflection and the *by*-phrase that the sentence was a passive, only the 3;5 children were able to revise their initial interpretation. After the second noun phrase, those in the passive condition showed less looks to the picture which had the first noun as the agent, compared to those in the active condition. Furthermore, the same results were found in an offline picture selection task.

Huang, Zheng, Meng, and Snedeker (2013) investigated online thematic role assignment in Mandarin and in older children (age: 5;0) using a visual world eye-tracking paradigm. They manipulated the voice markers in the stimuli sentences (BA: designates the first noun as the agent, BEI: indicates the first noun as the patient) as well as whether the first noun was referential (noun) or non-referential (pronoun). Children were asked to act out sentences like (1.1) 'The seal is quickly eaten by it.' They were presented with three real objects: the mentioned item (seal), a plausible agent of the action eat (shark), and a plausible patient (fish). The results showed incremental use of the morphosyntactic markers, as well as a non-referential condition advantage. Children incorrectly interpreted the first noun as the agent in the BEI condition less often when the first noun was non-referential ('It BEI seal it' or 'It is eaten by the seal') than when the first noun was referential ('Seal BEI eat it' or 'The seal is eaten by it'). The authors claimed that children do not assign a thematic role to a non-referential noun (pronoun, i.e., *it*), but do so if the first noun is referential. Therefore, in the non-referential condition, no interpretation has yet been formed once the BEI marker is encountered, while in the referential condition, an initial first noun as agent interpreta-

tion needs to be revised. Such results are in line with Trueswell, Kaufman, Hafri, and Lidz's (2012) finding that comprehension is easier when the morphosyntactic markers are used for guiding an initial interpretation instead of revising one.

(1.1) Haibao BA/BEI ta henkuaijiu chidiao le
seal it quickly eating
'The seal is quickly eating it/being eaten by it.'

The studies presented so far have shown that children incorrectly interpret the first noun as the agent in non-canonical sentences. However, it remains open whether children actually rely on word order when the morphosyntactic markers disambiguate the thematic roles even before the first noun is given. Therefore, my dissertation is focused on Tagalog-speaking children's use of word order and morphosyntactic markers for thematic role assignment. Specifically, I tested the predictions of the frequency account, the Competition model, and the incremental processing account by investigating children's comprehension of non-canonical word order in this understudied language. I investigated the phenomenon in Tagalog not only because all accounts that are deemed to be universally applicable should be tested in as many languages as possible. Rather, Tagalog has properties that make it ideal for informing language acquisition and processing theories, as discussed in the next section.

1.2 Tagalog

Tagalog is a Philippine language with over 23 million native speakers (Simons & Fennig, 2018). It belongs to the Austronesian language family, and it is the basis of Filipino, the national language of the Philippines. Several Tagalog dialects exist, but those who participated in the experiments in this dissertation came only from Metro Manila where standard Tagalog is spoken.

Tagalog has garnered attention from linguists because its characteristics are different from commonly studied Indo-European languages. However, many aspects of its grammar are still matters of debate. For instance, it has been described as nominative-accusative (Kroeger, 1993a; Rackowski & Richards, 2005a), ergative-absolutive (Aldridge, 2012; Hoekstra, 1986; Reid & Liao, 2004; Schachter & Reid, 2008), and a symmetrical voice language (Foley, 1998; Himmelmann, 2005a; Riesberg, 2014). In this dissertation, I follow the symmetrical voice language description, which considers Tagalog to have multiple basic transitive constructions, and a specific marker for each voice alternation. Unlike in active-passive alternations in Indo-European languages, one argument is not demoted to an oblique when voice is changed (Riesberg & Primus, 2015).

A basic Tagalog sentence contains a predicate and the *ang*-phrase (1.2), which is considered as the subject (Kroeger, 1993a). The *ang*-phrase has also been called pivot (LaPolla, 2014), trigger (Schachter, 2015), and topic because it is the locus of attention in the sentence (Schachter & Otanes, 1972). Other sentence arguments and adjuncts may be preceded by *ng*[1], a

[1]It must be noted that *ang* per se is not a subject marker as it can also mark predicates,

marker for common objects, possessors, or adjectival modifiers (Schachter & Otanes, 1972); or by *sa*, a locative preposition (Himmelmann, 2005b). The marker *ng* is used for non-subject agents, as well as non-subject non-human patients which are preferably but not necessarily indefinite; while the marker *sa* is used for non-subject human and definite patients (Himmelmann, 2005b, 2015).

(1.2) H<**um**>i~hila ng baboy **ang** baka
<AV>IPFV~pull NSUBJ pig SUBJ cow
'The cow is pulling a pig.'

(1.3) H<**in**>i~hila ng baboy **ang** baka
<PV>IPFV~pull NSUBJ pig SUBJ cow
'The/A pig is pulling the cow.'

(1.4) H<**um**>i~hila **ang** baka ng baboy
<AV>IPFV~pull SUBJ cow NSUBJ pig
'The cow is pulling a pig.'

(1.5) H<**in**>i~hila **ang** baka ng baboy
<PV>IPFV~pull SUBJ cow NSUBJ pig
'The/A pig is pulling the cow.'

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and *ng* also marks a possessor (Himmelmann, 2005b). However, for convenience, they are labeled as SUBJ and NSUBJ in the glosses, respectively. *Ang* is pronounced as /ʔaŋ/ and *ng* as /naŋ/.

The predicate is usually a verb that is inflected for voice, aspect, and mood.[2] In Tagalog's voice-marking system (historically called 'focus' system), the affix on the verb assigns the thematic role of the *ang*-phrase (Himmelmann, 2005b). The different voices are agent voice and the undergoer voices: patient voice, locative voice, and conveyance voice[3]. The following text only deals with sentences that describe events/actions with a volitional agent. States of affairs with non-volitional agents are of different forms, and are beyond the scope of this dissertation.

In the agent voice, the verb infix *–um–* (1.2, 1.4) or prefixes *mag–*, *nag–*, and *naN–* indicate that the *ang*-phrase is the agent of the action. The choice of the agent voice marker depends on the verb base, and may also indicate reflexivity and intensity of the action. In the undergoer voices (i.e., patient voice, locative voice, and conveyance voice), the verb affix indicate that the *ang*-phrase is the undergoer or patient of the action. In the realis mood (it is known that the event happened or did not happen), the patient voice infix *–in–* indicates that the *ang*-phrase is the patient (1.3, 1.5)[4]. Aside from the infix *–in–*, the locative voice has an additional suffix *–an* which indicates that the *ang*-phrase is a recipient or goal of the action, a patient that is indirectly

[2]Voice and mood are conflated in Tagalog verbs. The voice-markings in the examples in this dissertation also signal realis mood.

[3]AV refers to agent voice, PV to patient voice, IPFV to imperfective aspect, SUBJ to subject, NSUBJ to non-subject, and LIN to linker.

[4]It must be noted that the agent voice and patient voice differ from active and passive voice, as there is no argument demotion in a symmetrical voice language (Riesberg & Primus, 2015). Therefore, in the patient voice, the agent is not demoted into an oblique, unlike in a passive.

affected by the action, a location where something happened, or a location to and from which an event occurred. The conveyance voice in the realis mood also has an additional prefix *i–* which denotes that the *ang*-phrase is a physically-displaced theme, instrument, or beneficiary. In the non-realis mood (it is not known whether the event happened, such as when it has not yet started), the patient voice is marked by the suffix *–in*, the locative voice by the suffix *–an*, and the conveyance voice by the prefix *i–* (see Table 1.1). In the analyzed corpus data in this dissertation, the term patient voice is used to refer to Himmelmann's (2005b) umbrella term—undergoer voice. Given these properties, with only a change in the voice-marking on the verb, the agent and patient roles are reversed, as shown in examples (1.2) and (1.3).

Table 1.1

Undergoer voice realisations of the verb bili *'buy' in the imperfective aspect for realis and non-realis moods.*

	Patient voice	Locative voice	Conveyance voice
Realis imperfective	b<in>ibili	b<in>ibilh-an	i-b<in>ibili
Non-realis imperfective	bibilh-in	bibilh-an	i-bibili

The voice-marking that is used in a given sentence is affected by several factors which include definiteness (Himmelmann, 2005b), specificity (Rackowski, 2002), and topicality (Carrier-Duncan, Inquiry, & Winter, 1985) of the arguments. Because the *ang*-marker also signals definiteness, the patient voice is chosen whenever a sentence has a definite patient. As regards the frequency of occurrence of each voice type, Cooreman, Fox, and Givón's (1984) written

corpus study, as well as Tanaka et al.'s (2015) picture description experiment provide evidence that the patient voice (infix *–in–*) is preferred when the sentences contain both an agent and a patient. However, Tanaka et al. (2014) also showed that this preference for the patient voice *–in–* marker is weakened whenever the patient is indefinite and inanimate.

Another interesting feature of Tagalog is its predicate-initial canonical order, which means that unlike in SVO or SOV languages, listeners immediately receive the verbal information (the meaning of the verb itself, and the voice, mood, and aspect inflections). The order of the arguments in Tagalog is relatively free (Schachter, 2015), and their basic order remains controversial. According to some researchers, both voices are preferred to have a verb-agent-patient order (Buenaventura Naylor, 1975; Manueli, 2010; Sauppe, 2016; Schachter, 2015). Billings (2005) claimed that for the agent voice, the canonical order is verb-patient-agent, while it is verb-agent-patient for the patient voice. In contrast, Aldridge (2002) argued for verb-agent-patient for the agent voice and verb-patient-agent for the patient voice. It has also been proposed that the preferred order is verb-agent-patient for the patient voice, and both verb-agent-patient and verb-patient agent for the agent voice (Guilfoyle, Hung, & Travis, 1992; Kroeger, 1993b). The *ang*-phrase can also occur at the beginning of the sentence (before the verb), but this is more common in formal, written language (Schachter & Otanes, 1972). The essential point in this dissertation is that Tagalog does not rely on word order for assigning thematic roles in basic sentences. Examples (1.2) and (1.4) mean the same even if (1.2) has a verb-patient-agent order and (1.4) is verb-agent-patient, because both of these sentences are in the agent voice.

As both (1.3) and (1.5) are in the patient voice, these two also have the same thematic role assignment.

Studies on the acquisition of Tagalog are scarce. In 1971, Tucker used an imitation and completion task to investigate 10-year-old children's ability to inflect real and novel verbs for voice. He found that children were more accurate in producing the patient voice infix *–in–* compared to the agent voice infix *–um–*. In terms of word order in production, Bautista (1983) found through a picture description task that 2- to 4-year-old children preferred the agent-initial order compared to the patient-initial order. More recently, Tanaka (2016) reported that this agent-initial preference was also shown by 5-year-old children. Additionally, she found that children produced more utterances in the patient voice than the agent voice. Marzan (2013) found a similar agent-initial preference in her corpus of spontaneous speech samples from six children (ages: 1;2–4;11).

In comprehension, Segalowitz and Galang (1978) used a sentence-picture matching task to test children's interpretation of reversible transitive sentences. All groups of children (ages: 3;6, 5;6, 7;4) were accurate in interpreting patient voice (verb-agent-patient) sentences. However, they reversed the thematic roles in the agent voice (verb-patient-agent). Verb-medial sentences (agent-verb-patient in the agent voice and patient-verb-agent in the patient voice) were also used in a follow-up experiment in order to tease apart the effect of voice from that of word order. Children performed well in all the verb-medial sentences, even if the patient voice condition was patient-initial. This result shows that they did not always rely on interpreting the first noun as the agent. Moreover, a patient voice advantage was observed, which is in

line with Galang's (1982) findings that given pictures of transitive actions, children (ages: 3;4, 5;3, 7;4, 8;3) were numerically more accurate in pointing to the patient when asked a question in the patient voice (*Ituro mo ang **in**akain*, 'Point to that which is being eaten') than in pointing to the agent when asked a question in the agent voice (*Ituro mo ang k**um**akain*, 'Point to that which is eating').

However, a recent study showed an agent voice advantage instead. Tanaka et al. (2015) found that children (age: 4;11) were more accurate in interpreting agent relative clauses (agent voice-marked verb, [1.6]) compared to patient relative clauses (patient voice-marked verb, [1.7]). Then again, as the agent relative clauses were also agent-initial, and the patient relative clauses were patient-initial, it is also plausible that the agent voice advantage came from a word order strategy.

(1.6) Lalaking h<**um**>a~habol ng babae
Man-LIN <AV>IPFV~chase NSUBJ woman
'The man that is chasing the/a woman.'

(1.7) Lalaking h<**in**>a~habol ng babae
Man-LIN <PV>IPFV~chase NSUBJ woman
'The woman that is chasing the/a man.'

In summary, the production studies have shown that children prefer to mention the agent before the patient. Moreover, the patient voice seems to

be produced more often than the agent voice. However, the effect of voice on word order preference has not yet been teased apart from the effect of other factors like animacy and definiteness. Additionally, it is difficult to judge children's word order preference in the agent voice since the agent voice was not produced often.

The comprehension studies have shown that Tagalog-learning children also rely on a first-noun-as-agent strategy. However, children's comprehension of agent voice verb-agent-patient and patient voice verb-patient-agent has not yet been investigated, as voice, order and the ambiguity of the first noun's thematic role were confounded in the previous studies. In addition, these measures were offline, so the results cannot inform the incremental processing account.

1.3 Current research

In this dissertation, I investigated children's use of word order and morphosyntactic markers for assigning thematic roles. I used Tagalog's voice-marking system and flexible word order to test the predictions of the frequency account, the Competition model, and the incremental processing account. The main research questions are as follows:

1. Do Tagalog-speaking children use word order or the morphosyntactic markers—voice marker on the verb and noun marker—for thematic role assignment?

2. Does this use change across age groups?

Tagalog is interesting because the patient voice (the patient is the subject) is supposed to be more frequent than the agent voice. If child-directed speech also contains a high frequency of patient voice, similar to findings in written Tagalog, then the frequency account predicts that children would find patient voice sentences easier than agent voice sentences.

The language's complex but reliable voice-marking system makes Tagalog a remarkable testing ground for the claims of the Competition model. The more valid cue (word order or morphosyntactic markers) is predicted to be acquired earlier and used to assign thematic roles when the two cues assign different agents. The cue validities of word order and morphosyntactic markers in Tagalog are yet to be calculated.

The fact that the thematic roles are disambiguated before the nouns are encountered in a basic sentence in Tagalog permits testing of the incremental processing account's claim that children's difficulties with non-canonical sentences originates from their trouble in revising an initial assignment of thematic roles. Because sentences are canonically verb-initial and the nominal markers occur prior to the noun, the morphosyntactic markers for thematic role assignment are already available before the first noun is encountered. If children immediately use the morphosyntactic markers, it is predicted that patient-initial sentences would not cause problems because there is no revision required.

Before testing these predictions, I first looked at a possible basis for a word order strategy by checking the word order preference of both adult and children native speakers of Tagalog (Chapter 2). Five- and 7-year-old children and an adult control group were asked to describe pictures of re-

versible actions by completing sentences which started with voice-marked verb prompts (agent voice or patient voice). Controlling the voice-marking on the verb allowed elicitation of the same number of agent voice and the patient voice productions.

In Study 1 of Chapter 3, I analyzed Marzan's (2013) corpus of Tagalog child-directed speech in order to make specific predictions for the frequency account, Competition model, and incremental processing account. The corpus was used to calculate the frequency of occurrence of the agent voice and patient voice, as well as to determine the predominant word order used in the input, and the cue validities of word order and morphosyntactic markers.

Chapter 3 also reports a combined self-paced listening and picture verification experiment, which was used to investigate Tagalog-speaking children's use of word order and/or the voice-marking on the verb and the nominal marker to assign thematic roles in reversible transitive sentences. Five- and 7-year-old children, as well as an adult control group, participated in the experiment. Voice (agent voice, patient voice) and word order (agent-initial, patient-initial) were manipulated in the stimuli sentences. In each trial, participants were shown a picture of an action between two animate entities (e.g., a cow pulling a pig), and were asked to listen to a sentence like examples (1.2–1.5) segment-by-segment (e.g., verb, noun phrase, temporal adverb phrase) in order to get the listening times for each segment of the sentence. The participants were then asked if the sentence they heard matched the picture they saw. Such an online task permitted comprehension to be tested before the end of a sentence, so it was most appropriate for testing the claims of the incremental processing account. Both accuracy and listening times for

the sentence segments were collected.

Chapter 4 reports an eye-tracking study with a picture selection task to investigate the timing of the use of word order and morphosyntactic markers for thematic role assignment. In this study, adults' and 5- and 7-year-old Tagalog-speaking children's looks to the screen were tracked as they tried to identify which of two pictures (e.g., a cow pulling a pig, and a pig pulling a cow) matched the sentence they heard. Voice (agent voice, patient voice) and word order (agent-initial, patient-initial) were again manipulated in the stimuli sentences. Both accuracy and gaze data obtained with an automatic eye-tracker were collected. Aside from informing on the timing of use of the cues, eye-tracking allowed a closer access to 'natural' sentence processing since it required no secondary task.

Chapter 2

Word order preferences of Tagalog-speaking adults and children

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.

Abstract

We investigated the word order preferences of Tagalog-speaking adults and 5- and 7-year-old children. The participants were asked to complete sentences to describe pictures depicting actions between two animate entities. Adults preferred agent-initial constructions in the patient voice but not in the agent voice, while the children produced mainly agent-initial constructions

regardless of voice. This agent-initial preference, despite the lack of a close link between the agent and the subject in Tagalog, shows that this word order preference is not merely syntactically-driven (subject-initial preference). Additionally, the children's agent-initial preference in the agent voice, contrary to the adults' lack of preference, shows that children do not respect the subject-last principle of ordering Tagalog full noun phrases. These results suggest that language-specific optional features like a subject-last principle take longer to be acquired.

2.1 Introduction

A critical task in language acquisition is learning the specific word order regularities of the ambient language. Children acquiring languages like English must learn that the position of an argument in a sentence is crucial for determining who the agent and the patient of an action denoted by the verb are. For example, to express that a girl named *Mary* is kicking a boy named *John*, they should code *Mary* as the subject and therefore, at the initial position of the sentence, and *John* as the object, which comes after the verb.

It is claimed that children generally acquire the language's canonical forms before the non-canonical patterns, with *canonical* referring to structures which speakers produce with minimal assumptions regarding the listener's background knowledge (Slobin, 1982; Slobin & Bever, 1982). Studies on spontaneous speech have shown that children prefer a subject-initial word order in both fixed (Brown, 1973 for English; Slobin & Bever, 1982 for Italian) and relatively more flexible word order languages (Lee, 2010 for

Mandarin; Slobin & Bever, 1982 for Serbo-Croatian and Turkish; Tanaka & Shirai, 2012 for Japanese). The same preference was found in production experiments wherein children had to describe pictures (Hakuta, 1982 for Japanese), videos (Cannizzaro, 2012 for Dutch and English), or act-outs (Angiolillo & Goldin-Meadow, 1982 for English; Cannizzaro, 2012).

In most of these studied languages, the canonical order is subject-initial, and the agent usually corresponds to the subject (Dryer, 2013), which means that the subject-initial order is also agent-initial (agent-before-patient). This order reflects both the grammatical relational hierarchy (the subject is the highest grammatical relation; Johnson, 1977) and the thematic role hierarchy (the agent is the highest thematic role; Fillmore, 1968; Siewierska, 1993). The subject-initial preference is considered to have such great importance in word ordering patterns that Greenberg (1963) proposed it as Universal #1: In declarative sentences with nominal subject and object, the dominant order is almost always one in which the subject precedes the object. Another—maybe not independent—ordering principle relates to the thematic roles of the argument with the agent preferably occurring before the patient. This order is considered to result from a universal principle that the thematically independent role (agent) tends to precede and/or c-command the role that is thematically dependent (patient) (Primus, 2006). A patient is thematically dependent on the agent, because there would be no patient if there were no agent acting on it in the first place. Primus (2003) proposed that this thematic dependency may be derived from the dependency of an effect to a cause. Others have claimed that an agent-initial preference reflects, in an iconic manner, how an agent initiates a causal event which affects the patient

(Cohn & Paczynski, 2013; Kemmerer, 2012).

In languages with a subject-initial/agent-initial canonical order, children do not face a conflict on which argument should occur first—it is the subject which is also usually the agent, except for the passive voice. Therefore, in these languages, it cannot easily be disentangled whether the choice of the word order is driven by a subject-initial preference or by an agent-initial preference. After all, Jackendoff and Wittenberg (2014) have proposed that already at the two-word stage, children have a preference for an agent-initial order in utterances containing only nouns—an agent and a patient. They claim that this is a direct mapping from thematic roles to linear position without the need to resort to grammatical relations, which means that children prefer an agent to appear before a patient, even when the former is not a subject.

In this paper, we investigate children's acquisition of word order patterns in Tagalog—a language wherein the first noun phrase position is not confounded with the subject position, and the agent is not closely linked to the subject. These properties lead to the question of which word order Tagalog-learning children would prefer—subject-initial or agent-initial. Studying the acquisition of Tagalog can thus show whether children's word order preference is syntactically-driven, i.e., subject-initial, or semantically-driven (determined by thematic roles), i.e., agent-initial.

2.1.1 Tagalog voice-marking and word order

Tagalog, a Malayo-Polynesian Austronesian language with over 23 million speakers, is one of the major Philippine languages (Simons & Fennig, 2018). Many aspects of its grammar remain controversial. Some scholars claim that Tagalog is a nominative-accusative language (Rackowski & Richards, 2005b), while others argue that it is ergative-absolutive (Aldridge, 2012; Schachter & Reid, 2008). In this article, we follow Foley (1998), Himmelmann (2005a), and Riesberg (2014) who categorize Tagalog as a symmetrical voice language, which means that the language has multiple basic transitive constructions, which are considered symmetrical because the verb bears a specific marker in all of the voice alternations. Furthermore, there is no demotion of an argument to an oblique sentence element across the voice alternations, which is different from the active-passive alternation in other languages like English or German (Riesberg & Primus, 2015).

Tagalog's basic sentence structure includes the predicate and the so-called *ang*-phrase, which is the sentence subject (Guilfoyle et al., 1992; Kroeger, 1993a; see Schachter, 2015 for an alternative view). Other arguments as well as adjuncts are preceded by the morphological marker *ng*, which can signify a common noun object, a possessor, or also an adjectival modifier (Schachter & Otanes, 1972), or by the morphological marker *sa*, which is a locative preposition (Himmelmann, 2005b). According to Himmelmann (2005b, 2015), *ng* marks non-subject agents, and non-subject non-human patients which are preferably but not obligatorily indefinite; while *sa* marks non-subject human and definite patients.

In the Tagalog voice-marking system, a morphological marker on the verb assigns the thematic role of the *ang*-phrase or the subject (Himmelmann, 2005b). In the agent voice (AV), the verbal infix *–um–* (see Latrouite, 2001 for a discussion of affix choice), indicates that the *ang*-phrase is the agent, see example (2.1). In contrast, in the patient voice (PV)[1], the verbal infix *–in–* denotes that the ang-phrase is the patient, see example (2.2). Hence, the roles of agent and patient are reversed with only a change in the voice-marking on the verb. The thematic role assignments are not affected by the order of the arguments such that there is no change in meaning between examples (2.1) and (2.3) in agent voice and between examples (2.2) and (2.4) in patient voice.

(2.1) H<**um**>i~hila ng baboy **ang** baka
<AV>IPFV~pull NSUBJ pig SUBJ cow
'The cow is pulling a pig.'

(2.2) H<**in**>i~hila ng baboy **ang** baka
<PV>IPFV~pull NSUBJ pig SUBJ cow
'The/A pig is pulling the cow.'

(2.3) H<**um**>i~hila **ang** baka ng baboy
<AV>IPFV~pull SUBJ cow NSUBJ pig
'The cow is pulling a pig.'

[1]AV refers to agent voice, PV to patient voice, IPFV to imperfective aspect, SUBJ to subject, NSUBJ to non-subject, and LIN to linker.

(2.4) H<**in**>i~hila **ang** baka ng baboy
<PV>IPFV~pull SUBJ cow NSUBJ pig
'The/A pig is pulling the cow.'

The choice of voice seems to be affected by several factors. Definiteness is one of them (Himmelmann, 2005b): *ang*-phrases are always interpreted as definite, therefore patient voice is used in sentences with definite patients. A written corpus study by Cooreman et al. (1984), and a picture description task by Tanaka et al. (2015), provide empirical evidence that the patient voice is generally preferred when a patient is present. However, Tanaka and colleagues (2014) also showed that when the patient is indefinite and inanimate, the patient voice preference is weakened.

Another feature of Tagalog is its relatively free word order. The canonical order is verb-initial, but the order of the arguments is not fixed (Schachter, 2015). An *ang*-phrase-verb-*ng*-phrase[2] order (from here on referred to as *ang*-verb-*ng*) is also grammatical, but it is considered more formal and is usually found in writing (Schachter & Otanes, 1972). The basic orders of arguments and grammatical functions are still matters of controversy. There are claims that the canonical order is verb-*ng*-*ang* (Billings, 2005), verb-*ang*-*ng* (Aldridge, 2002), agent-initial (Buenaventura Naylor, 1975; Manueli, 2010; Schachter, 2015), or verb-*ng*-*ang* for the patient voice and both verb-*ng*-*ang* and verb-*ang*-*ng* for the agent voice (Guilfoyle et al., 1992; Kroeger,

[2]For simplicity, we refer to a non-subject argument as a *ng*-phrase. However, such an argument can alternatively be marked by *sa*.

1993b).

In verb-initial sentences with a pronominal argument, the pronoun occurs immediately after the verb (Billings, 2005). Pronouns have corresponding *ang*-argument, *ng*-argument, and *sa*-argument forms (e.g., *siya*, *niya*, *kaniya*, respectively for the third-person singular; Himmelmann, 2005b). Concerning sentences with non-pronominal arguments, Kroeger (1993b) proposed three principles which determine the preferred order of full noun phrases. First, the agent tends to precede the other arguments (which we will call the agent-first principle)[3]. Second, the *ang*-phrase tends to be the last phrase (subject-last principle). Third, heavier noun phrases (longer constituents) follow lighter noun phrases (shorter constituents). The first and third principles are commonly observed across languages but the second seems to go against the widely observed subject-initial preference.

There have been a few experimental studies that shed light on speakers' preferences of ordering non-pronominal arguments in Tagalog. Manueli (2010) manipulated the voice-marking of the verb kain 'eat,' and the order of the arguments *fish* and *cat*, and asked native adult speakers of Tagalog to rate the grammaticality of the sentences, such as *Kumakain ng isda si Muning* ('Muning (cat) is eating fish'). All 11 participants judged the agent voice patient-initial and patient voice agent-initial orders (verb-*ng*-*ang*) as grammatical, while three participants judged the agent voice agent-initial and patient voice patient-initial (verb-*ang*-*ng*) as less grammatical. More re-

[3]Billings (2005) claims that the agent-first principle actually applies only to given agents. The effect of givenness on Tagalog speakers' word order preference is beyond the scope of this study.

cently, Hsieh (2016) used more verbs in a task wherein participants read aloud a sentence, and then rated its naturalness[4]. The results showed that patient voice agent-initial (verb-*ng*-*ang*) was judged as the most natural, followed by both orders in the agent voice. Patient voice patient-initial (verb-*ang*-*ng*) was judged as the least natural. Similar to Manueli's results, in the patient voice, ratings for the agent-initial condition (verb-*ng*-*ang*) were statistically higher (more grammatical) than the ratings for the patient-initial condition (verb-*ang*-*ng*). In contrast, in the agent voice, the ratings for the two orders were not statistically different from each other, unlike the patient-initial (verb-*ng*-*ang*) preference in Manueli's study.

Using eye-tracking and a picture description task, Sauppe, Norcliffe, Konopka, Van Valin Jr., and Levinson (2013) showed that adult speakers preferred to produce patient voice agent-initial sentences (verb-*ng*-*ang*, 62%), followed by agent voice patient-initial (verb-*ng*-*ang*, 30%). The speakers produced only a few agent voice agent-initial (verb-*ang*-*ng*, 5%), and patient voice patient-initial (verb-*ang*-*ng*, 2%) sentences. Tanaka (2016) also used a picture description task but manipulated animacy and definiteness as well. The adult

[4]Hsieh (2016) also performed a prosodic analysis of the speech samples he collected from adult native speakers of Tagalog, and he found that verbs were shorter when they were followed by a *ng*-phrase than by an *ang*-phrase, and the first noun was lengthened when marked by *ng*- but not by *ang*-. Therefore, he concluded that the verb and the *ng*-phrase form one constituent when they are next to each other; while in verb-*ang*-*ng* sentences, the verb forms its own constituent, and the *ang*-phrase and *ng*-phrase form another. However, based on this data, we are hesitant to conclude that verb-*ng*-*ang* is the canonical order in Tagalog, given that *ang* and *ng*'s phonological properties might have affected the results, which Hsieh also recognized.

participants' preferences showed the same trend as the preferences shown in Sauppe et al.'s study, but there was a smaller difference between the frequency of agent voice patient-initial (verb-*ng*-*ang*, 15%) and agent voice agent-initial (verb-*ang*-*ng*, 8%) productions.

The studies reported so far all indicate that patient voice agent-initial (verb-*ng*-*ang*) is the overall most preferred construction for adult speakers of Tagalog. The production data further suggest that in the agent voice, subject-final (i.e., agent-final) constructions are preferred compared to agent-initial/subject-initial constructions. This finding is in line with the majority of proposals on Tagalog's basic word order and supports the assumption that adults' preferences are driven by an agent-first but also by a subject-last principle. The patient voice agent-initial (verb-*ng*-*ang*) structure obeys both of these principles, which could explain the overall preference for these constructions. The results for the agent voice suggest a slight dominance of the subject-last principle over the agent-first principle, as the participants preferred patient-initial sentences in this voice (subject-last utterances). This pattern could indicate that for Tagalog-speaking adults, grammatical principles of word order dominate principles that consider the thematic roles of the arguments. However, such a conclusion is premature based on the present data. In both production experiments, agent voice constructions were produced less, so there were fewer data points to compare. Moreover, Sauppe et al. (2013) did not control for the animacy of the themes in their stimuli. In Tanaka's (2016) study, there was no agent voice production from stimuli with animate patients (N. Tanaka, personal communication, February 15, 2017). As studies have shown that animacy has an effect on word order

choice and grammatical role assignment (Branigan, Pickering, & Tanaka, 2008; Ferreira, 1994; Prat-Sala, Shillcock, & Sorace, 2000), animacy should be controlled for in an experiment in order to dissociate the subject-initial from an agent-initial preference.

2.1.2 Acquisition of Tagalog word order

Empirical studies on the acquisition of Tagalog word order are scarce. One of the earliest studies that looked at the interaction of voice and word order in Tagalog acquisition was done by Segalowitz and Galang in 1978. They found that Tagalog-speaking children (mean ages: 3;6, 5;6, 7;4) correctly interpreted verb-*ng*-*ang* sentences in the patient voice (agent-initial) but not in the agent voice (patient-initial). This asymmetry was not observed in their production experiment, which showed no difference in children's accuracy in using the agent voice and the patient voice. However, their study does not inform on children's word order preference because they provided the initial argument in order to check for voice mastery.

Focusing more on word order preference, Bautista's (1983) picture description task showed that children (mean ages: 2;2–4;6) had a preference for the agent-initial order (88%) compared to the patient-initial order (12%). In a longitudinal study of spontaneous speech samples of six children (ages: 1;2–4;11), Marzan (2013) reported that verb-agent-patient constructions were one of the most used constructions in the data set. However, voice was not considered in Marzan's study, and Bautista did not report the interaction of word order and voice, so it cannot be determined based on these data

whether the agent-initial preference is dependent on voice.

More recently, Tanaka (2016) gave children (mean age: 5;5) the same picture description task as in her production experiment with adults described above. According to her results, children—like adults—mostly produced patient voice agent-initial (verb-*ng*-*ang*) constructions. However, in contrast to the adults, children preferred agent-initial utterances for the agent voice (verb-*ang*-*ng*) as well. There were also a few patient voice patient-initial (verb-*ang*-*ng*) constructions, but unlike the adults in her study, the children did not produce agent voice patient-initial (verb-*ng*-*ang*) constructions.

The results from the reported studies on word order in Tagalog suggest differences between word order preferences of children and adults: Unlike adults who show an agent-initial preference only in the patient voice (verb-*ng*-*ang*), children also seem to prefer agent-initial sentences in the agent voice (verb-*ang*-*ng*). This finding suggests that children are less driven by the grammatical function of an argument but by the agent-first principle when choosing a word order in their production and thus follow different principles in word order than adult speakers of their language. However, the data based on Tagalog-learning children is still too scarce to draw such a strong conclusion. First, due to the general preference of patient voice in children, as well as adults, the number of utterances in agent voice was very limited in the previous production studies. Furthermore, Tanaka (2016) did not consider a potential effect of animacy on word order as both sentences with and without animacy contrast of the arguments were included in her task but not analyzed separately. Since animacy has been shown to interact with children's word order preferences in other languages (Cannizzaro, 2012), we

further investigated word order preferences in Tagalog using an experimental design that held animacy constant and provided conditions in which a higher number of agent voice productions could be elicited.

2.1.3 Current study

In this study, we examined Tagalog-learning children's word order preferences to determine whether an agent-first principle is stronger in guiding their word order preferences than a word order that is based on the grammatical function of the argument as data from adult Tagalog speakers suggest. We directly manipulated the voice-marking of the verbs in a sentence completion task to experimentally test and compare Tagalog adult's and children's word order preferences in agent and patient voice. Providing a voice-marked verb allowed us to investigate word order preferences in a highly controlled fashion and to elicit the same number of productions for the agent voice and the patient voice. We also held animacy constant to control for the possible bias to code an animate argument before an inanimate argument. Furthermore, in order to see when children reach adult-like behaviour, we included adult participants and two groups of children that differed in age: 5-year-olds as in the study by Tanaka (2016) and an older group of 7-year-old children.

2.2 Experiment 1: Word order preferences of adults

In Experiment 1, we gave adult native speakers a sentence completion task to determine their word order preferences in both the agent and patient voice. Based on Kroeger's (1993b) proposed agent-first and subject-last principles of ordering full noun phrases in Tagalog, we would expect the adults to show an agent-initial preference in the patient voice (verb-*ng*-*ang*), but no such preference in the agent voice. However, if adults' word order preference is more strongly guided by the subject-last than the agent-first principle, we would expect more patient-initial than agent-initial orderings in the agent voice.

2.2.1 Method

Participants

Twenty native Tagalog speakers (mean age: 19 years, age range: 18–24 years, males: 10) from a university in Manila participated in this study. They were all raised in Metro Manila, which was a selection criterion because there are different Tagalog dialects in other Philippine provinces. No participant reported a history of language delay, or a psychiatric or neurologic disorder. Informed consent was obtained. Participation was absolutely voluntary without any monetary compensation. Ethical approval was obtained from the University of Potsdam.

Materials

Sixteen transitive verbs (*hila* 'pull,' *silip* 'peek at,' *sipa* 'kick,' *huli* 'capture,' *palo* 'hit,' *pasan* 'give a piggyback ride,' *kagat* 'bite,' *tira* 'hit,' *sagip* 'rescue,' *gamot* 'cure,' *pili* 'choose,' *tawag* 'call,' *salo* 'catch,' *karga* 'carry,' *baril* 'shoot,' and *habol* 'chase') were selected so that either of two animate entities could act as the agent or the patient. We chose animals as doers and receivers of the actions to make the task more interesting for children, and because animals are usually in children's vocabulary. We assigned each verb to an animal pair from a pool of eight animals. Each verb was depicted in two pictures, such that the agent animal on the first picture was the patient animal on the second (see Figure 2.1 for an example of such a picture pair), resulting in a total of 32 pictures. The pictures were created by a professional artist. All of these images were digital, colored, and with a resolution of 1650 x 1276 pixels. We also counterbalanced the side on which the agent and patient appeared in the picture.

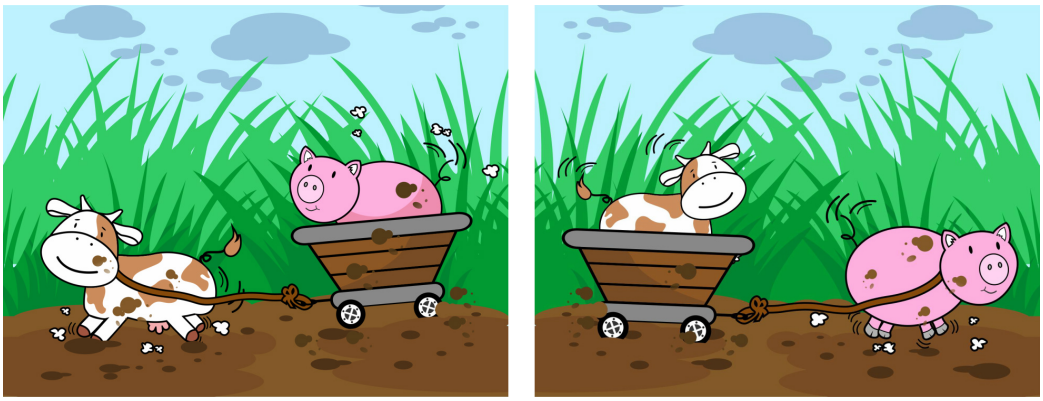

Figure 2.1. Picture pair for the verb–hila 'pull'

Each verb was used in both voices leading to a total of 32 verb forms. For example, the verb *hila* 'pull' is *humihila* in the agent voice and *hinihila* in the patient voice condition. All verbs were inflected for the imperfective aspect, which is the easiest aspect for children to understand (Galang, 1982).

To produce the stimulus materials, verb-initial sentences containing the voice-inflected verbs were recorded by a female native Tagalog speaker in an audio recording booth using the Audacity(R) 2.1.0 program (Audacity Team, 2015). The verbs were then cut from the wav files. Each sound file contained one inflected verb, had no silence, and was about 800ms long.

Each of the 32 pictures was combined to each audio-recorded verb form resulting in 64 verb-picture combinations. Each verb-picture combination was assigned to four different lists, following a Latin square design. Each list contained eight verbs in the agent voice and eight verbs in the patient voice with each lexical verb being used only once. Moreover, each participant was assigned to only one list. The experiment was presented using DMDX Version 5 (Forster & Forster, 2014), in a pseudo-randomized order, such that the same experimental condition was not presented more than three times consecutively.

Procedure

The participants were tested individually in a quiet university room. The experimenter (first author) sat next to each participant, and presented the experiment on a 13-inch laptop which was about 50 centimeters away from the participant. The responses were recorded using a video or audio recorder.

First, the experimenter presented single pictures of the animals that

would appear in the main experiment, as well as the actions mentioned in the stimuli sentences (the pictures showed the actions between two boys instead of between two different animals like in the main experiment). The pictures were presented four at a time, and the participants were asked to point to the picture of the concept that was labeled by the experimenter. This task was administered to ensure consistency with Experiment 2, in which children were tested. Next, the sentence completion task was conducted. The participants were informed that they would first see a picture, and then hear a word through the head phones. Their task was to complete the sentence which starts with this voice-marked verb, in order to describe the scene depicted in the picture. They were instructed not to repeat the verb, and only mention the arguments. Each picture was presented in full screen for 2500ms before the audio-recorded verb was played. The picture remained on the screen and the audio was replayed after every 10 seconds as long as no response was provided.

Four practice items were presented before the actual experiment. Feedback was given, but was limited to reminders that the given word (the verb) should be in the beginning of the sentence, and that the event in the picture should be completely described. During the actual experiment, no feedback was given. The participants were offered a chance to have a break halfway through the experiment.

Data analysis

The video and audio recordings of the testing sessions were transcribed by a native Tagalog speaker. The independent variable was voice-marking (agent

voice, patient voice), and the depicted agent's position in the sentence was treated as dependent variable. The statistical analysis software R version 3.2.5 (R Core Team, 2016) was used for computations. Chance performance was analyzed using logistic mixed models, specifically the R function glmer (family = binomial, optimizer = bobyqa) of the lme4 package version 1.1-12 (D. Bates, Mächler, Bolker, & Walker, 2015). The model included the fixed effect of voice, and the random effect of voice by subject and by item.

Single-argument productions (3%)[5] and trials wherein participants produced verbs which were different from the presented stimuli were not included in the analysis. Items including the verb *pasan* 'give a piggyback ride' (6%) were removed from all subsequent analysis due to an unexpected thematic role assignment by several participants. For example, for a picture of a chicken giving a mouse a piggyback ride, we expected that in the agent voice the *ang* marker would be used for the chicken as it is the agent of the action. However, six out of the 20 adult participants used *ang* for the mouse, and the preposition *sa* instead for the chicken which turned it into a locative, which means that the mouse is the agent, doing the action of riding the chicken. We also excluded another case of incorrect verb interpretation, i.e., use of *karga* 'carry' to mean *talon* 'jump unto' (0.3%). A total of 10% of the data points were excluded. In addition, there were instances of a mismatch between the noun markings and the action in the picture (1%): reversals of the markers *ang* and *ng*, and use of the *ang* marker for both arguments. However, these were still included in the chance-level testing. The results do not differ when

[5]The adults' single-argument productions (8) were all in the agent voice and contained only an agent.

these instances are excluded. To summarize, we analyzed 141 data points in the agent voice and 150 data points in the patient voice.

2.2.2 Results

The mean percentage of agent-initial productions and 95% confidence intervals are presented in Figure 2.2. In the agent voice, 50% of productions were agent-initial; while 98% of patient voice productions were agent-initial. We analyzed whether adults' production of agent-initial constructions exceeded chance-level, i.e., 50% as the agent could occur only before or after the patient. The logistic mixed model showed that the amount of agent-initial constructions was not different from chance in the agent voice (Estimate = 0.50, SE = 0.59, z = 0.004, p >.99), but above chance in the patient voice condition (Estimate = 1.00, SE = 2.37, z = 2.67, p = .008).

We performed an item-analysis in the agent voice productions of the adults, and considering 70% as the minimum for showing a preference, we found that they showed an agent-initial preference in four verbs (*silip* 'peek at,' *tawag* 'call,' *baril* 'shoot,' and *habol* 'chase'), a patient-initial preference in three verbs (*huli* 'catch,' *tira* 'hit,' and *pili* 'choose'), and no preference in the remaining eight verbs[6]. A subject-analysis showed that six adults had an agent-initial preference, six a patient-initial preference, and eight had

[6]It is widely recognized that transitivity is not a dichotomy, but rather a scale (Hopper & Thompson, 1980), such that some verbs have arguments that have more typical agent and patient characteristics, while other verbs do not. This difference between verbs may or may not contribute to Tagalog-speakers' word order preference. However, this issue cannot be addressed by the current research.

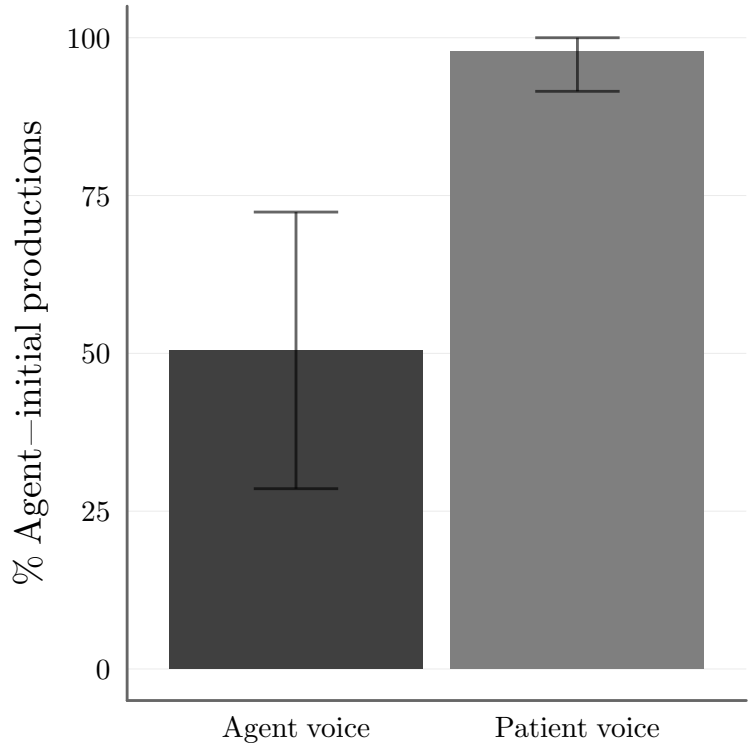

Figure 2.2. Mean percentage of agent-initial productions in Experiment 1 with between participant 95% confidence intervals per voice condition.

no word order preference. These results show that the chance-level performance was not only brought about by half of the items/subjects showing an agent-initial preference, and the other half a patient-initial preference.

2.2.3 Discussion

Adults showed an agent-initial preference in the patient voice (verb-*ng*-*ang*), but no preference for one of the orders in the agent voice, showing that voice affects word order preferences in Tagalog speakers. The agent-initial preference in the patient voice is in line with findings from previous studies

on Tagalog, which utilized other methods, such as grammaticality judgement and free picture description tasks (Hsieh, 2016; Manueli, 2010; Sauppe et al., 2013; Tanaka, 2016)

The lack of a clear preference in the agent voice, which is in line with Hsieh's (2016) findings, provides empirical support for Kroeger's (1993b) claim regarding the ordering of non-pronominal arguments. As mentioned in the introduction, Kroeger claims that the order of full noun phrases in Tagalog is guided not only by an agent-first principle but also by a subject-last principle. In the agent voice, these two principles are in competition with each other as an agent-initial construction (verb-*ang*-*ng*) satisfies only the agent-first principle, but violates the subject-last principle; while a patient-initial construction (verb-*ng*-*ang*) satisfies only the subject-last but not the agent-first principle. This competition could explain why no preferred word order could be found in this condition. In contrast, in the patient voice, both principles are satisfied in an agent-initial construction (verb-*ng*-*ang*), but violated in a patient-initial construction (verb-*ang*-*ng*) which may lead to a high and homogeneous preference for the agent-initial and simultaneously subject-last order in this condition.

However, the results do not fully conform to Sauppe et al.'s (2013) and Tanaka's (2016) findings which seemed to show that adult native speakers put more weight on the subject-last principle compared to the agent-first principle. In contrast, in the current experiment, no principle seems to outweigh the other as no statistically significant preference for one or the other order was found in our results for the agent voice. As already mentioned, our study did not elicit productions with animacy contrasts between the arguments, so

differences in the results between our study and those of Sauppe et al. and Tanaka could be due to the fact that they did not control for this factor. Since animacy has been shown to affect both word order and grammatical functions (Branigan et al., 2008; Ferreira, 1994; Prat-Sala et al., 2000), the use of animate patients in the current study and mostly inanimate patients in the previous studies makes it difficult for the results to be compared with each other.

2.3 Experiment 2: Word order preferences of children

In Experiment 2, Tagalog-speaking children (5- and 7-year-olds) were tested with the same experimental design and the same materials as the Tagalog-speaking adults in Experiment 1. We wanted to know whether Tagalog-speaking children have a general agent-initial bias, similar to children learning other languages; or if they show this preference only in the patient voice, similar to the adults in Experiment 1.

2.3.1 Method

Participants

In total, 65 typically-developing children from Metro Manila, Philippines, participated in the study. There were thirty-four 5-year-old and thirty-one 7-year-old participants. All of the children had Tagalog as their native and dominant language. Most of them were also exposed to English, while a

few had exposure to other Philippine languages like Cebuano (4), Bikol (2), Ilonggo (2), Waray (1), and Ilokano (1). The 5-year-old children (mean age: 5;9, range: 5;4–5;11, males: 11) were Kindergarten students from two public elementary schools, while the 7-year-olds (mean age: 7;8, range: 7;3–7;11, males: 20) were Grade 2 students from the same schools. Informed consent was obtained from the children's parents. No history of language delay was reported for any of the children.

Materials

The materials were identical to those used in Experiment 1.

Procedure

The procedure was similar to that of Experiment 1, with a few additional instructions for the children. Whenever a participant had made a mistake during the pre-experiment phase where they had to identify the animals and actions used in the experiment, they were reminded to look at all of the pictures again, and to listen more carefully. They were then asked to identify all the items on the screen again. The practice session for the actual experiment was started only when the participant had succeeded in identifying all the animals and actions.

There were four practice items. During this phase, feedback was given, but was limited to reminders that the given word (the verb) was the beginning of the sentence, that the word should not be changed, and that the event in the picture should be completely described. No corrections were given when the participants used morphological markers on the nouns which did

not match the event depicted in the picture. During the actual experiment, no feedback was given except when the participants changed the inflection of the verb (most of the children repeated the verb to start their sentence). These incorrectly repeated items were presented again, by waiting for the 10-second programmed time for the verb prompt to be replayed. In addition, to motivate the children to finish the task, the experiment was presented as a game, in which they had to help a boy reach the finish line in a race.

Data analysis

Data analysis followed Experiment 1, with the addition of age group (5-year-olds, 7-year-olds) as an independent variable. The correctness of the morphological markers on the noun phrases, and the specific errors made (morphological marker reversals, or the use of *at* 'and' to conjoin the two noun phrases, and of *ang* or *ng* for both noun phrases) were also noted. Self-corrections were considered as correct only when the children produced single-argument constructions on the first try (twice in the 5-year-olds, four times in the 7-year-old group). The trials in which the participants changed the voice-marking on the verb were not included. The item *pasan* 'give a piggyback ride' was also excluded from subsequent analyses because of the same reason as in Experiment 1.

Aside from the *pasan* items, 9% of the remaining data points were excluded because of the following reasons: single-argument productions (4% from the 5-year-olds, 2% from the 7-year-olds), incorrect interpretation of the verb (0.9% from the 5-year-olds, 0.4% from the 7-year-olds), conjoined noun phrase productions (0.5% from the 5-year-olds, 0.7% from the 7-year-

olds), not following the instructions (0.5% from the 5-year-olds, 0.1% from the 7-year-olds), and skipped trials (0.1% from the 5-year-olds, and 0.2% from the 7-year-olds).

In addition, in 14% of the data, there was a mismatch between the noun markers and the action in the picture (8% from the 5-year-olds, 6% from the 7-year-olds). For example, given an agent voice-inflected verb, a participant marked *pig* with *ang*, when the agent in the picture was the cow, and thus, should have had the *ang* marker. However, these were still included in the model, as we were mostly interested in the order of mention of the agent of the action depicted in the picture. So in the example, as the cow was mentioned first, regardless of the noun marker, this utterance was judged as *agent-initial* (see Appendix A for the results of the analyses when nouns with mismatched markers were excluded). The breakdown of the errors is discussed in a separate section. The number of analyzed data points per condition is shown in Table 2.1.

Table 2.1

Number of analyzed data points per condition in Experiment 2.

	5-year-olds	7-year-olds
Agent voice	217	214
Patient voice	237	222

2.3.2 Results

The mean percentage of agent-initial productions and 95% confidence intervals are presented in Figure 2.3. In the 5-year-olds, agent-initial productions comprised 87% of agent voice productions, and 74% of patient voice productions. In the 7-year-olds, agent-initial order was observed in 90% of agent voice productions and 82% of patient voice productions. We analyzed whether 5- and 7-year-olds produced more agent-initial constructions in each voice condition compared to chance. The logistic mixed model showed that both age groups more often used an agent-initial construction than expected by chance in both voice-marking conditions (see Table 2.2). Performing a subject-analysis showed that only one of the 7-year-olds showed a patient-initial preference in the agent voice condition, while the remaining 30 showed an agent-initial preference. The 7-year-olds also showed an agent-initial preference in all of the items.

Table 2.2

Results of chance-level testing using a logistic mixed model on children's word order preference in Experiment 2.

Predictor	Estimate	Standard error	z value	p value
5-year-olds agent voice	0.91	0.35	6.72	<.001
5-year-olds patient voice	0.83	0.40	4.03	<.001
7-year-olds agent voice	0.94	0.39	6.90	<.001
7-year-olds patient voice	0.92	0.46	5.24	<.001

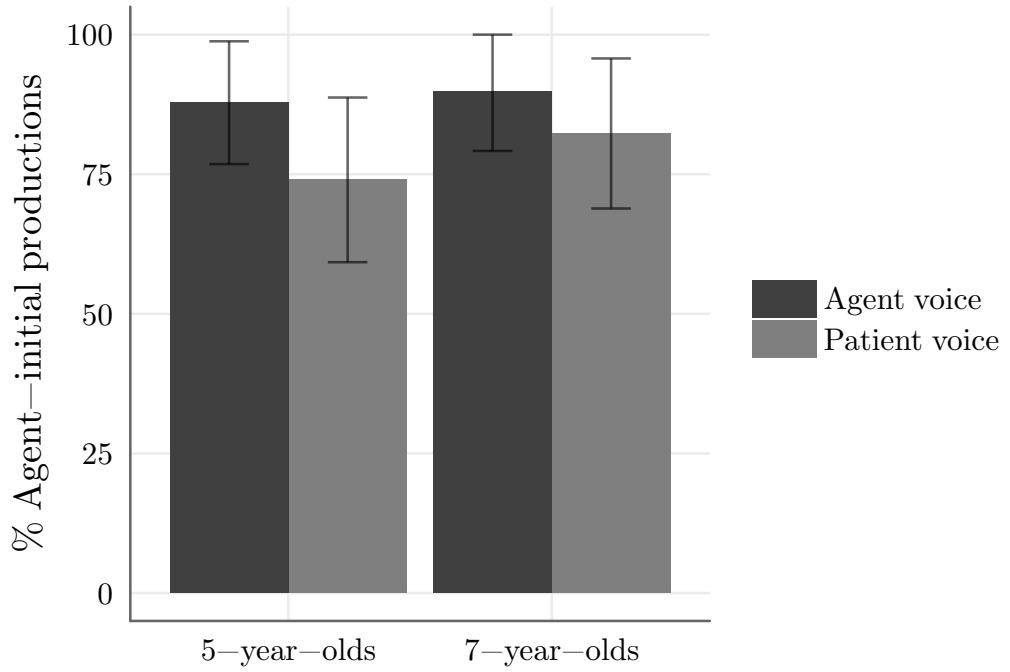

Figure 2.3. Mean percentage of agent-initial productions in Experiment 2 with between participant 95% confidence intervals per voice condition within each age group.

As noun marking errors provide insight on the children's mastery of the Tagalog voice-marking system and their preferred voice-marking on the verb, we also analyzed the accuracy in marking the nouns with *ang* and *ng* (see Figure 2.4). Accurate means that both nouns were marked correctly in relation to the voice-marking on the verb, such that the sentence interpretation matches the action depicted on the picture. We fitted a mixed-effects logistic model to determine the effects of voice, age, and their interaction, on the accuracy in marking the nouns with *ang* and *ng*. The results showed a main effect of voice (see Table 2.3), such that the children were more accurate in marking the nouns given a patient voice-inflected verb compared to an agent

voice-inflected verb.

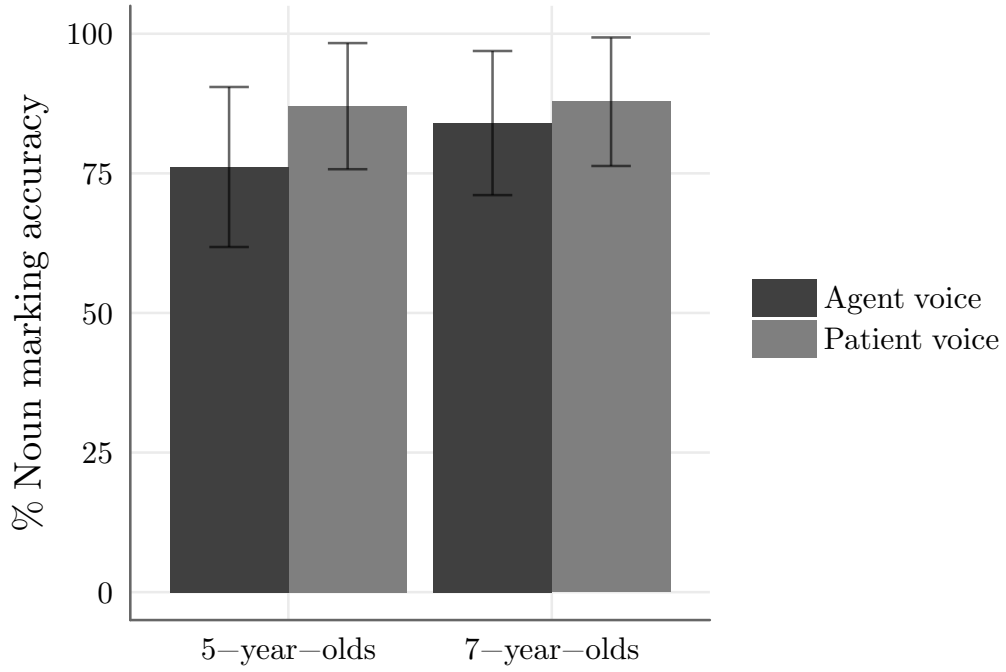

Figure 2.4. Mean percentage noun marking accuracy in Experiment 2 with between participant 95% confidence intervals per voice condition within each age group.

The 5-year-olds produced 17% of the nouns with a wrong marking while the 7-year-olds made only 14% of such errors. In the 5-year-old group, 66% of the errors occurred in the agent voice, while this was the case for 52% of the errors in the 7-year-olds. For both 5- and 7-year-olds, more than half of the errors were reversals of *ang* and *ng* (see Figure 2.5 for a breakdown of the errors per age and voice-marking). The remaining errors consisted of the use of *ang* for both arguments or *ng* for both arguments, and of dropping a noun marker in one of the arguments.

Table 2.3

Summary of the fixed effects of voice, age, and their interaction on children's noun-marking accuracy in Experiment 2 (N = 890; log-likelihood = -327.5).

Predictor	Estimate	Standard error	*z* value	*p* value
Intercept	2.66	0.31	8.50	<.001
Voice	1.16	0.54	2.17	.03
Age	0.36	0.50	0.72	.47
Voice*Age	-0.31	0.38	-0.80	.42

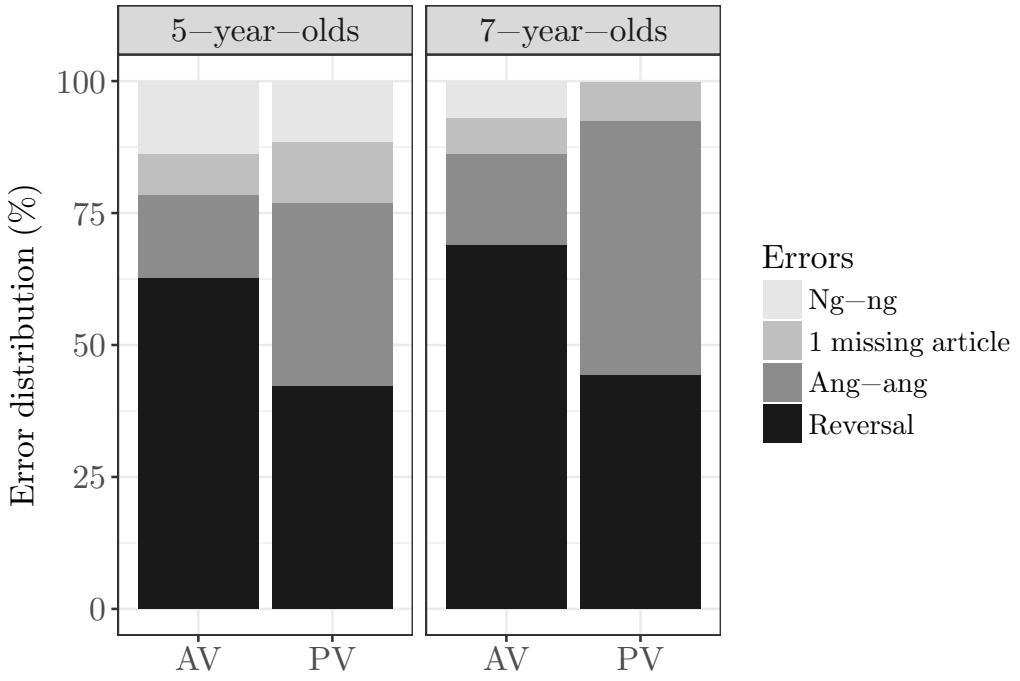

Figure 2.5. Percentage distribution of noun-marking error within each voice condition (AV: agent voice, PV: patient voice) within each age group in Experiment 2.

We also further analyzed the reversals of *ang* and *ng*. We fitted a mixed-effects logistic model to determine the effects of age, voice, and the interaction of the two, on the number of reversal errors. The results showed no significant main effects of age, voice, nor the interaction of the two (see Table 2.4).

Table 2.4

Summary of the fixed effects of voice, age, and their interaction on children's noun-marking reversal errors in Experiment 2 (N = 890; log-likelihood = -220).

Predictor	Estimate	Standard error	*z* value	*p* value
Intercept	-4.15	0.69	-6.06	<.001
Voice	-2.35	1.36	-1.73	.08
Age	-0.18	0.62	-0.29	.77
Voice*Age	0.26	0.65	0.39	.69

Out of the 34 five-year-olds, 30 repeated the verb before completing the sentence, while 25 out of the 31 seven-year-olds did so. The 5-year-olds incorrectly repeated the verb in 7% of the experimental trials, and the 7-year-olds in 8% of the trials. For the 5-year-olds, 79% of these incorrect repetitions involved a change of an agent voice-inflected verb to a patient voice-inflected verb, 14% of changes from patient voice to agent voice, and 7% of instances of use of other verbs aside from the one provided (i.e., *sagip* 'rescue'). For the 7-year-olds, 90% of the incorrect repetitions involved a change from agent voice to patient voice, 3% change from patient to agent

voice, and 7% of use of other patient voice-inflected verb for *sagip* 'rescue.'

2.3.3 Discussion

Five- and 7-year-old children showed a preference for agent-initial constructions in both the agent voice (verb-*ang*-*ng*) and the patient voice (verb-*ng*-*ang*). The same preference was shown by the 5-year-old Tagalog-speaking children in Tanaka's (2016) free picture description experiment. Moreover, these results are in line with findings of an early agent-initial preference in other languages (Angiolillo & Goldin-Meadow, 1982; Brown, 1973 for English; Cannizzaro, 2012 for Dutch and English; Lee, 2010 for Mandarin; Slobin & Bever, 1982 for Italian, Serbo-Croatian, and Turkish; Tanaka & Shirai, 2012 for Japanese). The current results also support Jackendoff and Wittenberg's (2014) proposal that children prefer a word order that places the agent before the patient.

More importantly, these findings support the claim that this word order preference results from a direct mapping of thematic roles and linear argument order, without regard for grammatical categories like subject and object, and their preferred positions. In Tagalog, an agent-initial order is the same as a subject-initial order only in the agent voice. However, in the current experiment, an agent-initial preference was also found in the patient voice, which has a subject-final order. As the first noun phrase position in Tagalog is not confounded with the subject position, and the agent is not a preferred subject, the results show that children's word order preference is semantically-driven, and not merely brought about by the preferred order

of grammatical functions (i.e., subject-initial). The current findings support claims that the agent-initial preference is due to more general and not exclusively linguistic reasons such as the agent's higher ranking in the thematic hierarchy (Siewierska, 1993), and thematical independence (Primus, 2006).

The results further revealed that children used the appropriate noun markings in both the agent and the patient voice in more than 75% of their productions. However, they still made noun marking errors, such as the use of *ang* instead of *ng* or vice versa, or not using a noun marker at all, which may indicate that they have not yet fully mastered the voice-marking system of Tagalog. However, we attribute these errors to the design of the experiment. Children might have anticipated a particular voice-marked verb upon seeing the action in the picture, and could not overwrite this when they heard another voice-marking instead. The errors in noun-marking and the exchange of the voice-marker on the verb provide insight on this anticipation or voice preference. For both groups of children, there were more noun-marking errors in the agent voice than in the patient voice, and the incorrect repetitions of the voice-marking of the verbs were mostly changes of the agent voice inflection to the patient voice compared to the reverse. These findings implicate a general patient voice preference, which has also been previously found in a less restricted picture description task for children as well as adults (Tanaka, 2016; Tanaka et al., 2015).

2.4 General discussion

This study investigated the word order preferences of Tagalog-speaking adults and children. The results of Experiment 1 showed that adults preferred agent-initial constructions in the patient voice (verb-*ng*-*ang*), but they had no word order preference in the agent voice, supporting previous research on word order preferences in Tagalog (Hsieh, 2016). The results are also in line with Kroeger's (1993b) proposed principles guiding the ordering of non-pronominal arguments in Tagalog: agent-first and subject-last.

In Experiment 2, the findings revealed that 5- and 7-year-old children preferred agent-initial constructions not only in the patient voice (verb-*ng*-*ang*), but also in the agent voice (verb-*ang*-*ng*)—a pattern different from the one shown by the adults. The children's data are consistent with Tanaka (2016) findings, supporting the claim that children exhibit this universal tendency of an agent-initial preference early on (Jackendoff & Wittenberg, 2014). The results do not show a subject-initial preference, but an agent-initial preference by the children instead. Primus (2006) proposed that an agent-initial preference is due to a universal principle that the thematically independent role (agent) tends to precede and/or c-command the role that is thematically dependent (patient). Our data from Tagalog-speaking children support this assumption and show that this preference is quite stable in children even if their language does not provide unique support for this ordering.

The results also imply that adults' word order preferences are affected by the voice-marking on the verb. Adults showed a preference for agent-initial orderings only in the patient voice, but not in the agent voice. This result

suggests that Tagalog has a preferred word order only in the patient voice, which could be characterized as agent-initial and subject-final. If children first acquire the language's canonical forms (Slobin, 1982; Slobin & Bever, 1982), Tagalog-speaking children would first acquire the patient voice agent-initial order. The results of the current study support this claim. As regards the children's agent-initial preference in the agent voice, it could be the case that they have derived this pattern from the preferred order for the patient voice. After all, the patient voice is also more frequently used compared to the agent voice in constructions with two arguments. When we analyzed a child-directed speech sample taken by Marzan (2013) from daily family interactions of one Tagalog-speaking child (from the age of 3;0–4;11), 83% of constructions with voice-inflected verbs and two arguments were in the patient voice, and only 17% were in the agent voice. The patient voice constructions were also 90% agent-initial. The results of the current study imply that children overgeneralize this preferred order for the patient voice to the agent voice.

It could be argued that children have the same word order preference for the two voices, only because they could not distinguish and make use of the verb markers for the agent and for the patient voice. However, children's correct use of the noun markers in both voices in the current experiment actually shows that they know that the agent voice infix on the verb marks the *ang*-phrase as the agent of the action while the patient voice infix on the verbs marks the *ang*-phrase as the patient. Their preference for an agent-initial construction for both voices also shows that they are aware of the differences between the two voices, since agent-initial is verb-*ang*-*ng* in the

agent voice, but verb-*ng*-*ang* in the patient voice.

Children's agent-initial preference in the agent voice shows that they rely more strongly on the agent-first principle than on the subject-last principle for ordering non-pronominal arguments in Tagalog. It could be that children are aware of the two principles, but give priority to the agent-first principle compared to the subject-last principle. Another possibility is that even 7-year-old Tagalog-speaking children follow only the more universal agent-first principle, but have not yet acquired the more language-specific subject-last principle. This inference suggests that the acquisition of some language-specific features may go beyond the age of 7 years.

The lower priority or the late acquisition of the subject-last principle might also be due to the low frequency of utterances with two full noun phrases which is typical of spontaneous speech in general (Du Bois, 1987). If most utterances contain a pronoun, the subject-last principle may not be well-attested in the language input that children receive, given the more constrained order of pronouns in Tagalog. Given verb-initial sentences, pronouns are expected to appear immediately after a verb irrespective of their grammatical function (Billings, 2005). In fact, in the same child-directed speech sample from Marzan (2013), we found that only 3% of the utterances with a voice-inflected transitive verb had two non-pronominal arguments. Among these utterances, only one had a subject-last order. The rest of the utterances with two arguments contained pronouns. In 97% of sentences with one pronoun and one full noun phrase, the pronoun referred to the agent. Therefore, it could be that Tagalog-speaking children hear very few non-pronominal constructions with a subject-last order.

Children might prefer agents in the initial position, even in the agent voice, because they overgeneralize the stricter order of pronouns in their input. As shown by Matthews, Lieven, Theakston, and Tomasello (2005), children may learn word order from distributionally regular items like pronouns. Since agents are usually given information in discourse (Du Bois, 2003), and pronouns are used to represent given information (Weber & Müller, 2004), agents tend to be coded as pronouns (Bowerman, 1978). There is even evidence that pronouns tend to be used for agents rather than for patients (Angiolillo & Goldin-Meadow, 1982). Since pronouns occupy the position immediately after the verb in canonical Tagalog sentences (Billings, 2005), agent-initial constructions are probably more frequent in the input if pronouns are typically referring to agents. In the same child-directed speech sample from Marzan (2013) as described above, 86% of the two-argument utterances which contained at least one pronominal argument had an agent-initial order. In addition, all of the agent voice utterances with pronouns were actually agent-initial. We can say that children might have overgeneralized the dominant agent-initial order of sentences with pronouns in the input to sentences with non-pronominal arguments like in the current experiment.

Overall, the results showed that children were aware of the flexibility of word order in Tagalog, since they preferred verb-*ang*-*ng* in the agent voice but verb-*ng*-*ang* in the patient voice. However, at age seven, they still did not show adult-like distribution of productions in the agent voice. Concerning the children's ability to use voice-marking per se, there were more instances of incorrect repetitions of the verbs from the agent voice to the patient voice, compared to the opposite direction. Moreover, both groups of

children made more errors in marking the nouns in the agent voice compared to the patient voice. These results imply a patient voice preference which is in line with findings from adult corpus data (Cooreman et al., 1984) and previous production experiments (Sauppe et al., 2013; Tanaka, 2016; Tanaka et al., 2015). These findings show that with respect to the distribution of the agent and patient voice, even 5-year-old children are more adult-like than with respect to word order properties. It could be that the complex interplay of verbal and nominal markings and word order in Tagalog makes the system more difficult for children to acquire. It is then of interest to test older children to see when they start showing adult-like distributions. In addition, cross-linguistic comprehension studies show that children start correctly interpreting non-canonical word orders (e.g., use of morphological markers instead of a first-noun-phrase-as-agent strategy) as early as around two years of age in Turkish (Slobin & Bever, 1982), and between the ages of five and seven in German (Dittmar et al., 2008). Given the strong preference for agent-initial productions in Tagalog even at the age of seven, it would be interesting to see whether this preference is also found in comprehension.

In conclusion, even at the age of seven, Tagalog-speaking children are still tuning into the word order preferences of their language. A lot remains to be explored in the acquisition of word order, and investigations using understudied languages can broaden our understanding of this phenomenon.

Chapter 3

Thematic role assignment in Tagalog: A self-paced listening study

[1] Garcia, R., Roeser, J., & Höhle, B. (2018). Thematic role assignment in the L1 acquisition of Tagalog: Use of word order and morphosyntactic markers. *Language Acquisition*. doi: 10.1080/10489223.2018.1525613

Abstract

It is a common finding across languages that young children have problems in understanding patient-initial sentences. We used Tagalog, a verb-initial language with a reliable voice-marking system and highly frequent patient voice constructions, to test the predictions of several accounts that have been

[1] A version of Chapter 3 is published as this article.

proposed to explain this difficulty: the frequency account, the Competition model, and the incremental processing account. Study 1 presents an analysis of Tagalog child-directed speech which showed that the dominant argument order is agent-before-patient, and that morphosyntactic markers are highly valid cues to thematic role assignment. In Study 2, we used a combined self-paced listening and picture verification task to test how Tagalog-speaking adults and 5- and 7-year-old children process reversible transitive sentences. Results showed that adults performed well in all conditions, while children's accuracy and listening times for the first noun phrase indicated more difficulty in interpreting patient-initial sentences in the agent voice compared to the patient voice. The patient voice advantage is partly explained by both the frequency account and incremental processing account.

3.1 Introduction

One of the critical tasks in language acquisition is identifying *who* did *what* to *whom* in a sentence. A number of studies across different languages have shown that children initially follow a word order strategy and interpret the first noun as the agent, resulting to reversals of the agent and patient roles in patient-initial sentences. This has been observed not just in languages which heavily rely on word order for expressing thematic roles, like English (Bever, 1970; de Villiers & de Villiers, 1973; Gertner et al., 2006; Tager-Flusberg, 1981; van der Lely, 1994) and Portuguese (Coelho de Barros Pereira Rubin, 2009), but also in languages with a more flexible word order wherein thematic roles are assigned by morphosyntactic markers, such as German

(Dittmar et al., 2008; Lindner, 2003), Hebrew (Frankel et al., 1980), Hungarian (MacWhinney et al., 1985), Italian (E. Bates et al., 1984), Japanese (Hakuta, 1977), and Serbo-Croatian and Turkish (Slobin & Bever, 1982).

However, the reasons behind children's difficulties with interpreting semantically reversible non-canonical sentences (patient-before-agent; referred to from here on simply as *non-canonical sentences*) are still a matter of debate. In this research, we used Tagalog to test three of the proposed claims: the frequency account, the Competition model and the incremental processing account. We first review the evidence supporting each claim, and then discuss properties of Tagalog which are interesting for testing the predictions that these models make. This review is followed by an analysis of word order and morphosyntactic markers in Tagalog child-directed speech (Study 1). Finally, we describe an experiment which tests Tagalog-speaking children's use of word order and morphosyntactic markers for interpreting simple transitive sentences (Study 2).

3.1.1 Possible reasons behind children's difficulties with non-canonical sentences

Different accounts have been proposed to explain children's difficulties with non-canonical sentences. These claims shed light on the strategies which children use for sentence comprehension, and when children are expected to acquire non-canonical word order in different languages.

The frequency account

According to the frequency account, children have difficulties with non-canonical sentences such as passives because these are infrequent in the input, hence children do not yet have enough experience to interpret such sentences correctly (Demuth, 1989; Gordon & Chafetz, 1990; Kline & Demuth, 2010). Corpus studies have shown that child-directed speech contains only few passive sentences in languages where passives are acquired rather late (e.g., Abbot-Smith & Behrens, 2006 for German; Gordon & Chafetz, 1990 for English). For example, Gordon and Chafetz (1990) found that in English child-directed speech, passives comprised only 0.04% of the total input.

Other studies have shown that when English-speaking children are exposed to more non-canonical sentences by experimentally increasing the input, children showed earlier acquisition of such constructions. Brooks and Tomasello (1999) showed that after extensive exposure to passive sentences, 3;5 English-speaking children could use novel verbs in passive constructions. Also, 4;0 English-speaking children who were exposed to increased passive input in story sessions produced more passive sentences and showed better comprehension (Vasilyeva et al., 2006)

An earlier acquisition of passives has also been found in languages where passives are frequent. Children already produced passives at 2;0 in Jakarta Indonesian (Gil, 2006), at 2;1 in Inuktitut (Allen & Crago, 1996), Kiswahili and Kigiriama (Alcock et al., 2012) and K'iche' Mayan (Pye & Poz, 1988), at 2;5 in Zulu (Suzman, 1987) and at 2;8 in Sesotho (Demuth, 1989; Kline & Demuth, 2010). At the age of three years, Sesotho-speaking children showed

comprehension and generalization of the passive structure to novel verbs (Demuth et al., 2010).

The Competition model

The *Competition model* (MacWhinney, 1987; MacWhinney & Bates, 1989) also recognizes the significance of frequency on the acquisition of non-canonical sentences, but it additionally emphasizes the notion of reliability of linguistic cues, e.g., word order and case-marking, for thematic role assignment. This framework provides a way to quantify the availability and usability of a particular cue. According to this model, there are three different properties that determine the relevance of a cue for sentence interpretation: availability, reliability, and validity. Cue availability refers to how frequent a cue is present in the speech input, while cue reliability reflects how often a cue points to the correct thematic role assignment. The overall measure of a cue's validity is the product of its availability and reliability.

The model predicts that sentences in which all cues point to the same argument as the agent are easier for children to understand compared to structures in which these cues are in competition with each other indicating different agents. This claim is supported by experimental findings in different languages (Abbot-Smith & Serratrice, 2015 for Italian; Dittmar et al., 2008 for German; Janssen et al., 2015 for Russian; Staroń & Kail, 2004 for Polish). For example, Dittmar et al. (2008) showed that two-year-old German-speaking children could correctly interpret only those sentences wherein both word order and case-markers indicated the same agent.

When two cues indicate different agents, the model predicts that the cue

with higher validity will win the competition and will be used for assigning thematic roles. Additionally, the most valid cue is predicted to be acquired earliest, resulting in cross-linguistic differences concerning the age at which children start to use a cue for sentence interpretation. For instance, word order has higher validity in English compared to Dutch, and English-speaking children use word order for comprehension earlier than their Dutch counterparts (McDonald, 1986). In addition, the same study showed that in Dutch, word order has a higher cue validity than case-marking (present in pronouns), and that Dutch learning children rely on word order for thematic role assignment instead of relying on case-marking which is what adults do. In contrast, an early reliance on case-marking instead of word order has been found in Russian (Janssen et al., 2015) and Turkish (Slobin & Bever, 1982), which fits to the high validity of case-marking in these languages.

The incremental processing account

Like the Competition model, the incremental processing account claims that a listener uses several cues like word order and morphosyntactic markers for thematic role assignment. However, the account incorporates the importance of when a cue is given in a sentence. According to this account, children process incoming information incrementally and immediately similar to adults, but a problem occurs when a late-arriving cue is in conflict with the interpretation of previously given information, because children have difficulties in revising an earlier interpretation (Trueswell & Gleitman, 2004, 2007).

Children's difficulty in revising an initial interpretation has been found in studies involving ambiguities in prepositional phrase attachment (Trueswell

et al., 1999), long-distance dependencies (Omaki et al., 2014), and quantified noun phrases (Musolino & Lidz, 2006). For example, Trueswell et al. (1999) showed that when listening to sentences such as *Put the frog on the napkin in the box* while being presented with an array of objects outside of an empty box such as a frog, a napkin, and a frog on a napkin, adults and children first interpreted 'on the napkin' as the destination of the action. After hearing the second prepositional phrase in the box, adults correctly moved the frog which was on the napkin into the box. However, children did not revise their destination interpretation, and still moved the frog to the napkin.

As regards passive sentences, Huang et al. (2013) showed that in Mandarin, 5-year-olds correctly interpreted passives more often when the passive marker BEI (indicates that the first noun phrase is a patient) appeared after a pronoun (It BEI seal eat *It is eaten by the seal*), compared to when the marker appeared after a referential noun (Seal BEI it eat *The seal is eaten by it).* The authors argued that children do not immediately assign a thematic role to a non-referential noun (e.g., *it*), but do so for a referential noun. Therefore, there is no need to revise an earlier thematic role assignment for the former when the passive marker is encountered, but a revision is needed for the latter. This finding supports Trueswell et al.'s (2012) claim that processing is easier when morphosyntactic markers are used for guiding instead of revising an initial interpretation.

3.1.2 Thematic role assignment in Tagalog

Tagalog is a language that has structural properties that allow for further testing the accounts targeting children's difficulties with non-canonical sentences. Tagalog is different from previously studied languages, because due to its canonical verb-initial order and voice-marking system, the thematic role of an argument is always unambiguously marked in basic sentences.

In this language, the verb is inflected for voice, aspect, and mood. The voice marker on the verb assigns the *ang*-phrase its thematic role (Himmelmann, 2005b). Most important for the purpose of our study, the marker *ang* precedes the noun. The agent voice (AV)[2] infix –*um*– denotes that the *ang*-phrase is the agent as in (3.1, 3.3). The patient voice (PV) infix –*in*– indicates that the *ang*-phrase is the patient as in (3.2, 3.4). Therefore, a mere change in the voice-marking on the verb in a given sentence reverses the roles of agent and patient. Based on a corpus of written text, Cooreman et al. (1984) claimed that the patient voice is more frequent than the agent voice given transitive verbs. This finding makes Tagalog interesting because the *ang*-phrase is usually the patient instead of the agent which is comparable to passives in other languages.

(3.1) H<**um**>i~hila ng baboy **ang** baka
<AV>IPFV~pull NSUBJ pig SUBJ cow
'The cow is pulling a pig.'

[2]AV refers to agent voice, PV to patient voice, IPFV to imperfective aspect, SUBJ to subject, NSUBJ to non-subject, and LIN to linker.

(3.2) H<**in**>i~hila ng baboy **ang** baka
<PV>IPFV~pull NSUBJ pig SUBJ cow
'The/A pig is pulling the cow.'

(3.3) H<**um**>i~hila **ang** baka ng baboy
<AV>IPFV~pull SUBJ cow NSUBJ pig
'The cow is pulling a pig.'

(3.4) H<**in**>i~hila **ang** baka ng baboy
<PV>IPFV~pull SUBJ cow NSUBJ pig
'The/A pig is pulling the cow.'

The order of the post-verbal arguments in Tagalog is relatively free (Schachter, 2015), and its basic order remains controversial with various proposals from different researchers: verb-agent-patient for both voices (Buenaventura Naylor, 1975; Manueli, 2010; Schachter, 2015); verb-patient-agent for the agent voice and verb-agent-patient for the patient voice (Billings, 2005); verb-agent-patient for the agent voice and verb-patient-agent for the patient voice (Aldridge, 2002); and verb-agent-patient for the patient voice and both verb-agent-patient and verb-patient-agent for the agent voice (Guilfoyle et al., 1992; Kroeger, 1993b). What is important for the current study is that word order is irrelevant for assigning thematic roles in basic sentences, so (3.1) and (3.3) have the same meaning, because they are both in the agent voice, and only the order of the nouns differs between the two sentences. The same goes

with examples (3.2) and (3.4).

Only a few studies have focused on the acquisition of Tagalog. There is evidence that children follow a word order strategy for thematic role assignment. Using a sentence-picture matching task, Segalowitz and Galang (1978) found that 3-, 5-, and 7-year-old Tagalog-speaking children correctly interpreted verb-agent-patient sentences in the patient voice but misinterpreted verb-patient-agent sentences in the agent voice. Follow-up testing using verb-medial sentences (agent-verb-patient in the agent voice and patient-verb-agent sentences in the patient voice), which are grammatical but mostly occur in formal, written language, was also performed. Children correctly interpreted agent-verb-patient sentences in the agent voice but also patient-verb-agent sentences in the patient voice, showing that children did not always just assign the agent role to the first noun.

There is also evidence from a more recent study on Tagalog relative clauses showing that children have an agent-initial preference in comprehension (Tanaka et al., 2015). In agent relative clauses ([3.5] verb is inflected for the agent voice), the agent is mentioned first; while patient relative clauses ([3.6] verb is inflected for the patient voice) have a patient-initial order. Five-year-olds correctly interpreted more agent relative clauses than patient relative clauses.

(3.5) Lalaking h<**um**>a~habol ng babae
Man-LIN <AV>IPFV~chase NSUBJ woman
'The man that is chasing the/a woman.'

(3.6) Lalaking h<**in**>a~habol ng babae
Man-LIN <PV>IPFV~chase NSUBJ woman
'The woman that is chasing the/a man.'

Taken together, these studies provide evidence that Tagalog-speaking children use an agent-first strategy for thematic role assignment. However, it is yet to be investigated how children interpret verb-agent-patient sentences in the agent voice and verb-patient-agent sentences in the patient voice. In Segalowitz and Galang's (1978) study, voice, word order, and the ambiguity of the thematic role of the first noun phrase were confounded. In verb-initial sentences wherein the thematic role of the first noun phrase was unambiguous, the agent voice condition was always patient-before-agent and the patient voice was always agent-before-patient. In contrast, in verb-medial sentences, wherein the thematic role of the first noun phrase was ambiguous, the agent voice was always agent-initial and the patient voice was always patient-initial. In Tanaka et al.'s (2015) study, agent voice constructions were always agent-initial, and patient voice constructions were always patient-initial.

3.1.3 Current research

In the current research, we take advantage of Tagalog's voice-marking system and flexible word order to test the predictions of the frequency account, the Competition model, and the incremental processing account. In order to make precise predictions, we first looked at child-directed speech. We

then used a combination of online and offline tasks to analyze children's comprehension of basic transitive sentences. To our knowledge, the current study is the first in Tagalog acquisition research to use an online task. An online task can show whether or not children process the voice marking on the verb and the marker on the noun in real time, allowing comprehension to be tested before the end of a sentence, and thus is most appropriate to test the predictions of the incremental processing account.

We analyzed children's use of word order and the morphosyntactic markers for thematic role assignment, to answer the following questions: (1) Do Tagalog-speaking children use word order or the morphosyntactic markers—voice marker on the verb and noun marker—for thematic role assignment? (2) How does this use differ among age groups?

Tagalog is interesting because the patient voice is more frequent than the agent voice. If the high occurrence of patient voice sentences in written Tagalog is also found in child-directed speech, the frequency account predicts that children would show better comprehension for patient voice sentences than for agent voice sentences.

Tagalog's complex but reliable mapping of verbal voice-marking and noun morphology is also informative for testing the claims of the Competition model. Processing of sentences wherein word order and morphosyntactic markers indicate the same agent is expected to be easier compared to sentences wherein these two cues contradict each other. The more valid cue (word order or morphosyntactic markers) is also predicted to be acquired earlier and used for thematic role assignment when the cues are in conflict.

Lastly, the incremental processing account predicts that children imme-

diately assign a thematic role based on the information that is so far present in the unfolding input. According to this account, difficulties with non-canonical sentences are due to their problem in revising an initial thematic role assignment. The fact that the thematic role assignment in Tagalog verb-initial sentences is never ambiguous allows us to check this claim. Because Tagalog is canonically verb-initial and the noun markers occur before the noun, the morphosyntactic markers that are needed for thematic role assignment are already given before the first noun is encountered. Therefore, children are expected to immediately assign the correct thematic roles when they encounter the morphosyntactic markers in the sentence. According to this account, children would not have problems in interpreting patient-initial sentences in Tagalog and would show no differences in their ability to comprehend the two voices.

In Study 1, we investigated the validities of word order and the morphosyntactic markers using a corpus of Tagalog child-directed speech, and calculated the frequency of agent voice and patient voice utterances in order to formulate precise predictions for Study 2. In Study 2, we used a combined self-paced listening and picture verification task to investigate 5-year-old and 7-year-old children's use of word order and/or voice-marking on the verb and the noun marker to identify the agent in simple transitive sentences.

3.2 Study 1: Corpus study on Tagalog child-directed speech

As the different accounts emphasize the importance of the input that children hear, we first looked at a corpus of child-directed speech from Tagalog-speaking adults. We investigated adults' use of word order and the morphosyntactic markers in transitive sentences, and calculated the corresponding cue availability, cue reliability, and cue validity. We also looked at the distribution of agent and patient voice utterances, to see whether patient voice is more frequent than agent voice in transitive sentences in child-directed speech, just as found in a written corpus (Cooreman et al., 1984).

3.2.1 Method

The data were taken from transcriptions of six video recordings of three Tagalog-speaking children's daily family interactions (two 30-minute videos per child), which were collected by Marzan (2013). The videos were recorded when the children were between 2;4 and 2;7. The transcriptions were in the Codes for the Human Analysis of Transcripts (CHAT) format, which is part of the Child Language Data Exchange System or CHILDES (MacWhinney, 2000).

A total of 3,739 child-directed utterances of different adults were analyzed. These included declaratives, imperatives, and questions, which all varied from single-word utterances to complex sentences. First, utterances with verbs were manually identified by a native Tagalog speaker, excluding verbs which

occurred in idiomatic expressions or frozen phrases. Next, those verbs which were determined to be causative transitives based on Hopper and Thompson's (1980) criteria (e.g., volitionality and affectedness) were selected, e.g., *hinila* 'pulled' was counted but not *narinig* 'heard.' The presence of voice-marking on the verbs, as well as the markers on the nouns, were then coded.

Following Dittmar et al. (2008), cue availability was computed by dividing the number of times a cue occurred in the corpus by the total number of transitive causative utterances. Cue reliability was counted as the number of times a cue correctly indicated the agent of the action, divided by the total number of utterances wherein the cue was available. Cue validity was then calculated by multiplying cue availability and cue reliability. The word order cue was considered available when a verb occurred with two noun phrases. The morphosyntactic cue was considered available when an utterance contained a voice-inflected verb and at least one marked noun. We also calculated how many of the transitive verbs were uninflected or inflected for the agent voice or the patient voice. The data were submitted to Bayesian binomial tests (Kruschke, 2011) to estimate the relative proportion of agent voice and patient voice, and agent-initial and patient-initial utterances. The estimate of the inferred average is reported as $\tilde{\mu}$, and the 95% uncertainty intervals are enclosed in [ ] in this paper.

3.2.2 Results and discussion

There was a total of 1,140 child-directed utterances which contained a verb. Among these utterances, 594 were highly causative transitives, and these

utterances were the ones used in the subsequent analyses. The availability, reliability, and validity of word order and the morphosyntactic cue are illustrated in Figure 3.1. The word order cue was available in 34% of the utterances, as these contained both an agent and a patient. In 87% of these utterances containing the word order cue, the agent occurred as the first noun phrase, indicating the reliability of the word order cue. These calculations resulted in a cue validity of 29%.

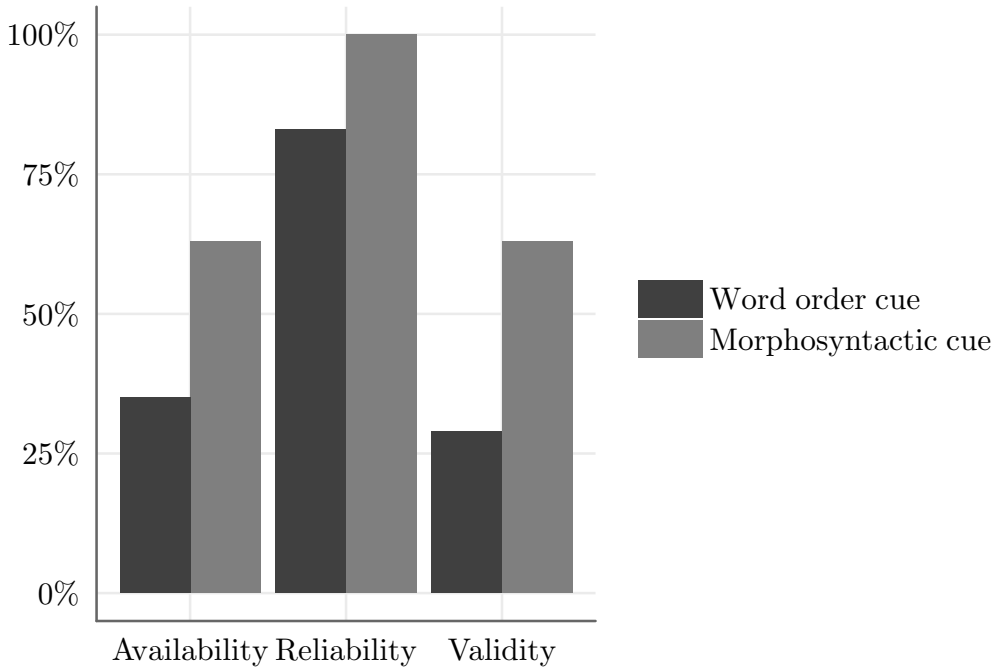

Figure 3.1. Word order cue and morphosyntactic cue's availability, reliability, and validity in transitive causative sentences in Tagalog child-directed speech from Study 1.

The morphosyntactic cue was available in 66% of the utterances. The cue was not available in 23% of the utterances because voice was not marked on the verb (20% were root words, 3% were inflected only for aspect). The rest

of the utterances contained only a verb and not a single noun (11%). The morphosyntactic cue was reliable in 100% of the times that it was available, resulting to a cue validity of 66%.

In order to make precise predictions for the frequency account, we checked the frequency of agent and patient voice in utterances with causative transitive verbs and at least one noun phrase (515 utterances). Among these utterances, 21% were inflected for the agent voice, while 53% were inflected for the patient voice. The remaining 26% contained verbs which were not inflected for voice. Among the agent voice utterances, 95% were agent-initial or contained only an agent; while 85% of the patient voice utterances were agent-initial or contained only an agent. The Bayesian binomial test showed that there was a higher posterior probability of patient voice-marked verbs in both agent-initial ($\tilde{\mu}$ = .69, [.64, .74]) and patient-initial sentences ($\tilde{\mu}$ = .86, [.76, .95]). Moreover, we also found a higher posterior of an agent-initial word order in both the agent voice ($\tilde{\mu}$ = .94, [.89, .98]) and the patient voice ($\tilde{\mu}$ = .84, [.80, .88]). These results corroborate the finding from the written corpus—patient voice is more frequent than the agent voice in transitive sentences (Cooreman et al., 1984).

The results of Study 1 provide more precise predictions based on the accounts: first, according to the Competition model, sentences in which word order and morphosyntactic cues assign the agent role to the same noun (agent-initial) would be easier to process than sentences wherein these cues indicate different agents (patient-initial). Second, given the higher validity of the morphosyntactic cue, the model also predicts that children would rely more on the morphosyntactic markers than on word order when these

two cues are in conflict. On the other hand, given the higher frequency of patient voice compared to agent voice, the frequency account predicts that children would be more likely to use the morphosyntactic markers in the patient voice than in the agent voice. As agent-initial sentences are also more frequent compared to patient-initial sentences regardless of voice, the account predicts easier processing of sentences in the agent-initial condition compared to the patient-initial condition.

3.3 Study 2: Experiment on Tagalog-speaking children's use of word order and morphosyntactic markers for thematic role assignment

In Study 2, we used a combined self-paced listening and picture verification task to determine if children rely on word order and/or morphosyntactic markers on the verbs and the nouns for thematic role assignment. In this paradigm, which was based on Marinis and Saddy (2013), participants first saw a picture and then heard an agent voice- or patient voice-inflected verb. They were instructed to press a button on a game controller to listen to the next fragment of the sentence. At the end of the sentence, they had to indicate whether the sentence matched the picture that was displayed. We crossed voice (agent voice, patient voice), order of mention of the animal doing the action in the picture (from here on referred to as *word order*: agent-

initial, patient-initial), and matching of the interpretation of the markers on the verb and the noun with the scene depicted on the picture (match, mismatch).

Based on the results of Study 1 and in line with the frequency account, children are predicted to show higher accuracies and overall shorter listening times in the patient voice condition compared to the agent voice. Also, the higher frequency of agent-initial sentences predicts shorter listening times for the first noun phrase in agent-initial compared to patient-initial sentences.

The Competition model predicts that sentences in which word order and morphosyntactic markers assign the agent role to the same noun phrase—agent-initial sentences—would be easier to understand than sentences in which the cues assign the agent role to different noun phrases—patient-initial sentences. The Competition model also predicts that when these cues conflict with each other, children would use the most valid cue. Given the result from Study 1, they are expected to rely on the morphosyntactic markers rather than on word order, so accuracy for the patient-initial conditions across voice conditions would be above chance.

Lastly, according to the incremental processing account, patient-initial sentences would not be more difficult than agent-initial sentences, nor agent voice constructions than patient voice constructions, because with Tagalog's verb-initial structure, there is no need to revise an earlier thematic role assignment. Moreover, the incremental processing account predicts that children are able to use the morphosyntactic markers online, so longer listening times for mismatching morphosyntactic markers compared to matching morphosyntactic markers would be observed by the first noun phrase.

3.3.1 Method

Participants

A total of 185 typically-developing children were recruited from Metro Manila, Philippines. Data gathered from 128 children (64 per age group: 5-year-olds, and 7-year-olds) were used for the analysis. Fifty-seven children had to be excluded because they did not show understanding of the picture verification task during the practice trials (thirty-eight 5-year-olds), had more than 4 errors out of the 16 filler items (five 5-year-olds and six 7-year-olds), always responded with a *match* for the experimental items (three 5-year-olds and four 7-year-olds), or answered before the sentence was finished (one 5-year-old). In total, forty-seven 5-year-olds and ten 7-year-olds were excluded based on these criteria.

All the children were from Tagalog-speaking households. The 5-year-old children (mean age: 5;7, age range: 5;1–5;11, males: 28) were Kindergarten students from three elementary schools, while the 7-year-olds (mean age: 7;5, age range: 7;0–7;11, males: 23) were Grade 2 students from the same schools.

Sixty-four adults from Metro Manila were recruited as a control group (mean age: 19, range: 18–22, males: 24). No participant reported a history of language delay, and psychiatric or neurologic disorder. Informed consent was obtained from the adult participants and from the parents of the children. There was no monetary compensation for participation.

Materials

The materials were created such that three factors—voice (agent voice, patient voice), word order (agent-initial, patient-initial), and matching of the sentence and the picture (match, mismatch) could be varied. For the match condition, the interpretation of the markings on the verb and nouns corresponded to the scene as depicted on the picture, while for the mismatch, the picture showed a role-reversal. This manipulation resulted in four conditions per voice: agent-initial match, patient-initial match, agent-initial mismatch, and patient-initial mismatch (see Table 3.1 for sample experimental sentences in the agent voice conditions and Table 3.2 for the patient voice conditions).

Semantically reversible sentences were created from 16 verbs which depict transitive actions: *hila* 'pull,' *silip* 'peek at,' *sipa* 'kick,' *huli* 'capture,' *palo* 'hit,' *pasan* 'give a piggyback ride,' *kagat* 'bite,' *tira* 'hit,' *sagip* 'rescue,' *gamot* 'cure,' *pili* 'choose,' *tawag* 'call,' *salo* 'catch,' *karga* 'carry,' *baril* 'shoot,' and *habol* 'chase.' In reversible sentences, either noun can serve as the agent or the patient of the action described by the verb.

Each of the lexical verbs was assigned to an animal pair from a pool of eight animals. We used animals as agents and patients to keep animacy constant. Each sentence was divided into fragments: verb, first noun phrase, temporal adverb, second noun phrase, and spatial adverb. Temporal and spatial adverbs were also included in the sentences, to serve as spill-over and wrap-up regions.

For each lexical verb, two corresponding pictures with reversed roles were created. See Figure 3.2 for examples. Mirror images of these were also used,

Table 3.1

Sample experimental items for the agent voice-inflected verb hila *'pull,' given a picture of a cow pulling a pig in Study 2, see Figure 3.1.*

a	H<**um**>ihila/	**ang**	baka/	tuwing umaga/	ng	baboy/	sa maputik/	na bukid/	Agent-initial Match
	<AV>pull	SUBJ	cow	every morning	NSUBJ	pig	in muddy	LIN field	
b	H<**um**>ihila/	ng	baboy/	tuwing umaga/	**ang**	baka/	sa maputik/	na bukid/	Patient-initial Match
	<AV>pull	NSUBJ	pig	every morning	SUBJ	cow	in muddy	LIN field	
	'The cow is pulling a pig every morning in the muddy field.'								
c	H<**um**>ihila/	ng	baka/	tuwing umaga/	**ang**	baboy/	sa maputik/	na bukid/	Agent-initial Mismatch
	<AV>pull	NSUBJ	cow	every morning	SUBJ	pig	in muddy	LIN field	
d	H<**um**>ihila/	**ang**	baboy/	tuwing umaga/	ng	baka/	sa maputik/	na bukid/	Patient-initial Mismatch
	<AV>pull	SUBJ	pig	every morning	NSUBJ	cow	in muddy	LIN field	
	'The pig is pulling a cow every morning in the muddy field.'								

Note. A slash indicates the end of a fragment.

Table 3.2

Sample experimental items for the patient voice-inflected verb hila *'pull,' given a picture of a pig pulling a cow in Study 2, see Figure 3.1.*

a	H<**in**>ihila/	ng	baboy/	tuwing umaga/	**ang**	baka/	sa maputik/	na bukid/	Agent-initial Match
	<PV>pull	NSUBJ	pig	every morning	SUBJ	cow	in muddy	LIN field	
b	H<**in**>ihila/	**ang**	baka/	tuwing umaga/	ng	baboy/	sa maputik/	na bukid/	Patient-initial Match
	<PV>pull	SUBJ	cow	every morning	NSUBJ	pig	in muddy	LIN field	
	'The pig is pulling a cow every morning in the muddy field.'								
c	H<**in**>ihila/	**ang**	baboy/	tuwing umaga/	ng	baka/	sa maputik/	na bukid/	Agent-initial Mismatch
	<PV>pull	SUBJ	pig	every morning	NSUBJ	cow	in muddy	LIN field	
d	H<**in**>ihila/	ng	baka/	tuwing umaga/	**ang**	baboy/	sa maputik/	na bukid/	Patient-initial Mismatch
	<PV>pull	NSUBJ	cow	every morning	SUBJ	pig	in muddy	LIN field	
	'The cow is pulling a pig every morning in the muddy field.'								

Note. A slash indicates the end of a fragment.

to counterbalance the side on which each animal or each agent appears.

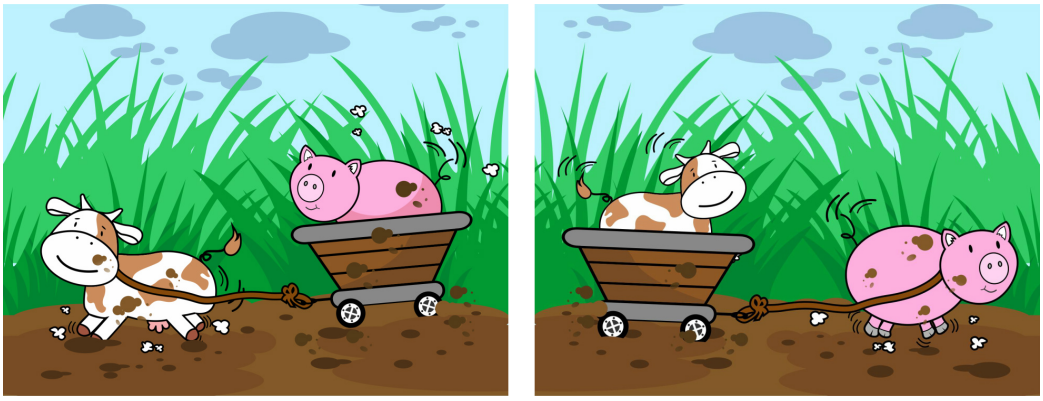

Figure 3.2. Pictures for the lexical verb *hila* 'pull' in Study 2. Mirror images of these two were also used in the experiment.

Additionally, 16 other transitive verbs (e.g., *kain* 'eat,' *inom* 'drink,' and *basa* 'read') were chosen to create non-reversible sentences serving as fillers. These verbs were inflected for the agent and patient voice. The same animals as in the experimental items were used as agents, while common concepts such as *mango*, *house*, and *book* were used as themes. Matching and mismatching (incorrect agent or theme) filler images were created.

The pictures were digital, colored, and had a resolution of 1650 x 1276 pixels. The sentences were audio recorded by a Tagalog native speaker using a normal speaking rate but with short pauses between the fragments, for easy splicing. The recording was done in an audio recording booth using the Audacity 2.1.0 program (Audacity Team, 2015), which was also used for splicing the fragments. The fragments contained no silence.

Each combination of picture and audio-recorded sentence was distributed into 16 different lists, following a Latin square design. Voice was a between-

subjects variable: Half of the participants were given the agent voice lists, and the other half were tested on the patient voice lists. In each list, each experimental condition appeared four times, and all lexical verbs and pictures appeared only once. In total, there were 32 trials per list—16 experimental trials and 16 fillers. The picture and the sentence matched for half of the trials in each list, but not for the other half. The stimuli were presented through DMDX version 5 (Forster & Forster, 2014), in a pseudo-randomized order, such that the same condition was not presented for more than three consecutive trials. The same program also recorded the time when the participants pressed the button to call for the next fragment of the sentence, which was in turn, used to measure listening times.

Procedure

The participants were tested individually in quiet class rooms—in schools for the children, and in the university for the adults. The experimenter sat next to each participant, and presented the experiment on a 13-inch laptop which was approximately 50 centimeters away from the participant.

First, the experimenter checked whether the children knew the animals and actions in the stimuli, by asking them to point to the concept which was named. Four concepts were presented at a time. This task was also given to the adults. If a mistake was made during this pre-experiment phase, the participant was reminded to look once more at the pictures, and to listen carefully. The experimenter proceeded to the practice session of the main experiment only if the participant had successfully identified all of the items.

The participants were informed that a picture would be presented on the

screen, and a sentence would be played in short segments through the headphones, and that they had to press a button on a game controller to hear the next segment. After each sentence, their task was to say whether or not the sentence matched the picture. Every trial started with the presentation of a picture, which remained on the screen until the sentence was finished. The presentation of the first sentence fragment started automatically 2500ms after the picture had appeared on the screen. The experiment was programmed such that the fragments stopped playing if the button was pressed too early, in order to prevent the participants from continuously just pressing the button. In addition, the participants were also reminded that no item could be replayed, so they should listen carefully. At the end of each sentence, a bell sound was played, and the stimulus picture was replaced by a screen with a check and a cross. The children were instructed that after they heard the bell, they should verbally respond whether or not the sentence they heard matched the picture they saw; while the adults used two other buttons on the game controller to give their match and mismatch responses.

Before the actual experiment, the participants were given four practice items, which were non-reversible transitive sentences like the fillers. For the first item, the experimenter provided hand-over-hand assistance to the children. During the whole practice phase, feedback was given. During the actual experiment, no feedback was given except for reminders when they were not waiting for the word to be finished before pressing the button for the next fragment. In addition, to motivate the children to finish the task, the experiment was presented as a game, in which they had to help a boy reach a race's finish line. Before, halfway through, and after the experiment,

a drawing of a boy in different stages of a race was presented on the screen.

Data analysis

A 2 x 2 x 2 x 3 factorial design was used. The independent variables were voice (agent voice, patient voice), word order (agent-initial, patient-initial), matching (match, mismatch) and age group (5-year-olds, 7-year-olds, adults). The dependent variables were accuracy of the picture verification response and listening times for the first noun phrase.

Statistical analyses were performed in R statistical software version 3.2.5 (R Core Team, 2016). Bayesian hierarchical models were essential to account for the complexity of the fixed and random effects structure of the data (Gelman et al., 2014; McElreath, 2016). The Bayesian models were fitted using the rstanarm package (Stan Development Team, 2016), with predictors for voice, word order, matching, and age (5:7, children:adults); two-way interactions of voice and word order, voice and matching, voice and age, word order and matching, word order and age, and matching and age; and three-way and four-way interactions of voice, word order, matching and age. Helmert contrasts were used for the age groups: comparing the 5-year-old group to the 7-year-old group, and both groups of children to the adult group. Sum contrasts were used for the other independent variables—voice, word order and matching. All models were fitted with random intercepts for subjects and items. By-item slope adjustments were fitted for all predictors (Barr, Levy, Scheepers, & Tily, 2013). By-subject slope adjustments were included for voice, word order, matching, and their interaction but we omitted by-subject age group adjustments and their respective interactions as age

group was a between-subjects factor.

The listening time for the first noun phrase was calculated by subtracting the fragment duration from the time between fragment onset and when the participant pressed the button to hear the next fragment. Listening times were log-transformed to account for right skew. The model predictors were the same as those in the fitted models for accuracy.

All models were fitted with weakly informative priors for each predictor. We calculated the 95% uncertainty intervals (enclosed in [ ] in this paper). Uncertainty intervals that do not contain zero show support for an effect of an independent variable on the dependent variable. We also calculated the proportion of posterior samples smaller than 0 (abbreviated as $P(b<0)$) which indicates a negative effect (i.e., lower accuracy or shorter listening times) given the data. Thus, the evidence supports a negative effect when $P(b<0)$) approaches 1, while a positive effect is supported when $P(b<0)$ approaches 0. Values in between indicate inconclusive evidence for an effect. See Sorensen, Hohenstein, and Vasishth (2016), and Nicenboim and Vasishth (2016) for an introduction to the use of Bayesian statistics in Psycholinguistics.

3.3.2 Results

We present the accuracy results of the picture verification task, followed by the listening times for the first noun phrase in the self-paced listening task.

Accuracy

The mean accuracies and 95% confidence intervals per condition are shown in Figure 3.3. The Bayesian mixed effects model showed main effects of age, voice, and matching; and two-way interactions of age (children:adults) and matching, age (children:adults) and voice, word order and matching, and voice and matching (see Table 3.3). There were also three-way interactions age (children:adults), voice and word order; age (children:adults), word order and matching; and voice, word order and matching.

Interactions were inspected in nested contrasts calculated from the inferred samples of the Bayesian model. Nested comparisons inspecting the three-way interaction of voice, word order and matching showed that accuracy was higher in the patient voice compared to the agent voice in the agent-initial mismatch (coefficient = 1.97, [0.20, 3.75], $P(b<0) < .02$) and patient-initial match (coef = 5.77, [3.20, 9.04], $P(b<0) < .001$) conditions, but not in the agent-initial match (coef = -0.46, [-2.96, 2.13], $P(b<0) = .64$) or patient-initial mismatch (coef = -1.85, [-4.36, 0.51], $P(b<0) = .94$). However, further inspection showed that the patient voice advantage in the agent-initial mismatch condition was shown only by the children (coef = 3.31, [1.95, 4.69], $P(b<0) < .001$), and not by the adults (coef = 0, [-1.12, 1.18], $P(b<0) = .51$). Comparisons in the match condition also showed that children scored higher in agent-initial sentences compared to patient-initial sentences in the agent voice condition (coef = -5.84, [-7.54, -4.25], $P(b<0) > .99$), but not in the patient voice condition (coef = -1.09, [-2.64, 0.42], $P(b<0) = .92$); while the adults did not show an effect of order in either of

the voice conditions (agent voice: coef = -0.03, [-1.39, 1.19], $P(b<0) = .52$; patient voice: coef = 1.44, [-0.96, 4.58], $P(b<0) = .14$).

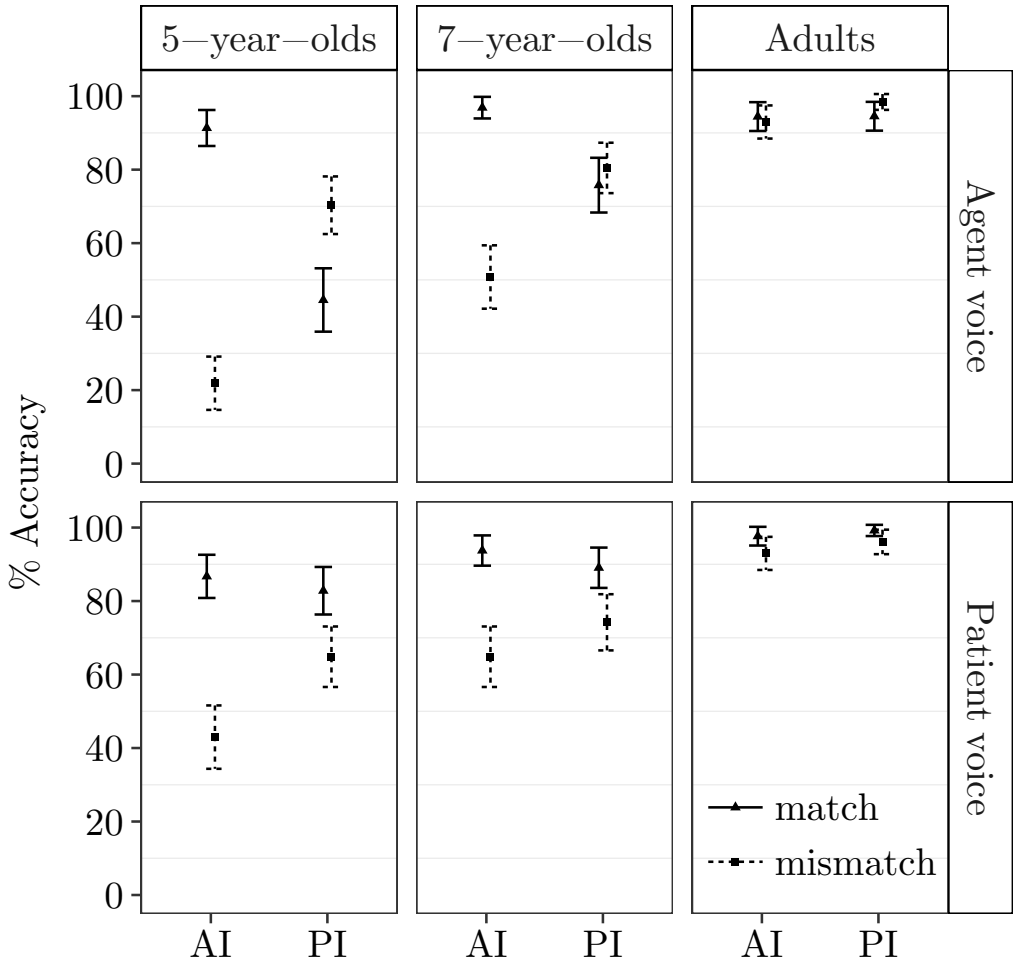

Figure 3.3. Mean accuracy with 95% confidence intervals for each condition per age group in Study 2.

Note. AI refers to agent-initial. PI refers to patient-initial.

Table 3.3

Summary of the fixed effects in the Bayesian model of the participants' accuracy in Study 2, including means, 95% uncertainty intervals, and P(b<0) which refers to the probability that the true parameter value is less than 0.

Comparison	Mean	Upper	Lower	$P(b<0)$
Intercept	2.20	1.95	2.46	<.001
Age(5:7)	8.61	5.76	11.67	<.001
Age(children:adults)	39.13	31.51	48.22	<.001
Voice	5.44	0.27	10.76	.02
Word order	-3.00	-7.99	1.78	.89
Matching	16.18	11.41	21.20	<.001
Age(5:7)*Voice	-1.99	-4.97	0.91	.90
Age(5:7)*Word order	1.46	-1.57	4.56	.16
Age(5:7)*Matching	0.55	-2.58	3.80	.36
Age(children:adults)*Voice	1.38	-6.19	9.91	.36
Age(children:adults)*Word order	-8.66	-17.07	-1.43	.99
Age(children:adults)*Matching	-10.02	-14.93	-5.47	>.99
Voice*Word order	-2.39	-7.10	2.07	.84
Voice*Matching	5.09	0.48	10.14	.02
Word order *Matching	14.07	9.11	18.83	<.001
Age(5:7)*Voice*Word order	0.51	-2.30	3.17	.35
Age(5:7)*Voice*Matching	-0.84	-3.98	2.46	.70
Age(5:7)*Word order*Matching	-1.60	-4.28	1.12	.87

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Table 3.3 – *Continued from previous page*

Comparison	Mean	Upper	Lower	$P(b<0)$
Age(children:adults)* Voice*Word order	1.43	-6.64	9.03	.37
Age(children:adults)* Voice*Matching	8.29	0.92	16.96	.02
Age(children:adults)* Word order* Matching	-10.56	-18.86	-3.13	>.99
Voice*Word order*Matching	-10.02	-14.93	-5.47	>.99
Age(5:7)*Voice*Word order*Matching	0.97	-1.75	3.75	.22
Age(children:adults)*Voice* Word order*Matching	2.43	-5.93	9.81	.28

From the posterior samples of the accuracy model, we calculated 95% uncertainty intervals and the posterior probability that the accuracy was below chance ($P(b<.5)$) (see Table 3.4 for the agent voice and Table 3.5 for the patient voice). If responses are not different from chance, the uncertainty intervals are expected to contain the chance level threshold (0.5).

In the agent voice, the 5-year-olds showed below chance level responses in the agent-initial mismatch condition, chance level in the patient-initial match condition, and above chance responses in the other agent voice conditions. In the patient voice, the 5-year-olds showed chance level responses in the agent-initial mismatch condition, and above chance responses in others. The 7-year-old group performed at chance level in the agent voice agent-initial

mismatch condition, and above chance in all other conditions. The adult control group showed above chance performance in all conditions.

Table 3.4

Summary of the posterior samples for each agent voice condition in the Bayesian model of the participants' accuracy in the picture verification task in Study 2, including means, 95% uncertainty intervals, and P(b<.5) which refers to the probability that the true parameter value is less than .5.

Comparison	Mean	Upper	Lower	$P(b<.5)$
5-year-olds				
Agent-initial Match	.93	.88	.97	<.001
Agent-initial Mismatch	.19	.11	.29	>.99
Patient-initial Match	.43	.30	.57	.84†
Patient-initial Mismatch	.73	.61	.83	<.001
7-year-olds				
Agent-initial Match	.98	.95	.99	<.001
Agent-initial Mismatch	.51	.38	.64	.44†
Patient-initial Match	.79	.69	.88	<.001
Patient-initial Mismatch	.83	.75	.91	<.001
Adults				
Agent-initial Match	.96	.92	.99	<.001
Agent-initial Mismatch	.95	.90	.98	<.001
Patient-initial Match	.96	.92	.99	<.001
Patient-initial Mismatch	.99	.97	1.00	<.001

Note. The † denotes chance level performance.

Table 3.5

Summary of the posterior samples for each patient voice condition in the Bayesian model of the participants' accuracy in the picture verification task in Study 2, including means, 95% uncertainty intervals, and P(b<.5) which refers to the probability that the true parameter value is less than .5.

Comparison	Mean	Upper	Lower	$P(b<.5)$
5-year-olds				
Agent-initial Match	.89	.82	.95	<.001
Agent-initial Mismatch	.42	.27	.57	.86†
Patient-initial Match	.85	.77	.92	<.001
Patient-initial Mismatch	.68	.54	.81	.006
7-year-olds				
Agent-initial Match	.95	.90	.98	<.001
Agent-initial Mismatch	.69	.55	.82	.005
Patient-initial Match	.91	.85	.96	<.001
Patient-initial Mismatch	.79	.67	.89	<.001
Adults				
Agent-initial Match	.98	.96	1.00	<.001
Agent-initial Mismatch	.95	.90	.98	<.001
Patient-initial Match	.99	.98	1.00	<.001
Patient-initial Mismatch	.97	.94	.99	<.001

Note. The † denotes chance level performance.

Listening times

The mean listening times and 95% confidence intervals of each age group per sentence fragment in each experimental condition are presented in Appendix B. Statistical analyses reported below are only for the first noun phrase as this was the critical region in which the thematic role of the first mentioned argument and the match or mismatch to the scene displayed on the picture became evident. Listening times below -200 and above 4000ms were excluded (0.30%) because these were judged as extreme values based on histograms, following Marinis and Saddy (2013). Extremely short values indicate premature responses and extremely long responses imply additional processing difficulty. The mean first noun phrase listening times and 95% confidence intervals per condition are shown in Figure 3.4.

The results showed main effects of age (children:adults), voice, and matching, and two-way interactions of order and matching, and age (children:adults) and matching on listening times for the first noun phrase region (see Table 3.6). Adults had shorter listening times compared to children. All participants also had shorter listening times for the patient voice compared to the agent voice. Nested comparisons inspecting the interaction of word order and matching showed that there were longer listening times in mismatch than match in the agent-initial condition (coef = 0.85, [0.63, 1.06], $P(b<0) < .001$) but not in the patient-initial condition (coef = 0.10, [-0.11, 0.30], $P(b<0) = .18$). Overall, there were also longer listening times for patient-initial sentences than for agent-initial sentences in the match condition (coef = 0.41, [0.19, 0.63], $P(b<0) < .001$). Nested comparisons inspecting the

three-way interaction of age, voice and matching showed that children had longer listening times in mismatch than in match in the patient voice (coef = 0.32, [0.14, 0.49], $P(b<0) < .001$) but not in the agent voice (coef = 0.13, [-0.04, 0.30], $P(b<0) = .07$); while adults had longer listening times for mismatch compared to match in both the agent voice (coef = 0.29, [0.17, 0.41], $P(b<0) < .001$) and the patient voice (coef = 0.20, [0.08, 0.33], $P(b<0) < .001$).

Table 3.6

Summary of the fixed effects in the Bayesian model of the participants' listening times for the first noun phrase region in Study 2, including means, 95% uncertainty intervals, and P(b<0) which refers to the probability that the true parameter value is less than 0.

Comparison	Mean	Upper	Lower	$P(b<0)$
Intercept	6.78	6.72	6.83	<.001
Age(5:7)	-0.86	-1.68	-0.03	.98
Age(children:adults)	-3.70	-5.12	-2.30	>.99
Voice	-1.20	-2.21	-0.19	.99
Word order	-0.08	-0.37	0.24	.69
Matching	-0.95	-1.24	-0.65	>.99
Age(5:7)*Voice	-0.27	-1.13	0.60	.74
Age(5:7)*Word order	0.00	-0.26	0.26	.49
Age(5:7)*Matching	-0.05	-0.29	0.20	.64

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Table 3.6 – *Continued from previous page*

Comparison	Mean	Upper	Lower	$P(b<0)$
Age(children:adults)*Voice	0.18	-1.23	1.62	.41
Age(children:adults)*Word order	0.24	-0.20	0.67	.14
Age(children:adults)*Matching	-0.55	-0.98	-0.12	.99
Voice*Word order	0.25	-0.05	0.56	.05
Voice*Matching	-0.10	-0.39	0.20	.64
Word order *Matching	-0.75	-1.05	-0.45	>.99
Age(5:7)*Voice*Word order	-0.24	-0.49	0.01	.97
Age(5:7)*Voice*Matching	0.16	-0.09	0.42	.10
Age(5:7)*Word order*Matching	0.08	-0.16	0.33	.26
Age(children:adults)* Voice*Word order	0.21	-0.22	0.63	.17
Age(children:adults)* Voice*Matching	0.37	-0.05	0.79	.04
Age(children:adults)* Word order* Matching	-0.48	-0.92	-0.06	.98
Voice*Word order*Matching	-0.10	-0.40	0.20	.76
Age(5:7)*Voice*Word order*Matching	-0.04	-0.29	0.21	.64
Age(children:adults)*Voice* Word order*Matching	0.04	-0.39	0.47	.43

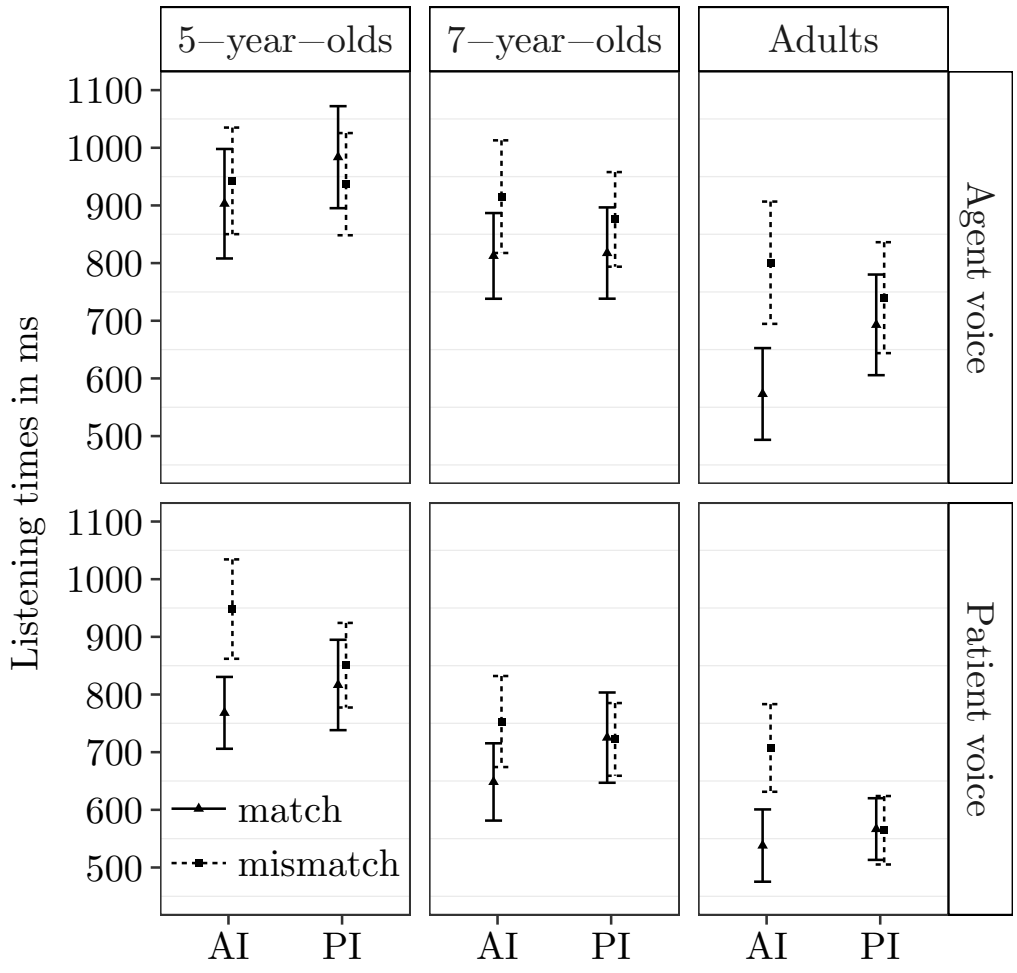

Figure 3.4. Mean listening times with 95% confidence intervals for the first noun phrase for each condition per age group in Study 2.

Note. AI refers to agent-initial. PI refers to patient-initial.

3.3.3 Discussion

We used a self-paced listening and a picture verification task to check whether Tagalog-speaking children use word order and/or morphosyntactic markers on the verb and the noun for thematic role assignment. We also tested adults as control participants. We first summarize and discuss the results from the picture verification task before coming to the results of the self-paced listening task. As expected, adults showed high accuracy in all the conditions without large effects of the experimental manipulations. However, it is noteworthy that their accuracy in the patient-initial match condition was lower in the agent voice than in the patient voice. The same effect was found in children. In addition, children were more accurate in rejecting agent-initial mismatch sentences in the patient voice compared to the agent voice. An effect of word order was observed only in the children's data, with higher rates of correct acceptances for agent-initial compared to patient-initial sentences but this agent-initial advantage was only obtained in the agent voice. Our analysis against chance level showed larger differences across the age groups. Adults scored above chance in all conditions, while the 7-year-olds performed at chance level in the agent initial mismatch condition and above chance in all other conditions. The picture for the 5-year-olds was more differentiated with below chance performance in the agent voice agent-initial mismatch condition, chance performance in the agent voice patient-initial match and the patient voice agent-initial mismatch condition, and above chance in the remaining conditions.

In the conditions predicted to be low in accuracy given a high reliance on

word order, namely agent-initial mismatch and patient-initial match, children showed higher accuracy in the patient voice compared to the agent voice. This result is similar to Segalowitz and Galang's (1978) findings from using an act-out task, and indicates that children relied more strongly on word order for thematic role assignment in the agent voice than in the patient voice. Additionally, children were generally more accurate in correctly accepting agent-initial than patient-initial sentences in the agent voice. This agent-initial advantage was not observed in the patient voice because children scored high for both word orders in this condition.

In the agent voice, 5-year-old children had high accuracy in the agent-initial match condition but showed below chance level performance in the agent-initial mismatch condition. These results indicate that 5-year-olds consistently interpreted the first mentioned noun as the agent regardless of the nominal morphology. As regards the patient-initial condition, they had higher accuracy in the mismatch compared to the match, which means that they judged the sentence as incorrect, whenever the patient was mentioned first, regardless of the noun markers. When word order and the morphosyntactic markers indicated different agents (mismatch conditions), the 5-year-olds relied on word order for thematic role assignment. However, the patient-initial condition results indicate that children did not solely rely on word order. If they did, they should have performed below chance level instead of showing chance level performance in the match condition. The children may have had a *yes* or *match* bias, as observed in 4-year-old Japanese and Vietnamese children (Okanda & Itakura, 2008), thus showing an increased accuracy in the patient-initial match condition. However, this bias does not

explain above chance accuracy in the patient-initial mismatch condition, as this result demonstrates that children were not generally hesitant to give a mismatch answer. It is possible that when 5-year-olds encountered a patient following an agent voice inflected verb, which was unexpected when they adhere to a word order strategy, they resorted to guessing.

In the patient voice, the 5-year-olds scored above chance in both the agent-initial and patient-initial match conditions, which also shows that they did not rigidly use a word order strategy. They also scored above chance in the patient-initial mismatch condition, showing that they used the patient voice marker on the verbs and the marker on the noun to correctly reject the patient-initial mismatch sentences. However, they scored at chance level in the agent-initial mismatch condition showing that word order affects their sentence interpretation also in the patient voice.

Compared to the 5-year-olds, the 7-year-olds showed above chance level performance in all of the conditions except for the agent voice agent-initial mismatch condition, for which they performed at chance. This condition would be below chance given a rigid word order strategy, demonstrating that the 7-year-olds' performance was affected by word order and the morphosyntactic markers. However, chance level performance in the agent-initial mismatch condition also demonstrates that 7-year-old learners of Tagalog still did not show adult-like use of the morphosyntactic markers for thematic role assignment.

Regarding the online measure, adults showed longer first noun phrase listening times for agent-initial sentences when the marker on the verb and the noun did not match what was depicted on the picture (mismatch con-

ditions), compared to when the markers matched the scene in the picture (match conditions), thus providing evidence that they incrementally processed the morphosyntactic markers. Additionally, in the match condition, listening times for patient-initial sentences were longer compared to agent-initial sentences, which indicates that adults did not expect the patient as the first noun phrase. This result is in line with the finding from Sauppe's (2016) study which demonstrated that adult Tagalog-speakers have a strong expectation that agents occur immediately after the verb.

In the patient voice, children had longer listening times for the mismatch compared to the match condition. This finding implies that children, similar to adults, recognized the difference between a mismatch in the interpretation of the verb and noun markers and the visual stimulus. Thus, children must have incrementally processed the information given by these morphosyntactic markers (but an effect of matching was not observed in the agent voice). In addition, children's listening times for the first noun phrase were longer for patient-initial sentences compared to agent-initial sentences in the match condition. This result implies that like adults, children have an agent-initial preference in both voices.

The listening times and the accuracy data both suggest that children are better able to make use of the morphosyntactic markers in the patient voice than in the agent voice. The better performance in the patient voice cannot be attributed to the fact that it was a between-subject variable. The 5-year-olds and 7-year-olds in both agent and patient voice versions of the experiment were enrolled in Kindergarten and Grade 2, respectively. However, during the data collection, the children who participated in the patient

voice version actually had been enrolled for only a month; while those children who were given the agent voice version were on the last month of the school year. Despite the fact that the children in the agent voice version had more experience in school, they still showed poorer comprehension compared to the children in the patient voice.

3.4 General discussion

We investigated why children find non-canonical sentences difficult by testing the claims of the frequency account, the Competition model, and the incremental processing account in Tagalog. We used a combination of online and offline tasks to investigate whether Tagalog-speaking children rely on word order and/or on the morphosyntactic markers for thematic role assignment.

In Study 1, the analysis of the child-directed speech corpus showed that the morphosyntactic cue—voice-marking on the verb and noun marker—has a higher validity in Tagalog compared to the word order cue. In addition, we found that patient voice sentences are more frequent in the child-directed speech input compared to agent voice sentences; and that sentences in both voices are predominantly agent-initial.

In Study 2, we tested the claims of the different accounts using a self-paced listening and picture verification task. The listening times data showed children's processing of the morphosyntactic markers on the verb and the noun, while the accuracy data evaluated children's comprehension at the end of the sentence. We found that 5-year-olds showed more reliance on word order in the agent voice, and on the morphosyntactic markers in the patient

voice. Seven-year-olds generally exhibited less reliance on word order compared to the 5-year-olds, but they still did not show consistent use of the morphosyntactic markers for thematic role assignment, which was exhibited by adults. In the patient voice, all age groups also showed processing of the voice-marking on the verb and the noun marking by the first noun phrase, as evidenced by longer listening times for the mismatch compared to the match condition. In contrast, in the agent voice, only adults showed evidence of processing the morphosyntactic markers by the first noun phrase. In the match condition, there were also longer listening times for patient-initial sentences compared to agent-initial sentences, showing an agent-initial preference for all age groups.

We now evaluate the three hypotheses introduced in the introduction on the basis of these results. First, our results do not fully support the claims of the Competition model (MacWhinney, 1987; MacWhinney & Bates, 1989). The model predicts that when cues compete and indicate different agents, the cue with a higher validity will be used for thematic role assignment. Based on the results of Study 1, the morphosyntactic markers are more valid than word order as a cue to thematic role assignment in Tagalog, so children would acquire it early on. However, our results indicate that children used the morphosyntactic markers in the patient voice but not in the agent voice, for which they relied on a word order strategy.

It can be argued that the corpus in Study 1 is too small for the cue validity calculations, because they were based on recordings of only three families, compared to six in other studies using the Competition Model framework (Chan et al., 2009; Dittmar et al., 2008). However, the number of analyzed

utterances with verbs in the current research is even higher than in the previous studies, as two recordings per family were used. Moreover, we did the calculations per family, and per session per family, and the results were comparable to the grand average which was presented in this paper. Our findings show that a cue with a higher validity (i.e., morphosyntactic markers) is not necessarily acquired earlier compared to a cue with lower validity.

Another argument can be that the availability of the word order cue should be calculated differently (Dittmar et al., 2008). If what matters is only the post-verbal position and not the positional relation between two noun phrases given the verb-initial canonical order of Tagalog, then even sentence fragments contain a word order cue. If these fragments are included in the counts for our corpus, then the word order cue's availability dramatically increases from 34% to 72%. In 87% of these utterances containing the word order cue, the agent occurred as the first noun phrase. The overall cue validity of word order then increases from 29% to 62%. With such a calculation, the validity of word order is similar to that of the morphosyntactic cue (62% to 63%), making it difficult to generate predictions for cue use. However, even when cue validity is calculated in this way, word order does not come out to have a higher validity than the morphosyntactic markers. Hence, cue validity still cannot explain children's reliance on a word order strategy when the two cues competed.

The incremental processing account (Huang et al., 2013; Trueswell & Gleitman, 2004, 2007) claims that children can incrementally process early-arriving cues in the sentence, but have difficulties in revising their initial thematic role assignment when the later-arriving cues contradict the earlier

cues. Moreover, there should be fewer processing issues when the cues are used to guide instead of revise an earlier interpretation (Trueswell et al., 2012). Because the morphosyntactic markers are given early in Tagalog sentences, the account predicts no difficulty even in non-canonical patient-initial sentences regardless of voice.

Children—like adults—did show evidence of incremental use of the patient voice marker on the verb and the marking on the noun, as they had longer listening times for the mismatching noun marker compared to the matching noun marker in the first noun phrase segment. However, if the problem with non-canonical sentences is only in revision as predicted by the incremental processing account, it is then puzzling why children were not able to use the agent voice marker on the verb which was also an early-arriving cue, much like the patient voice marker. The general advantage in accuracy for sentences in the patient voice compared to sentences in the agent voice is therefore not compatible to the predictions by the incremental processing account as in both constructions, the thematic role assignment is unambiguous from the occurrence of the first noun phrase in the sentence.

According to the frequency account (Demuth, 1989; Gordon & Chafetz, 1990; Kline & Demuth, 2010), this asymmetry in performance between agent and patient voice is expected and due to the higher frequency of the patient voice in child-directed speech, as observed in Study 1. This better performance in the patient voice corroborates findings in languages with higher frequency of passives in the input which showed earlier passive acquisition (e.g., Alcock et al., 2012 for Kiswahili and Kigiriama; Allen & Crago, 1996 for Inuktitut; and Demuth, 1989; Demuth et al., 2010; and Kline & Demuth,

2010 for Sesotho). Tagalog patient voice is comparable to passives in other languages, in which the patient is the subject of the sentence instead of the agent.

However, considering the frequency of the specific constructions that were used in our study shows that the result pattern does not exactly mirror frequency. Going back to the corpus that we analyzed in Study 1, we found the following frequencies in utterances with transitive sentences and at least one argument: 60% of these utterances were patient voice agent-initial, 27% agent voice agent-initial, 11% patient voice patient-initial, and 2% agent voice patient-initial. Based on these numbers, a purely frequency-based account would predict that children would perform better in the patient voice agent-initial than in the agent voice agent-initial. In contrast, no differences in accuracy between these two conditions were observed in the children's data. Moreover, based on the frequency account, better performance would also be expected in patient voice agent-initial compared to the patient voice patient-initial sentences, but this prediction was also not supported by the data.

Overall, none of the factors that have been proposed to be relevant for children's problems in thematic role assignment can explain the result pattern of our study on its own. We suggest that both frequency and incremental processing can partly account for our data. First, the patient voice is overall more frequent, so children have more experience with the patient voice marker on the verb, and they become aware that they have to map this voice marker with the noun markers, namely that the *ang*-marked noun is the patient, and the *ng*-marked noun is the agent. As the self-paced listening data show, they can use this information immediately when they encounter

the morphosyntactic information provided by the verb and the first noun in the sentence such that no revision of an initially incorrect assignment may be necessary for a correct sentence interpretation. In contrast, children may not yet be fully familiar with the agent voice, so they resort to heuristics like a word order strategy when they encounter this voice marker on the verb. Given the fact, that—independent of the voice—agent-initial sentences are by far the most frequent construction in the input, it is not surprising that a word order heuristic has an effect on sentence interpretation. What is remarkable is that children follow this word order heuristic only selectively and that the rather complex system of morphosyntactic marking can override this heuristic at least in the more frequent voice. What remains an open issue is the cause of the general disadvantage for the agent voice compared to the patient voice. Further research is needed to investigate whether only the relatively low frequency or other structural properties of the agent voice makes this construction hard for children to acquire.

In conclusion, our research showed that even at the age of seven, Tagalog-speaking children have not yet fully mastered the use of the voice-marking on the verbs and the noun markers for assigning thematic roles in their language. It adds to the understanding of cross-linguistic and language-specific factors which affect children's acquisition of thematic role assignment, and shows that less-studied languages contribute in a relevant way to the study of children's sentence comprehension skills.

Chapter 4

Thematic role assignment in Tagalog: An eye-tracking study

Garcia, R., Roeser, J., & Höhle, B. (submitted). Children's online use of word order and morphosyntactic markers in Tagalog thematic role assignment: An eye-tracking study. *Journal of Child Language*.

Abstract

We investigated whether Tagalog-speaking children incrementally interpret the first noun phrase as the agent of the sentence, even if the verbal and nominal markers for assigning thematic roles are given early in Tagalog sentences. We asked 5- and 7-year-old children and an adult control group to select which of two pictures of reversible actions matched the sentence they heard, while their looks to the pictures were tracked. The accuracy and eye-tracking data showed that agent-initial sentences were easier to comprehend

than patient-initial sentences, but the use of word order was modulated by voice. Moreover, our eye-tracking data provided evidence that by the first noun phrase, 7-year-old children looked more to the target in the agent-initial compared to the patient-initial conditions, but this word order advantage was no longer observed by the second noun phrase. The findings support language processing and acquisition models which emphasize the role of frequency in developing heuristic strategies (e.g., Chang, Dell, & Bock, 2006).

4.1 Introduction

In daily communications, we often have to identify the doer (agent) and the receiver (patient) of an action described in a sentence that we hear. Therefore, it is crucial in language acquisition for children to learn how their language marks these agent and patient thematic roles and to integrate this knowledge in their sentence processing. Moreover, they have to do this thematic role assignment rapidly in the ongoing sentence interpretation process. Identifying the strategies that children use to perform this task is crucial in deepening our understanding of language acquisition and processing. The current study investigates thematic role assignment in children learning Tagalog—a language that has a complex but reliable system of morphosyntactic markers of thematic roles.

4.1.1 Thematic role assignment

Previous research has shown that thematic role assignment can be a challenge for children's sentence comprehension, especially for sentences with

non-canonical argument order (patient-before-agent, from here on referred to as *non-canonical sentences*) such as passives (Armon-Lotem et al., 2016 for Catalan, Lithuanian, and Hebrew; Bever, 1970 for English; Coelho de Barros Pereira Rubin, 2009 for Portuguese; Dittmar et al., 2008 for German; Frankel et al., 1980 also for Hebrew; Hakuta, 1977 for Japanese; MacWhinney et al., 1985 for Hungarian). Children tend to incorrectly interpret the first noun phrase (NP1) as the agent, thus reversing the thematic role assignments. This type of error in non-canonical sentence interpretation shows children's reliance on word order, which has been claimed to be due to the high frequency of sentences with agent-before-patient order in the input (Demuth, 1989; Gordon & Chafetz, 1990; Kline & Demuth, 2010), and to the high reliability of this cue for assigning thematic roles in many languages (MacWhinney, 1987; MacWhinney & Bates, 1989). It is notable that this difficulty has been observed not only in languages with fixed word orders such as English, but also in languages with more flexible orders such as German.

Cross-linguistic differences in the use of a word order strategy have also been found, especially because some languages use other features such as case-marking as cues to thematic role assignment. Previous studies suggest that children learning these languages begin to show a higher reliance on the morphosyntactic markers than on word order early on. For example, children speaking Serbo-Croatian begin to consistently rely on case-marking at around four years of age, while Turkish-speaking children use case-markers as early as two years (Slobin & Bever, 1982).

4.1.2 Incremental sentence processing

Recently, researchers have been investigating not only children's final sentence interpretation, but also how sentence interpretation unfolds over time. Looking at real-time processing provides insights on whether children are slower in processing compared to adults, or if they use different strategies to arrive at an interpretation (Snedeker, 2013). Studies with adults have shown that they process incoming information in an incremental fashion, and information is not buffered until the end of a larger linguistic unit, such as the end of a sentence (Altmann & Steedman, 1988; Kamide, Scheepers, & Altmann, 2003; Kamide, Altmann, & Haywood, 2003; Marslen-Wilson & Tyler, 1987).

Similar to adults, children have also shown evidence of incremental processing. For example, Trueswell et al. (1999) found that the temporary ambiguous phrase on the napkin in sentences such as 'Put the frog on the napkin in the box,' was initially interpreted as the goal of the action by adults and 5-year-olds. However, unlike the adults, children did not revise their interpretation once the disambiguating phrase in the box was presented. The authors concluded that children process sentences incrementally akin to adults, but they have difficulty revising initial parses if these turn out to be inconsistent with the rest of the sentence. Other studies have also shown that children can incrementally use lexical information (Snedeker & Trueswell, 2004) and prosody (Snedeker & Yuan, 2008) in ambiguity resolution.

Children's strategy in processing sentences can be explained by Chang et al.'s (2006) computational account of incremental word prediction and learning. According to this model, the parser continuously predicts the upcoming

input from the previous input, such as through the use of event-semantic representations, including thematic roles. Therefore, an online interpretation of the first noun as the agent is automatically pursued if an agent-before-patient order is highly frequent in the input. For example, because English has a strong agent-before-patient bias, the model sets a strong weight for mapping of the agent role to the first noun early in development. Through encountering deviations from this expected mapping of word order and thematic roles, the model gradually learns to put more weight on the post-NP1 structures for thematic role assignment.

To date, only a few experimental studies have focused on the real-time processing of non-canonical sentences in child language (Abbot-Smith et al., 2017; Huang et al., 2013; Schipke, Knoll, Friederici, & Oberecker, 2012; Zhou & Ma, 2018).These studies were interested in the time course of children's use of linguistic information such as word order and morphosyntax for thematic role assignment. For example, Schipke et al. (2012) showed using event-related potentials (ERP) that 6-year-old German-speaking children processed accusative-marked nouns in the sentence-initial position similar to adults (same ERP patterns at the NP1), but 3-year-olds did not show the same sensitivity to the case markers. However, while ERP studies provide evidence of children's sensitivity to a cue, it cannot clearly show children's interpretation of a sentence in real-time.

Studies using eye-tracking provide more information on how children interpret sentences as they unfold. For example, Abbot-Smith et al. showed that English-speaking children (ages 2;1 to 3;5) incrementally map the NP1 to the agent role, as the children were found to consistently look more to the

clip which showed the NP1 as the agent once they heard the initial noun of the sentence. Only the 3;5 children were able to revise their initial interpretation when the sentence turned out to be passive—after hearing the second noun phrase (NP2), the children in the passive condition showed fewer looks to the picture which showed the NP1 as the agent, in comparison to the children in the active condition.

Eye-tracking studies in Mandarin have also shown that 3- and 5-year-old children can rapidly use the voice markers BA (indicates that the preceding NP1 is an agent; active voice) and BEI (indicates that the preceding NP1 is a patient; passive voice) for sentence interpretation (Huang et al., 2013; Zhou & Ma, 2018). In Zhou and Ma's study, children heard sentences like (4.1) which always had the word order BA/BEI Marker + Noun + Adverb + Verb. The other argument was dropped. Upon encountering the noun (*lion* in 4.1), children already directed their gaze to the picture that showed the referent of the noun as the patient of the action in sentences that started with BA, and to the picture that showed the referent of the noun as the agent in sentences that started with BEI.

(4.1) BA/BEI shizi qingqingdi bao-le qilai
lion gently hold-PFV up
'Someone gently holds/is held by the lion.'

Huang et al. (2013) used two arguments in their stimuli sentences and manipulated whether the NP1 was a noun or a pronoun. They used the visual world eye-tracking paradigm, and asked 5-year-old children to act out sentences like (4.2) 'The seal is quickly eaten by it.' Children were presented

with three real objects at a time: 1) the mentioned item (seal), 2) a plausible agent of the action (shark), and 3) a plausible patient (fish). In addition to the incremental use of the morphosyntactic markers, the authors found that children were less likely to incorrectly interpret the NP1 as the agent in the BEI condition when the NP1 was a pronoun ('It BEI seal eat' or 'It is eaten by the seal') compared to when it was not ('Seal BEI it eat' or 'The seal is eaten by it'). The authors proposed that the advantage of the pronoun condition indicates that children do not yet assign any role when they encounter a pronoun in the NP1 position, but they only do so when the NP1 is lexical. Therefore, in the former case, there is no need to revise an initial interpretation once the BEI marker is encountered, while the lexical noun condition requires a revision of the thematic role assignment.

(4.2) Haibao BA/BEI ta henkuaijiu chidiao le
seal it quickly eating
'The seal is quickly eating it/being eaten by it.'

These online studies show that children incrementally use different cues like word order and morphosyntactic markers, depending on their age and target language. In Abbot-Smith et al. (2017) and Huang et al.'s (2013) experiments, the sentences used were temporarily ambiguous when the NP1 occurred, and in the beginning of the sentence, morphosyntactic markers could not play a role in interpretation. In Zhou and Ma's (2018) study, the initial argument was dropped, so there was no initial ambiguity. However, word order was still relevant for thematic role assignment in their study as

the position of an argument relative to the markers needs to be considered for thematic role assignment in Mandarin.

There is evidence that children incrementally use word order for thematic role assignment, but there is an issue regarding the fact that in most of the previous studies, the morphosyntactic markers (verb inflection and *by*-phrase in English, or the voice markers in Mandarin) only come after the NP1. Therefore, it is not clear how morphosyntactic markers influence the real-time processing of the NP1, mainly because most languages are not verb-initial. In addition, it remains a question whether children incrementally map the NP1 as an agent in a language that does not linguistically use word order for assigning thematic roles. Lastly, it is of interest to see whether children can use the morphosyntactic markers when the thematic role assignment system of the language is more complex than in Mandarin. In this paper, we investigated children's online comprehension of transitive sentences in Tagalog, a verb-initial language which does not use word order for thematic role assignment but instead uses verb and noun morphology that are given early on in the sentence, such that there is no initial ambiguity in interpretation.

4.1.3 Thematic role assignment in Tagalog

In Tagalog, the verb carries voice, aspect, and mood information. The voice affix on the verb denotes the thematic role of the noun phrase that is marked by *ang* (from here on referred to as the *ang*-phrase) (Himmelmann, 2005b).

In the agent voice (AV)[1], the verb infix *–um–* assigns the *ang*-phrase the agent role (4.3, 4.5), while in the patient voice (PV), the verb infix *–in–* assigns the *ang*-phrase the patient role (4.4, 4.6). Cooreman et al. (1984) found in a written corpus that in sentences with transitive verbs, the patient voice occurs more frequently than the agent voice. The high frequency of the patient voice makes Tagalog interesting, as this structure is comparable to a passive, which is usually rare in other languages. Moreover, Tagalog's voice-marking system allows the subject position to be differentiated from the NP1 position.

(4.3) H<**um**>i~hila ng baboy **ang** baka
<AV>IPFV~pull NSUBJ pig SUBJ cow
'The cow is pulling a pig.'

(4.4) H<**in**>i~hila ng baboy **ang** baka
<PV>IPFV~pull NSUBJ pig SUBJ cow
'The/A pig is pulling the cow.'

(4.5) H<**um**>i~hila **ang** baka ng baboy
<AV>IPFV~pull SUBJ cow NSUBJ pig
'The cow is pulling a pig.'

[1]The following abbreviations are used: AV for agent voice, PV for patient voice, LIN for linker, IPFV for imperfective, SBJ for subject, and NSBJ for non-subject.

(4.6) H<**in**>i~hila **ang** baka ng baboy
<PV>IPFV~pull SUBJ cow NSUBJ pig
'The/A pig is pulling the cow.'

The post-verbal argument order is relatively free (Schachter, 2015), and the basic order remains a matter of debate. From a grammatical perspective, word order is irrelevant for thematic role assignment in basic Tagalog sentences. Even if the order of the arguments differs between (4.3) and (4.5), the thematic roles are the same because both sentences are in the agent voice. Examples (4.4) and (4.6) also have the same meaning because they are in the patient voice.

Despite this flexible word order and the availability of morphosyntactic markers, Sauppe (2016) claimed using evidence from a visual world paradigm eye-tracking experiment that adult Tagalog speakers have a tendency to anticipate agent nouns to follow the verb (also providing evidence of incremental processing). He found more looks to the agent image after hearing the verb, regardless of the voice-marking.

Tagalog-learning children's real-time processing of basic transitive sentences has not yet been widely investigated, as most of the previous studies used offline measures. Through a sentence-picture matching task, Segalowitz and Galang (1978) tested 3-, 5-, and 7-year-old's comprehension of reversible transitive sentences. The results showed that children correctly interpreted agent-initial patient voice sentences (verb-agent-patient) but reversed the roles in patient-initial agent voice sentences (verb-patient-agent). Since voice

and the order of arguments were confounded in this experiment, verb-medial sentences (agent-verb-patient for the agent voice and patient-verb-agent for the patient voice), which mostly occur in formal, written language, were used in a follow-up experiment. Children correctly interpreted both of these verb-medial sentences even if the patient voice was patient-initial, showing that they did not always use a word order strategy. Moreover, Galang (1982) claimed that children acquire the patient voice marker earlier than the agent voice inflection. She presented pictures with transitive actions (five out of 15 were reversible) to 3-, 5-, 7-, and 8-year-old children, and instructed them with utterances like, *Ituro mo ang k**um**akain* (agent voice) */k**in**akain* (patient voice), 'Point to that which is eating/being eaten.' All age groups of children were more accurate in the patient voice compared to the agent voice, but results of statistical analysis were not reported.

Instead of a patient voice advantage, a study on relative clauses in Tagalog showed that children performed better in interpreting agent relative clauses (verb is in the agent voice) than patient relative clauses (verb is in the patient voice) (Tanaka et al., 2015). Since agent relative clauses were always agent-initial, and patient relative clauses were always patient-initial, the results also imply that children use a word order strategy in comprehending relative clauses.

A recent study by Garcia, Roeser, and Höhle (2018) used a combined self-paced listening and picture verification task to investigate Tagalog-learning children's use of word order and morphosyntactic markers for thematic role assignment. The results of their picture verification task showed that 5- and 7-year-olds were more accurate in patient-initial sentences in the patient

voice compared to the agent voice. In their online measure, for both the agent voice and patient voice, adults and 7-year-olds had longer listening times for the NP1 when the markers on the verb and the noun signaled a mismatch to the action in the picture, compared to when the markers and the picture matched. However, the 5-year-olds showed this effect only in the patient voice but not in the agent voice. The authors concluded that children relied more on the morphosyntactic markers in the patient voice, and on a word order strategy in the agent voice. They attributed the better performance in the patient voice to the high frequency of the patient voice in the input, which they found to comprise 53% of transitive verbs with at least one noun phrase in Marzan's (2013) child-directed speech corpus. On the other hand, agent voice-inflected verbs comprised only 21% of these utterances. Both voices were dominantly agent-initial (agent voice: 95%, patient voice: 85%).

These studies provide some evidence that Tagalog-learning children use an NP1-as-agent strategy, at least in the agent voice. However, the previous studies could not demonstrate how and when children assign thematic roles to the noun phrases that they encounter while the sentence unfolds. To close this gap, the current study combined a picture-selection task with eye-tracking which allowed for an online observation of the ongoing interpretation process.

Based on Chang et al.'s (2006) model, we would expect Tagalog-speaking children to incrementally interpret the NP1 as the agent, given that the input they receive mostly has an agent-before-patient order (Garcia et al., 2018). Given that Chang et al.'s model uses error-based learning, the model also predicts that children would learn to use the morphosyntactic markers in

the patient voice earlier than in the agent voice, given that they encounter more patient voice patient-initial sentences in their input than agent voice patient-initial sentences.

In the current experiment, children and adults were given a picture selection task while their looks to the screen were tracked. They first saw two pictures of a reversible action between two animals, e.g., a cow pulling a pig and a pig pulling a cow. They then heard a sentence describing one of the two pictures. Their task was to identify which picture matched the sentence. We crossed voice (agent voice, patient voice) and word order (agent-initial, patient-initial) to create the experimental items.

If children generally rely on word order and expected the NP1 to be the agent, they would show more looks to the target picture in the agent-initial condition compared to the patient-initial condition regardless of the voice-marking on the verb. In contrast, if they can incrementally use the morphosyntactic markers for thematic role assignment, they would start looking at the correct picture in all conditions when the NP1 of the sentence is presented. However, if eye-tracking data mirror the accuracy data, based on Garcia et al.'s (2018) results, we would expect children to incrementally use the morphosyntactic markers more efficiently in the patient voice than in the agent voice, resulting in more looks to the target in the patient voice patient-initial condition, compared to the agent voice patient-initial condition.

4.2 Method

Participants

A total of 65 typically-developing children were recruited from Metro Manila, Philippines. All children were from Tagalog-speaking households, and reported to have Tagalog as their dominant language. The thirty-three 5-year-old children (mean age: 5;4, age range: 5;0-5;10, males: 18) were Kindergarten students from a public elementary school, while the thirty-two 7-year-olds (mean age: 7:4, age range: 7;0-7;10, males: 13) were Grade 2 students from the same school. Data from one 5-year-old participant was excluded because of errors in the fillers.

Thirty-two adults from Metro Manila were also recruited (mean age: 20, range: 18-27, males: 9). No participant was reported to have a history of language delay, and psychiatric or neurologic disorder. Informed consent was obtained from the adult participants and from the parents of the children. There was no monetary compensation for participation.

Materials

Semantically reversible sentences were created from sixteen transitive verbs: *hila* 'pull,' *silip* 'peek at,' *sipa* 'kick,' *huli* 'capture,' *palo* 'hit,' *pasan* 'give a piggyback ride,' *kagat* 'bite,' *tira* 'hit,' *sagip* 'rescue,' *gamot* 'cure,' *pili* 'choose,' *tawag* 'call,' *salo* 'catch,' *karga* 'carry,' *baril* 'shoot,' and *habol* 'chase' (taken from Garcia et al., 2018). In these sentences, both of the nouns that fill the argument positions of the verb can be the agent or the

patient of the verb, e.g., *Humihila ang baka ng baboy* 'The cow is pulling a pig.'

Voice (agent voice, patient voice) and word order (agent-initial, patient-initial) were varied in the stimuli sentences, resulting in four conditions (see Table 4.1). Animals served as the agents and patients in the sentences. A temporal adverb was placed after the NP1 to prolong the time before the NP2 was given, and thus, allowing more time to observe how the NP1 information is used for sentence interpretation. A spatial adverb was also added after the NP2 in order to have more time to observe the use of the NP2.

For each verb, target and distractor (showing the reversal of the agent and the patient roles) pictures were created (see Figure 4.1 for an example), resulting in 16 picture pairs. The side of the picture where the agent appeared and the direction of the action were counterbalanced. The target and distractor had either a blue frame or a red frame. Each picture pair was used twice, and only the color of the frames was changed, such that in the first one, the picture on the left of the screen had a blue frame; and in the second one, the picture on the left had a red frame (resulting in 32 framed pairs). The side of the screen where the target appeared was also counterbalanced.

For the fillers, 16 other transitive verbs (e.g., *kain* 'eat,' *inom* 'drink,' and *basa* ''read') were chosen to create non-reversible sentences. They appeared in the same four conditions as the experimental items. The same animals were used as agents, while common inanimate concepts like *mango*, *house*, and *book* were used as themes. Temporal and spatial adverbs were also used, so the sentence length matched that of the experimental items. Target and distractor (incorrect agent or theme) filler images were created.

Table 4.1

Sample experimental items for the verb hila *'pull,' given a picture of a cow pulling a pig.*

a	H<**um**>ihila	**ang**	baka	tuwing umaga	ng	baboy	sa maputik	na bukid	Agent voice Agent-initial
	<AV>pull	SUBJ	cow	every morning	NSUBJ	pig	in muddy	LIN field	
b	H<**um**>ihila	ng	baboy	tuwing umaga	**ang**	baka	sa maputik	na bukid	Agent voice Patient-initial
	<AV>pull	NSUBJ	pig	every morning	SUBJ	cow	in muddy	LIN field	
	'The cow is pulling a pig every morning in the muddy field.'								
c	H<**in**>ihila	ng	baboy	tuwing umaga	**ang**	baka	sa maputik	na bukid	Patient voice Agent-initial
	<PV>pull	NSUBJ	pig	every morning	SUBJ	cow	in muddy	LIN field	
d	H<**in**>ihila	**ang**	baka	tuwing umaga	ng	baboy	sa maputik	na bukid	Patient voice Patient-initial
	<PV>pull	SUBJ	cow	every morning	NSUBJ	pig	in muddy	LIN field	
	'The pig is pulling a cow every morning in the muddy field.'								

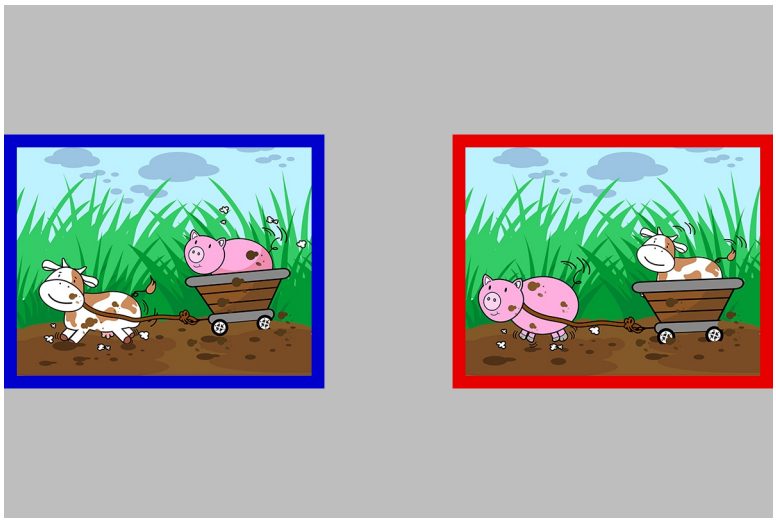

Figure 4.1. Sample picture pair for the experimental item—'The cow is pulling a pig every morning in the muddy field.'

The sentences were audio recorded by a Tagalog native speaker using a normal speaking rate. The recording was done in an audio recording booth using the Audacity 2.1.0 program (Audacity Team, 2015). The audio-recorded sentences (64) were combined with their corresponding picture pairs (note that each sentence and picture pair were used twice to control for the color of the frames, i.e., whether the blue frame was on the left or the right side of the screen), and then turned into a video using Adobe Flash CS3 Professional Version 9.0. The framed target and distractor pictures (460 x 356 pixels in size) appeared in the middle of the screen with a gray background. After 2000ms from visual stimulus onset, the audio-recorded stimulus sentence started to play. The visual stimulus remained on the screen throughout the audio presentation, and for around 3000ms after the end of the sentence. Each experimental item was 11000ms long.

Each experimental item (128) was distributed into eight different lists, following a Latin square design. In each list, each lexical verb appeared only once and each experimental condition appeared four times. There were 32 items per list—16 experimental items (four from each condition) and 16 fillers. Moreover, half of the lists had the blue frame on the left and the red frame on the right, while the other half had the red frame on the left and the blue frame on the right.

Procedure

Children were individually tested in quiet rooms in the schools, the adult participants in a room at the university. The experimenter sat next to each participant, and presented the experiment on a 17-inch laptop with a 1024 x 768 pixel resolution. An SMI RED-mobile eye-tracker with 60 Hz sampling rate was placed below the laptop's screen to record the participants' eye movements. The stimuli were presented with SMI's Experiment Center 2 in a pseudo-randomized order such that no condition was presented more than two times in a row. The acoustic stimuli were presented through headphones. Each participant was tested with only one of the lists.

First, the experimenter checked whether the children were familiar with the animals in the stimuli by asking them to point to the animal which she labeled, with four animals presented at a time. The participants' knowledge of the verbs was also tested by asking them to point to the picture showing the action denoted by the uninflected verb that the experimenter said. These pictures showed two boys performing different actions and not the animals

used for the pictures in the main experiment. This task was also given to the adults just for consistency in data collection between the children and the control group. If a mistake was made during this pre-experiment phase, the participant was reminded to look once more at the pictures, and to listen carefully. The experimenter proceeded to a 5-point calibration of the eye-tracker if the participant successfully identified all the animals and verbs. Practice trials were given after the calibration phase.

In the practice trials, the participants were presented with items similar to the fillers used in the experiment (i.e., non-reversible actions). They first saw the target and distractor pictures, then heard the stimulus sentence. They were asked to name the color of the frame of the picture that matched the sentence they heard. Feedback was given during the practice trials. They were also verbally reminded not to point to the picture that matched the sentence. A verbal response was more preferred than pointing, as pointing was expected to initiate larger movements. The experimenter proceeded to the experiment if the participant correctly answered at least three out of the four practice items.

In the experiment, the instructions were the same as in the practice trials, but no feedback was given. The experimenter manually recorded the responses. A validation of the calibration was done after the last stimulus sentence was presented, in order to check whether the participant considerably moved from his/her position after the beginning of the experiment.

Data analysis

The experiment involved a 2 x 2 x 3 factorial design. The independent variables were voice (agent voice, patient voice), word order (agent-initial, patient-initial), and age (5-year-olds, 7-year-olds, adults). The dependent variables were accuracy in the picture selection task, and the percentage of looks to the target picture (PLT).

For the eye-tracking data, five time windows were analyzed. The first time window encompassed the verb (see Table 4.2 for the length of each window per condition). The second time window corresponded to the NP1. The third time window contained the temporal adverb. The fourth covered the NP2. The fifth time window contained the first two words of the spatial adverb. Only the first two words of the spatial adverb were considered in order to make this time window more similar in length to the other time windows. The PLT was calculated by dividing the fixation on the target by the sum of fixations to the target and the distractor. These percentages were transformed into empirical logits for the statistical analyses.

Statistical analyses were performed in R statistical software version 3.2.5 (R Core Team, 2016). Bayesian hierarchical models (Gelman et al., 2014) were fitted using the rstanarm package (Stan Development Team, 2016). For both accuracy and PLT per time window, the models were fitted with predictors for voice, word order, and age; two-way interactions of voice and word order, voice and age (5:7, children:adults), and word order and age (5:7, children:adults); and two three-way interactions of age, word order, and voice. Helmert contrasts were used for the age variable: comparing the 5-year-old

group to the 7-year-old group, and both groups of children to the adult group. Sum contrasts were used for voice and word order. All models were fitted with random intercepts for subjects and items. By-item slope adjustments were fitted for all predictors. By-subject slope adjustments were included for voice, word order, and their interaction but we omitted by-subject age adjustments and their respective interactions as age was a between-subjects factor. All models were fitted with weakly informative priors for each predictor. From the posterior samples of the Bayesian model, we calculated the 95% uncertainty intervals (enclosed in [ ] in this paper). Support for an effect on the dependent variable is indicated by uncertainty intervals that do not contain zero as a possible parameter value. We also calculated the proportion of posterior samples smaller than 0 (abbreviated as $P(b<0)$) which indicates the probability of a negative effect, given the data. Thus, the evidence supports a negative effect (e.g., lower accuracy, fewer looks to the target) when $P(b<0)$ approaches one, while a positive effect is supported when $P(b<0)$ approaches zero. Values in between indicate inconclusive evidence for an effect. See Sorensen et al. (2016) and Nicenboim and Vasishth (2016) for an introduction to the use of Bayesian statistics in Psycholinguistics.

Table 4.2

Average lengths of each time window per condition in ms.

	Verb	NP1	Temporal adverb	NP2	Spatial adverb
Agent voice Agent-initial	1099	934	1281	1040	884
Agent voice Patient-initial	1056	1081	1314	992	881
Patient voice Agent-initial	1065	1041	1343	921	870
Patient voice Patient-initial	1106	958	1265	1094	864

4.3 Results

We first present the accuracy data from the picture selection task, followed by the eye-tracking data.

4.3.1 Accuracy

The mean accuracy and 95% confidence intervals for each condition are shown in Figure 4.2. The Bayesian mixed effects model showed main effects of age and word order; and two-way interactions of age (5:7) and word order, and voice and word order (see Table 4.3). Nested comparisons inspecting the two-way interaction of age (5:7) and word order showed that the 7-year-olds scored higher than the 5-year-olds in both word order conditions, but this difference was more pronounced in the agent-initial condition (coefficient = 3.60, [2.26, 5.00], $P(b<0) < .001$) than in the patient-initial condition (coef = 1.45, [0.54, 2.38], $P(b<0) = .001$). Nested comparisons inspecting the

interaction of voice and word order showed an agent-initial over patient-initial advantage for both voices, but with word order having a greater effect in the agent voice (coef = -9.82, [-13.59, -6.69], $P(b<0) > .99$) than in the patient voice (coef = -3.98, [-7.00, -1.20], $P(b<0) > .99$). The voice and word order interaction also showed higher accuracy in the patient voice compared to the agent voice in the patient-initial condition (coef = -4.57, [-6.93, -2.19], $P(b<0) > .99$) but not in the agent-initial condition (coef = 1.27, [-2.44, 5.26], $P(b<0) = .25$). However, nested comparisons also showed that this effect of voice in the patient-initial condition was found in the children (coef = -3.52, [-5.07, -2.00], $P(b<0) > .99$) but not in adults (coef = -1.05, [-2.25, 0.17], $P(b<0) = .96$).

To check for chance level performance, we calculated 95% uncertainty intervals and the posterior probability that the accuracy was below chance ($P(b<.5)$) from the posterior samples of the accuracy model (see Table 4.4). The uncertainty intervals are expected to contain the chance level threshold (.5) if responses are not different from chance. In the agent voice patient-initial condition, the 5-year-olds scored below chance; the 7-year-olds scored at chance level; and the adults above chance. All the other conditions were above chance for all age groups.

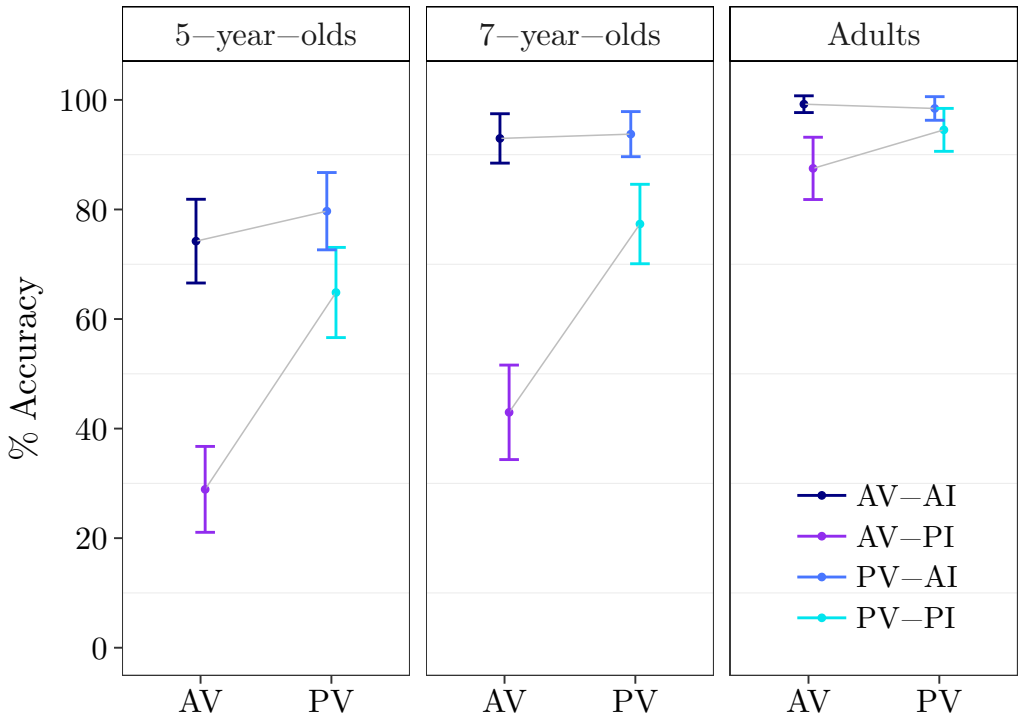

Figure 4.2. Mean accuracy with 95% confidence intervals for each condition per age group.

Note. AV refers to agent voice, PV to patient voice, AI to agent-initial, and PI to patient-initial.

Table 4.3

Summary of the fixed effects in the Bayesian model of the participants' accuracy, including means, 95% uncertainty intervals, and P(b<0) which refers to the probability that the true parameter value is less than 0.

Comparison	Mean	Upper	Lower	$P(b<0)$
Intercept	2.20	1.82	2.64	<.001
Age(5:7)	5.04	3.40	6.80	<.001
Age(children:adults)	22.32	17.19	29.73	<.001
Voice	-3.37	-7.54	1.36	.93
Word Order	13.71	9.58	18.43	<.001
Age(5:7)*Voice	0.60	-1.04	2.27	.24
Age(5:7)*Word order	2.14	0.56	3.79	<.001
Age(children:adults)*Voice	4.12	-1.34	10.88	.09
Age(children:adults)* Word order	2.02	-3.44	9.17	.25
Voice*Word order	5.76	1.40	10.56	.01
Age(5:7)*Voice*Word order	0.59	-1.03	2.23	.24
Age(children:adults)* Voice*Word order	1.25	-4.38	7.93	.33

Table 4.4

Summary of the posterior samples in the Bayesian model of the participants' accuracy in the picture selection task, including means, 95% uncertainty intervals, and P(b<.5) which refers to the probability that the true parameter value is less than .5.

Condition	Mean	Upper	Lower	$P(b<.5)$
5-year-olds				
Agent voice Agent-initial	.77	.64	.88	<.001
Agent voice Patient-initial	.27	.16	.40	>.99
Patient voice Agent-initial	.83	.73	.91	<.001
Patient voice Patient-initial	.67	.53	.80	.01
7-year-olds				
Agent voice Agent-initial	.96	.91	.99	<.001
Agent voice Patient-initial	.43	.28	.58	.83†
Patient voice Agent-initial	.95	.90	.98	<.001
Patient voice Patient-initial	.81	.69	.90	<.001
Adults				
Agent voice Agent-initial	1.00	.98	1.00	<.001
Agent voice Patient-initial	.90	.83	.96	<.001
Patient voice Agent-initial	.99	.97	1.00	<.001
Patient voice Patient-initial	.96	.92	.99	<.001

Note. The † denotes chance level performance.

4.3.2 Eye-tracking data

We analyzed the proportion of looks to the target for each time window: verb, NP1, temporal adverb, NP2, and spatial adverb (see Figure 4.3 for the adults, Figure 4.4 for the 5-year-olds, and Figure 4.5 for the 7-year-olds). Each time window was shifted by 200ms to consider the time needed to program saccadic eye-movements (Matin, Shao, & Boff, 1993). Trials with more than 50% track loss in the time window being analysed were excluded (0.01%). Moreover, we grouped the data into 250ms time bins.

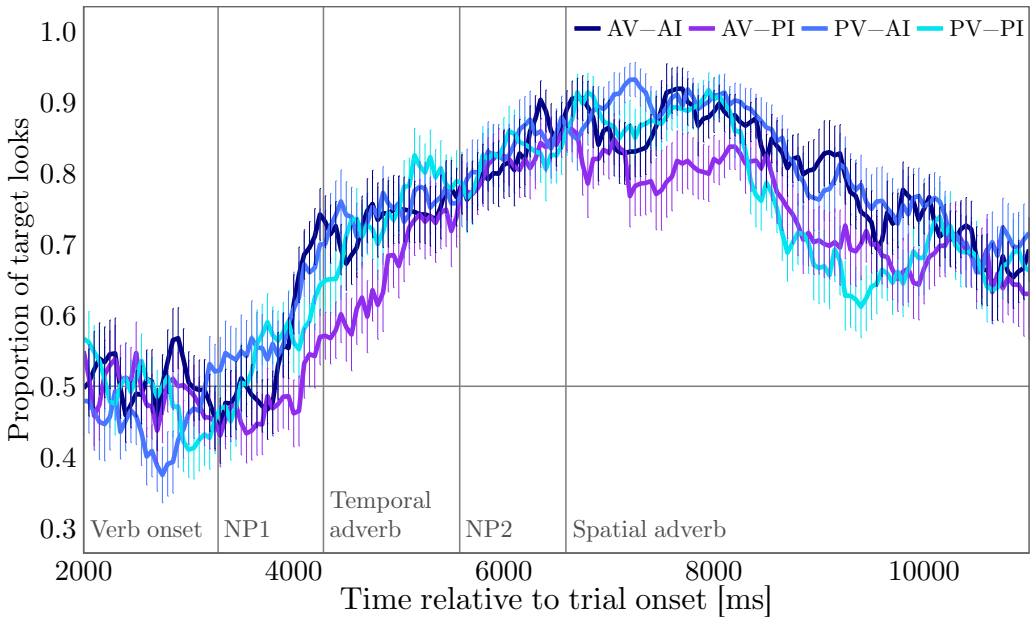

Figure 4.3. Adults' mean proportion of target looks with 95% confidence interval per condition relative to trial onset.

Note. AV refers to agent voice, PV to patient voice, AI to agent-initial, and PI to patient-initial.

Figure 4.3 suggests that immediately after the NP1, adults started looking

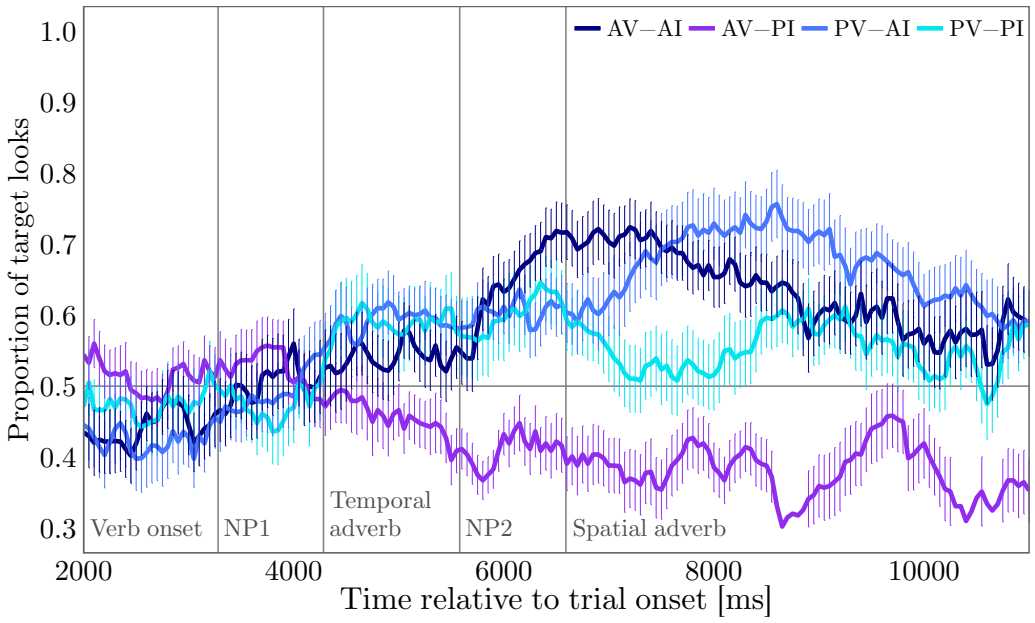

Figure 4.4. Five-year-olds' mean proportion of target looks with 95% confidence interval per condition relative to trial onset.

Note. AV refers to agent voice, PV to patient voice, AI to agent-initial, and PI to patient-initial.

to the target in all of the conditions. Figure 4.4 indicates that 5-year-olds' looks were still around chance level after the NP1, but by the NP2, they already looked to the target in most of the conditions, except for the agent voice patient-initial condition where they showed more looks to the distractor. Figure 4.5 suggests that at the temporal adverb time window, 7-year-olds looked more to the target in the agent-initial conditions compared to the patient-initial conditions. However, by the NP2 time window, their PLT in the patient voice patient-initial condition has reached a similar level as in the agent-initial conditions, but has remained low in the agent voice patient-

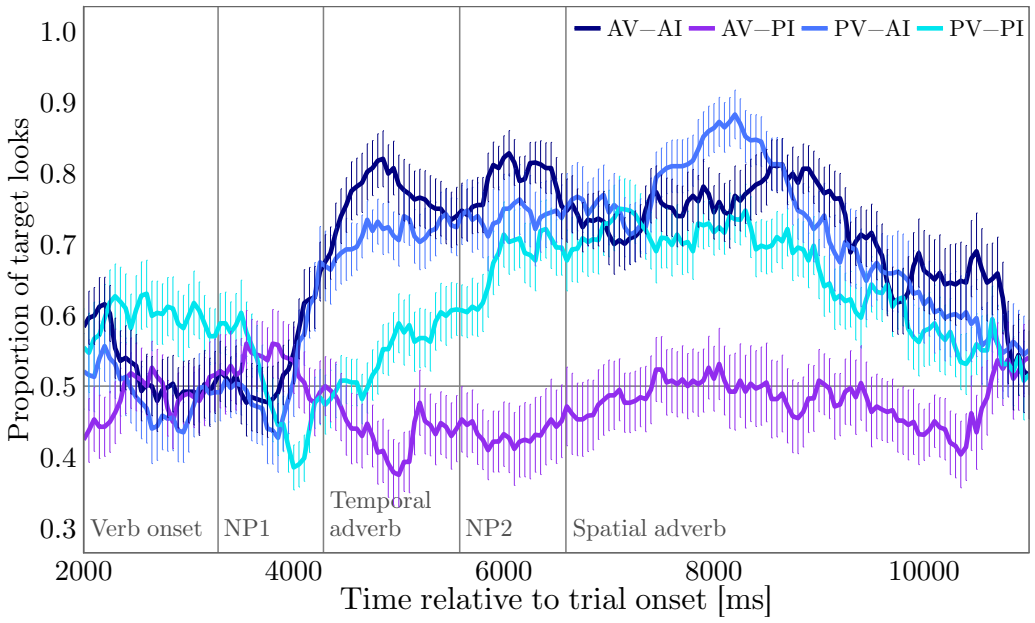

Figure 4.5. Seven-year-olds' mean proportion of target looks with 95% confidence interval per condition relative to trial onset.

Note. AV refers to agent voice, PV to patient voice, AI to agent-initial, and PI to patient-initial.

initial condition.

The Bayesian mixed model showed evidence for an effect of age (5:7) in the PLT in the verb time window, with 7-year-olds looking more to the target compared to the 5-year-olds (see Appendix C). However, this time window is prior to the disambiguation point which was the NP1, where we found no effect of the independent variables on the PLT. In the succeeding temporal adverb time window, there were main effects of age (5:7 and children:adults) and word order; and two-way interactions of age (5:7 and children:adults) and word order. Inspecting the interaction of age and word order showed

that children had higher PLT in the agent-initial compared to the patient-initial condition (coef = -3.70, [-5.23, -2.20], $P(b<0) > .99$), while the adults did not show a difference between the word order conditions (coef = -0.39, [-1.35, 0.61], $P(b<0) = .79$). Checking the effect of word order in the two children groups separately showed that this effect of word order was present in the 7-year-olds (coef = -2.90, [-3.91, -1.93], $P(b<0) > .99$), but not in the 5-year-olds (coef = -0.8, [-1.85, 0.22], $P(b<0) = .94$).

In the NP2 time window, the model showed main effects of age, voice, and word order, and two-way interactions of age (children:adults) and word order, and voice and word order; and a three-way interaction of age (children:adults), voice, and word order. Seven-year-olds had more looks to the target compared to the 5-year-olds. Nested comparisons showed that children had higher PLT in the agent-initial compared to the patient-initial condition in the agent voice (coef = -3.51, [-4.59, -2.42], $P(b<0) < .99$), but not in the patient voice (coef = -0.56, [-1.69, 0.60], $P(b<0) = .84$). However, there was no effect of word order found in the adults (agent voice: coef = -0.04, [-0.75, 0.68], $P(b<0) = .54$; patient voice: coef = 0.09, [-0.59, 0.8], $P(b<0) = .41$). The same results were obtained in the succeeding spatial adverb region.

4.4 Discussion

We examined children's online use of word order and morphosyntactic markers for thematic role assignment in Tagalog. More specifically, we investigated whether Tagalog-speaking children incrementally interpret the NP1 as the agent of the sentence, even if the verbal and nominal morphology

to assign thematic roles are given early in Tagalog sentences. Incremental sentence interpretation was investigated by recording children's eye movements to target and distractor pictures while listening to simple transitive sentences. The listening task was completed by a picture selection task.

The adults showed high accuracy scores in the picture selection task across all conditions. All age groups also showed higher accuracy in identifying the picture in agent-initial compared to patient-initial sentences. In children, we also found an effect of voice in the accuracy scores. In the patient-initial condition, children scored lower in the agent voice compared to the patient voice. Moreover, in the agent voice patient-initial condition, 7-year-olds scored at chance level, while the 5-year-olds scored below chance. In the patient voice patient-initial condition, both 5- and 7-year-olds scored above chance.

Regarding the eye-tracking data, adults showed an increasing proportion of looks to the target immediately after the point of disambiguation (NP1) in all of the conditions. In the temporal adverb time window (immediately after the NP1), 5-year-olds did not show a preference for the target nor the distractor picture in all of the conditions. On the other hand, 7-year-olds looked more to the target in the agent-initial than in the patient-initial conditions in this temporal window. By the NP2, both 5-year-olds and 7-year-olds showed more looks to the target in the agent-initial condition compared to the patient-initial condition, but this word order effect occurred only in the agent voice. In the patient voice, there was no effect of word order, and both groups of children showed more looks to the target than to the distractor.

Both the accuracy and eye-tracking data are consistent with previous findings that agent-initial sentences are easier to interpret than patient-initial

sentences for both adults (Ferreira, 2003) and children (e.g., Armon-Lotem et al., 2016; Dittmar et al., 2008; MacWhinney et al., 1985; Slobin & Bever, 1982). In the agent voice, above chance performance in the agent-initial condition, and below chance performance in the patient-initial condition indicate that the 5-year-olds relied on word order and interpreted the NP1 as the agent of the action, resulting in thematic role-reversals in the patient-initial condition. Chance performance of the 7-year-olds in the agent voice patient-initial condition shows that they did not consistently rely on word order for thematic role assignment, but it also demonstrates that these older children still did not show adult-like use of the agent voice marker on the verb for assigning the thematic role to the *ang*-phrase. It is not so surprising that 7-year-old children still did not perform like adults, given previous findings that German-speaking children use case markers which clearly disambiguate thematic roles only after the age of five (Dittmar et al., 2008).

Adults' immediate looks to the target after the NP1 shows their immediate use of the morphosyntactic markers on the verb and the noun for thematic role assignment. This evidence for incremental processing is consistent with Sauppe's (2016) findings with Tagalog-speaking adults, and also with conclusions from studies on other languages (Altmann & Steedman, 1988; Kamide, Altmann, & Haywood, 2003; Kamide, Scheepers, & Altmann, 2003).

Children also showed evidence of incremental processing. The agent-initial advantage in the 7-year-olds' looks to the target after the NP1 shows an early influence of word order in thematic role assignment. Even when the morphosyntactic markers were given early, the 7-year-olds showed that their interpretation was still affected by an NP1-as-agent expectation. The

5-year-olds showed a preference for one picture over the other only when they had encountered the NP2. This could indicate that the younger children are still slower in their general processing (Kail, 1991) but it could also indicate that they wait for more morphosyntactic evidence before committing to a specific sentence interpretation compared to adults or older children.

The findings of the current study support computational models which predict an early NP1-as-agent bias if an agent-before-patient order is highly frequent in the input (e.g., Chang et al., 2006). The dominance of this argument order was reported in Garcia et al. (2018) for child-directed speech in Tagalog for both agent and patient voice. The current results are also in line with findings from languages where thematic role assignment is ambiguous by the NP1, which have shown that children immediately assign the agent to the first noun they encounter (i.e., Abbot-Smith et al., 2017 for English; (Huang et al., 2013) for Mandarin). Moreover, the present study extends this finding of an incremental use of word order to a language where morphosyntactic markers clearly disambiguate the thematic roles from the start of the sentence.

However, children did not always rely on an NP1-as-agent strategy. Children's above chance accuracy in the patient voice patient-initial condition shows that they were able to use the patient voice marker on the verb to assign the thematic role to the *ang*-phrase. Additionally, in the patient voice, by the NP2, children looked more to the target than to the distractor in both the agent-initial and patient-initial condition, which means that they used the morphosyntactic markers for thematic role assignment. However, it must be noted that they used the morphosyntactic markers later than the adults,

which may again be due to slower processing speed (Kail, 1991).

This patient voice advantage is similar to findings by Segalowitz and Galang (1978) and Garcia et al. (2018) that Tagalog-speaking children rely more on word order than morphosyntactic markers in thematic role assignment in the agent voice, but rely more on the verb and noun morphology in the patient voice. The current results are also in line with findings of earlier acquisition of passives in languages where passives are frequent (Demuth, 1989; Gordon & Chafetz, 1990; Kline & Demuth, 2010), given that in Tagalog child-directed speech, there are more patient voice-marked verbs than agent voice-marked verbs (Garcia et al., 2018)

The patient voice advantage can also be explained by Chang et al.'s (2006) model. The model predicts error-based learning, which means that a structure is learned when an encountered word deviates from a predicted word. We can say that children first rely on a word order strategy because of its high frequency in the input, but this strategy can be overwritten by the morphosyntactic markers after a sufficient amount of patient-initial input was available. Given that the patient voice is more frequent, and it is 85% agent-initial (compared to the agent voice's 95% agent-initial word order), there is a higher probability for children to encounter patient-initial sentences (a deviation from an NP1-as-agent expectation) in the patient voice compared to the agent voice, so children learn faster not to rely only on word order in the patient voice than in the agent voice.

Our results also show that in parsing a sentence, word order appears to be used before the morphosyntactic markers. In the patient voice conditions where the 7-year-olds showed above chance accuracy, they initially showed

more looks to the target in the agent-initial compared to the patient-initial condition, but this word order effect was no longer found in the later NP2 time window. This finding implies that children have to first disregard an NP1-as-agent preference, before they could use the morphosyntactic markers; providing insight into why patient-initial sentences are generally more difficult to process than agent-initial sentences. These results could possibly mean that children have already interpreted the first noun as the agent before or upon encountering the NP1, but they were able to revise this interpretation once they have obtained more cue from the morphosyntactic marker in the NP2. Such an explanation goes against previous findings in other languages that children have difficulties in revising an initial interpretation (Trueswell & Gleitman, 2004). Unfortunately, our paradigm does not allow us to clearly observe a revision, as it can also be that children just needed more time or cues to assign their initial interpretation.

In conclusion, our study demonstrates that Tagalog-speaking children expect the NP1 to be an agent, even if the language does not formally use word order for thematic role assignment. Even if the markers disambiguate the thematic roles before the nouns are given, it seems that children's word order expectation significantly affects sentence interpretation such that they need to hear more cues (NP2) to correctly assign the thematic roles in patient-initial sentences. These findings inform on the timing of use of the cues during sentence interpretation, and show that research on understudied languages can improve our understanding of language acquisition and processing.

Chapter 5

General discussion

Through three experiments and a corpus analysis, I investigated Tagalog-speaking children's use of word order and morphosyntactic markers for thematic role assignment. This dissertation aimed to shed light on why non-canonical sentences are difficult for children to interpret, and specifically, to test the predictions of the frequency account, the Competition model, and the incremental processing account. This chapter contains a summary of the previous chapters, as well as concluding remarks.

Chapter 2 reports a production study which aimed to identify the word order preferences of Tagalog-speaking adults and children—a possible basis for a word order strategy in comprehension. In this experiment, 5- and 7-year-old children and adult control participants were asked to describe actions between two animals, by completing voice-marked verb prompts. The results showed that voice modulated word order preference in the adults, such that they showed an agent-initial preference only in the patient voice. They showed no preference in the agent voice. Such findings support Kroeger's

(1993b) proposal that early-agent and late-*ang*-phrase principles guide the order of nominals in Tagalog. An agent-initial (verb-*ng*-*ang*) structure satisfies both principles in the patient voice. However, in the agent voice, a verb-*ng*-*ang* structure satisfies only the early-agent principle but not the late-*ang* principle. Therefore, no order is more preferred. In contrast, children showed an agent-initial preference in both the agent and patient voice. This finding supports Jackendoff and Wittenberg's (2014) claim that children have an agent-before-patient preference early on that is independent from the specific language they are learning.

The analysis of child-directed speech in Chapter 3 also provides insights into the reason behind children's agent-initial preference in production. The results showed that most utterances that children heard were agent-initial. Even though most of these utterances consisted of at least one pronominal argument, it seemed that children used this dominant order in their production of full noun phrases too. Moreover, the patient voice occurred more frequently than the agent voice in the input. In other words, the *ang*-phrase was most frequently not an agent but a patient. Children might have overgeneralized the preferred agent-initial order in the patient voice to the agent voice. It must also be noted that children's utterances were grammatical, and the production experiment only showed word order preferences, which means that using a particular argument order was optional. Therefore, it is not worrisome that even 7-year-olds still did not show adult-like behavior in the production experiment.

The child-directed speech analysis in Chapter 3 also revealed that the morphosyntactic cue is highly available and reliable in Tagalog, so it is a

highly valid cue for thematic role assignment. This finding along with the frequency counts were used to test the predictions of the frequency account and the Competition model in children's comprehension of transitive sentences.

In Chapter 3, children's use of word order and morphosyntactic markers in thematic role assignment during comprehension was tested using the same visual stimuli as in Chapter 2. This experiment was done to test the predictions of accounts that aim to explain children's difficulties in comprehending non-canonical sentences namely, the frequency account, the Competition model, and the incremental processing account. In a combined self-paced listening and picture verification task, 5-year-olds, 7-year-olds, and adults were presented a picture of a reversible action between two animals, and asked to listen to a sentence like 'The cow is pulling a pig every morning in the muddy field' segment-by-segment (voice, word order, and matching of the interpretation of the morphosyntactic markers to the picture were manipulated) by pressing a button on a controller. At the end of the sentence, they had to judge whether or not the sentence they heard matched the presented picture.

The results of the picture verification task showed high accuracy for the adult participants. In the agent voice, 5-year-old children consistently interpreted the first mentioned noun as the agent of the action in the picture. They consistently answered that the agent-initial sentences they heard matched the pictures they saw, but the patient-initial sentences did not, regardless of the verbal and nominal markers in the sentence. These answers resulted to correct acceptance of matching agent-initial sentences (interpretation of the morphosyntactic markers matched the depicted picture) and

incorrect acceptance of mismatching agent-initial sentences (interpretation of the morphosyntactic markers showed a role reversal of what was depicted in the picture). On the other hand, in the patient-initial sentences, they correctly rejected mismatching sentences, but incorrectly rejected matching ones. The 7-year-olds showed higher accuracy than the 5-year-olds but still did not show adult-like performance in using the morphosyntactic markers in the agent voice. Compared to the agent voice, in the patient voice, both groups of children showed higher accuracy in the agent-initial mismatch (5-year-olds: chance as opposed to below chance performance in the agent voice; 7-year-olds: above chance compared to chance performance in the agent voice) and patient-initial match (5-year-olds: above chance in comparison to chance performance in the agent voice) conditions, which were expected to be below chance given a word order strategy.

The self-paced listening results showed that in the match conditions, listening times for the first noun phrase were longer for patient-initial sentences compared to agent-initial sentences, which means that all age groups expected the first noun phrase to be the agent. Additionally, children showed adult-like performance in the patient voice—they had longer listening times for the mismatch compared to the match condition. This result implies that children recognized the difference between a mismatch in the interpretation of the verb and noun markers and the picture. Furthermore, this finding means that children incrementally processed the morphosyntactic markers. However, such an effect of matching was not observed in the agent voice.

Chapter 4 reports a comprehension experiment which was conducted to investigate the timing of use of word order and morphosyntactic markers in

online thematic role assignment. An eye-tracking study with a picture selection task was created using the same stimuli as in the experiments presented in Chapters 2 and 3. Participants (again 5-year-olds, 7-year-olds, and adults) were presented with two pictures of reversible actions between two animals, with one showing role reversals of the other, e.g., a cow pulling a pig, and a pig pulling a cow. They then heard a sentence such as 'The cow is pulling a pig every morning in the muddy field,' (voice and word order were manipulated) and their task was to identify which of the two pictures matched the sentence they heard. The accuracy results showed that all age groups were more accurate in the agent-initial compared to the patient-initial condition. Additionally, in the patient-initial condition, children showed higher accuracy in the patient voice than in the agent voice.

The eye data showed that by the first noun phrase, adults were already anticipating looks to the target in all of the conditions. However, the 5-year-olds' looks were still at chance, while the 7-year-olds showed more looks to the target in the agent-initial compared to the patient-initial conditions, implying an online bias to interpret the first noun phrase as the agent. By the second noun phrase, both groups of children showed more looks to the target in the patient voice patient-initial condition, while in the agent voice patient-initial condition, 5-year-olds showed more looks to the distractor, and the 7-year-olds' looks were at chance. These online results corroborate the patient voice advantage observed in the accuracy data.

The offline and online results from the two comprehension experiments (Chapters 3 and 4) show that in Tagalog, canonical agent-initial sentences are easier to comprehend than patient-initial sentences, similar to findings

in other languages (e.g., Armon-Lotem et al., 2016; Dittmar et al., 2008; MacWhinney et al., 1985; Slobin & Bever, 1982). Moreover, in the agent voice, children showed reliance on word order when word order and morphosyntactic markers competed with each other and indicated different agents. This use of word order even at the age of seven is not surprising given findings in German that children use case markers for thematic role assignment only after the age of five (Dittmar et al., 2008). In the patient voice, Tagalog-speaking children exhibited more adult-like behavior, and used the morphosyntactic markers on the verbs and nouns to assign thematic roles. This patient voice advantage supports Segalowitz's (1982) findings from an act-out task.

According to the frequency account, the agent-initial and patient voice advantage are explained by the higher frequency of agent-initial compared to patient-initial utterances, and of patient voice than agent voice utterances in the input as found in the corpus data analysis in Chapter 2. Furthermore, following the frequency account, it can be said that the current results corroborate findings of an earlier passive voice acquisition in languages where passives are frequent in the input (Demuth, 1989; Gordon & Chafetz, 1990; Kline & Demuth, 2010). However, a strict use of frequency predicts that given the higher frequency of the patient voice agent-initial than the agent voice agent-initial, children would perform better in the former compared to the latter. In both comprehension experiments, I did not observe any difference in children's agent-initial performance between the two voices.

The Competition model also does not fully support the results, as it predicts the use of the more valid cue in case two cues compete and indicate

different agents. In the corpus data analysis, the word order cue was not found to have a higher validity compared to the morphosyntactic markers, yet the two comprehension experiments provide evidence that children relied on word order for thematic role assignment in the agent voice. Moreover, the Competition model also cannot explain the patient voice advantage found in patient-initial utterances.

Children did show in both listening times and eye data that they incrementally processed the sentences. However, the incremental processing account predicts that children immediately assign thematic roles as the sentence unfolds, and non-canonical sentences are difficult because an initial interpretation needs to be revised. As the morphosyntactic markers are given early in Tagalog, such that the thematic roles are always disambiguated, it was predicted that children would not have problems in interpreting patient-initial sentences in Tagalog and would show no differences in their ability to comprehend the two voices. Nevertheless, it was found that children relied on word order in the agent voice.

The findings in this dissertation cannot be fully explained by the accounts which have been proposed to be relevant for children's difficulty with non-canonical sentences namely, the frequency account, the Competition model, and the incremental processing account. Nonetheless, the results do imply that frequency of a structure affects comprehension and acquisition. Additionally, children showed evidence of incremental processing of transitive sentences. These findings support computational models of incremental word prediction and learning, such as that of Chang et al. (2006), wherein the upcoming input is predicted not only from the previous input, but also through

event-semantic representations, including thematic roles. This model uses highly frequent structures for prediction. For example, because English has a strong agent-before-patient bias, early in development, the model sets a stronger weight for mapping of the agent role to the first noun. Through encountering deviations from this expected mapping of the word order and thematic roles, the model gradually learns to put more weight on the post-first noun structures for thematic role assignment. This model explains Tagalog-speaking children's online assignment of the first noun as the agent, given that agent-initial structures dominate the input.

Moreover, the principle of error-based learning in Chang et al.'s (2006) model can best explain the patient voice advantage in the patient-initial condition. Since the model assumes that a structure is learned when an encountered word deviates from a predicted word, and given that the patient voice is more frequent, and it is 85% agent-initial (compared to the agent voice's 95% agent-initial word order), there are more opportunities for children to encounter patient-initial sentences (a deviation from an expectation of the first noun as the agent) in the patient voice compared to the agent voice. Therefore, it might be faster in the patient voice than in the agent voice for children to learn not to rely only on word order, but instead use the morphosyntactic markers for thematic role assignment.

Overall, the results of the experiments in this dissertation show that heuristics like a word order strategy plays a big role in children's sentence comprehension even in a language where the verbal and nominal morphosyntactic markers are reliable and provided from the beginning of the sentence before any argument is encountered. Nevertheless, if morphosyntactic mark-

ers are provided early in the sentence, voice also modulates the use of a word order strategy. The findings from Tagalog also demonstrate that the word order strategy is based on the order of thematic roles (agent-initial) instead of on grammatical roles (subject-initial). Additionally, the results of the eye-tracking experiment provide evidence that children (at least the 7-year-olds) incrementally assigned the agent to the first noun phrase before looking more to the target upon encountering the second noun phrase, which implies that they initially relied on word order before using the morphosyntactic markers for thematic role assignment, even if they had access to both cues at the same time.

As 7-year-olds still did not consistently use the morphosyntactic markers, future research should include older children to determine when Tagalog-learning children begin to show adult-like behavior. Moreover, collecting child-directed speech to older children could show whether there is a correlation between the input and children's ability to assign thematic roles. Additionally, an analysis of a more comprehensive Tagalog child-directed speech corpus would help in forming stronger conclusions about the effect of frequency on acquisition, and may provide a more reliable explanation for the patient voice advantage found in this research.

It is also interesting to determine the influence of pragmatics on children's choice of voice and word order. For example, it is yet to be tested whether Tagalog-speaking children would show better comprehension of less preferred sentences such as the agent voice patient-initial construction, if they are provided with a context that licenses the use of this structure.

The eye-tracking results also implied that children first had to overcome

an online first-noun-as-agent strategy in thematic role assignment. However, for patient-before-agent sentences in the patient voice, it is not clear from the current data whether children assigned an initial thematic role assignment after hearing the first noun, and then revised this interpretation; or if it just took them a long time to assign an initial interpretation. As the question of whether children have difficulties in revision is still a matter of debate, it is worthwhile to develop a paradigm which could show whether Tagalog-speaking children could revise their initial thematic role assignment.

Given that children incorrectly interpreted patient-before-agent sentences, especially in the agent voice, it is also of interest to look at whether experimentally increasing the exposure to such structures would help children's comprehension. Such an experiment could provide insight on how much priming can affect the representational strength of the syntactic structure. On the other hand, another experiment on Tagalog could show how much priming relies on the representational strength of the syntactic structures. Given that the voices in Tagalog are marked by several affixes (e.g., *–um-*, *mag–*, and *nag–* for the agent voice), it is interesting whether one affix could prime the comprehension of other affixes in the same voice. These structural priming experiments could inform computational models of acquisition and processing such as that of Chang et al. (2006).

In conclusion, this dissertation adds to the literature on cross-linguistic studies on children's acquisition of thematic role assignment. Moreover, it shows language-general and language-specific factors which affect first language acquisition. Lastly, it demonstrates that less-studied languages can deepen our understanding of children's language acquisition and processing.

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Appendix A

Chapter 2

A.1 Analysis of productions with correctly-marked nouns only

Analysis of the data without the instances of a mismatch between the noun markings and the action in the picture in the 5-year-old group (17%), and in the 7-year-old group (14%) shows similar results to that of the analysis including all of the productions. The fitted logistic mixed model showed above chance level agent-initial productions in both voice conditions for both age groups (see Table A.1), just like the main model.

Table A.1

Results of chance-level testing using a logistic mixed model on children's word order preference excluding incorrectly-marked nouns in Experiment 2.

Predictor	Estimate	Standard error	z value	p value
5-year-olds agent voice	0.94	0.45	6.11	<.001
5-year-olds patient voice	0.87	0.54	3.58	<.001
7-year-olds agent voice	0.96	0.51	6.20	<.001
7-year-olds patient voice	0.93	0.63	4.14	<.001

Appendix B

Chapter 3

B.1 Listening times for all sentence regions

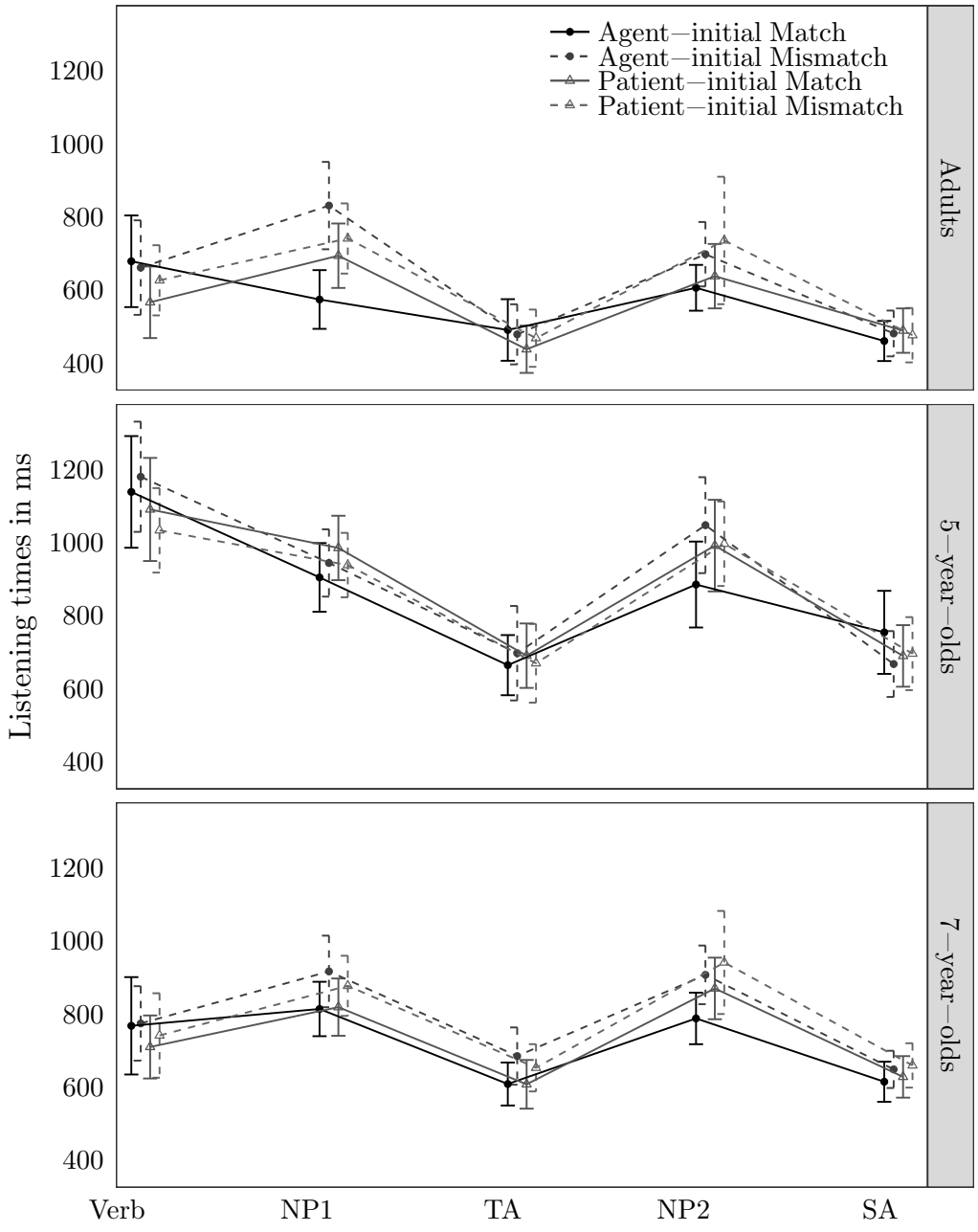

Figure B.1. Mean listening times with 95% confidence intervals for each sentence fragment for word order and matching conditions per age group in the agent voice condition in Study 2.

Note. NP1 refers to the first noun phrase, TA to temporal adverb, NP2 to the second noun phrase and SA to spatial adverb.

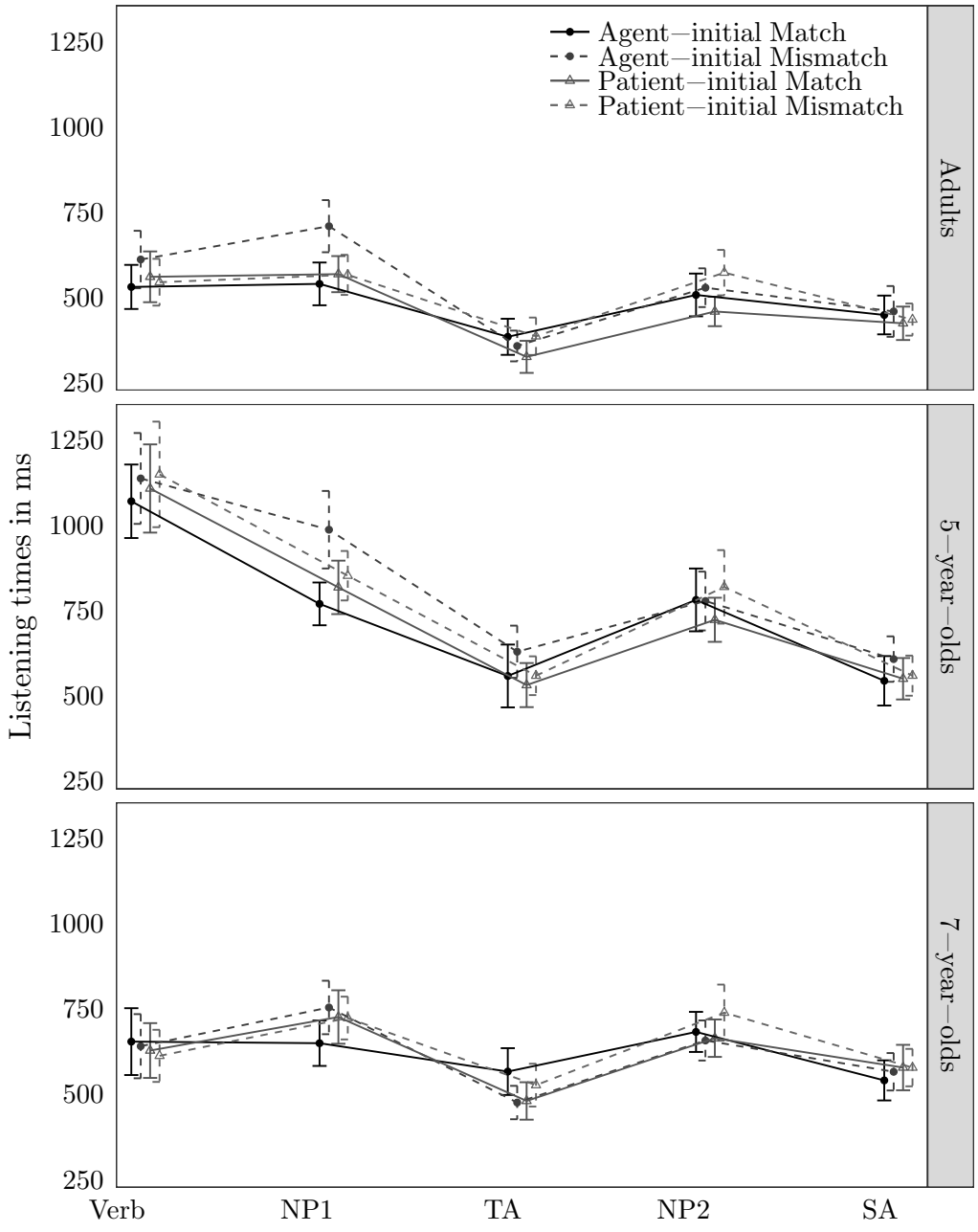

Figure B.2. Mean listening times with 95% confidence intervals for each sentence fragment for word order and matching conditions per age group in the patient voice condition in Study 2.

Note. NP1 refers to the first noun phrase, TA to temporal adverb, NP2 to the second noun phrase and SA to spatial adverb.

B.2 List of experimental sentences

Table B.1

List of experimental sentences for Study 1 and 2.

Item	Condition	Sentence
1. *Hila* 'Pull'		
1.1. 'The cow is pulling a pig every morning in the muddy field.'		
	Agent voice Agent-initial	*Humihila ang baka tuwing umaga ng baboy sa maputik na bukid.*
	Agent voice Patient-initial	*Humihila ng baboy tuwing umaga ang baka sa maputik na bukid.*
	Patient voice Agent-initial	*Hinihila ng baka tuwing umaga ang baboy sa maputik na bukid.*
	Patient voice Patient-initial	*Hinihila ang baboy tuwing umaga ng baka sa maputik na bukid.*
1.2. 'The pig is pulling a cow every morning in the muddy field.'		
	Agent voice Agent-initial	*Humihila ang baboy tuwing umaga ng baka sa maputik na bukid.*
	Agent voice Patient-initial	*Humihila ng baka tuwing umaga ang baboy sa maputik na bukid.*
	Patient voice Agent-initial	*Hinihila ng baboy tuwing umaga ang baka sa maputik na bukid.*

Continued on next page

Table B.1 – *Continued from previous page*

Item	Condition	Sentence
	Patient voice Patient-initial	*Hinihila ang baka tuwing umaga ng baboy sa maputik na bukid.*
2. *Silip* 'Peek'		
2.1. 'The pig is peeking at a cow today in the tidy house.'		
	Agent voice Agent-initial	*Sumisilip ang baboy ngayong araw ng baka sa maayos na bahay.*
	Agent voice Patient-initial	*Sumisilip ng baka ngayong araw ang baboy sa maayos na bahay.*
	Patient voice Agent-initial	*Sinisilip ng baboy ngayong araw ang baka sa maayos na bahay.*
	Patient voice Patient-initial	*Sinisilip ang baka ngayong araw ng baboy sa maayos na bahay.*
2.2. 'The cow is peeking at a pig today in the tidy house.'		
	Agent voice Agent-initial	*Sumisilip ang baka ngayong araw ng baboy sa maayos na bahay.*
	Agent voice Patient-initial	*Sumisilip ng baboy ngayong araw ang baka sa maayos na bahay.*
	Patient voice Agent-initial	*Sinisilip ng baka ngayong araw ang baboy sa maayos na bahay.*
	Patient voice Patient-initial	*Sinisilip ang baboy ngayong araw ng baka sa maayos na bahay.*

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Table B.1 – *Continued from previous page*

Item	Condition	Sentence
3. *Sipa* 'Kick'		
3.1. 'The dog is kicking a turtle this afternoon in the colorful garden.'		
	Agent voice Agent-initial	*Sumisipa ang aso ngayong hapon ng pagong sa makulay na hardin.*
	Agent voice Patient-initial	*Sumisipa ng pagong ngayong hapon ang aso sa makulay na hardin.*
	Patient voice Agent-initial	*Sinisipa ng aso ngayong hapon ang pagong sa makulay na hardin.*
	Patient voice Patient-initial	*Sinisipa ang pagong ngayong hapon ng aso sa makulay na hardin.*
3.2. 'The turtle is kicking a dog this afternoon in the colorful garden.'		
	Agent voice Agent-initial	*Sumisipa ang pagong ngayong hapon ng aso sa makulay na hardin.*
	Agent voice Patient-initial	*Sumisipa ng aso ngayong hapon ang pagong sa makulay na hardin.*
	Patient voice Agent-initial	*Sinisipa ng pagong ngayong hapon ang aso sa makulay na hardin.*
	Patient voice Patient-initial	*Sinisipa ang aso ngayong hapon ng pagong sa makulay na hardin.*

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Table B.1 – *Continued from previous page*

Item	Condition	Sentence
4. *Huli* 'Capture'		
4.1. 'The turtle is capturing a dog every Saturday in the high mountain.'		
	Agent voice Agent-initial	*Humuhuli ang pagong tuwing Sabado ng aso sa mataas na bundok.*
	Agent voice Patient-initial	*Humuhuli ng aso tuwing Sabado ang pagong sa mataas na bundok.*
	Patient voice Agent-initial	*Hinuhuli ng pagong tuwing Sabado ang aso sa mataas na bundok.*
	Patient voice Patient-initial	*Hinuhuli ang aso tuwing Sabado ng pagong sa mataas na bundok.*
4.2. 'The dog is capturing a turtle every Saturday in the high mountain.'		
	Agent voice Agent-initial	*Humuhuli ang aso tuwing Sabado ng pagong sa mataas na bundok.*
	Agent voice Patient-initial	*Humuhuli ng pagong tuwing Sabado ang aso sa mataas na bundok.*
	Patient voice Agent-initial	*Hinuhuli ng aso tuwing Sabado ang pagong sa mataas na bundok.*
	Patient voice Patient-initial	*Hinuhuli ang pagong tuwing Sabado ng aso sa mataas na bundok.*
5. *Palo* 'Hit'		

Continued on next page

Table B.1 – *Continued from previous page*

Item	Condition	Sentence
5.1. 'The mouse is hitting a chicken tonight in the dark street.'		
	Agent voice Agent-initial	*Pumapalo ang daga ngayong gabi ng manok sa madilim na kalye.*
	Agent voice Patient-initial	*Pumapalo ng manok ngayong gabi ang daga sa madilim na kalye.*
	Patient voice Agent-initial	*Pinapalo ng daga ngayong gabi ang manok sa madilim na kalye.*
	Patient voice Patient-initial	*Pinapalo ang manok ngayong gabi ng daga sa madilim na kalye.*
5.2. 'The chicken is hitting a mouse tonight in the dark street.'		
	Agent voice Agent-initial	*Pumapalo ang manok ngayong gabi ng daga sa madilim na kalye.*
	Agent voice Patient-initial	*Pumapalo ng daga ngayong gabi ang manok sa madilim na kalye.*
	Patient voice Agent-initial	*Pinapalo ng manok ngayong gabi ang daga sa madilim na kalye.*
	Patient voice Patient-initial	*Pinapalo ang daga ngayong gabi ng manok sa madilim na kalye.*
6. *Pasan* 'Give a piggyback ride'		
6.1. 'The chicken is giving a mouse a piggy back ride every night in the tiny park.'		

Continued on next page

Table B.1 – *Continued from previous page*

Item	Condition	Sentence
	Agent voice Agent-initial	*Pumapasan ang manok gabi-gabi ng daga sa maliit na parke.*
	Agent voice Patient-initial	*Pumapasan ng daga gabi-gabi ang manok sa maliit na parke.*
	Patient voice Agent-initial	*Pinapasan ng manok gabi-gabi ang daga sa maliit na parke.*
	Patient voice Patient-initial	*Pinapasan ang daga gabi-gabi ng manok sa maliit na parke.*
6.2. 'The mouse is giving a chicken a piggy back ride every night in the tiny park.'		
	Agent voice Agent-initial	*Pumapasan ang daga gabi-gabi ng manok sa maliit na parke.*
	Agent voice Patient-initial	*Pumapasan ng manok gabi-gabi ang daga sa maliit na parke.*
	Patient voice Agent-initial	*Pinapasan ng daga gabi-gabi ang manok sa maliit na parke.*
	Patient voice Patient-initial	*Pinapasan ang manok gabi-gabi ng daga sa maliit na parke.*
7. *Kagat* 'Bite'		
7.1. 'The monkey is biting a cat every day in the clean room.'		
	Agent voice Agent-initial	*Kumakagat ang unggoy araw-araw ng pusa sa malinis na kwarto.*

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Table B.1 – *Continued from previous page*

Item	Condition	Sentence
	Agent voice Patient-initial	*Kumakagat ng pusa araw-araw ang unggoy sa malinis na kwarto.*
	Patient voice Agent-initial	*Kinakagat ng unggoy araw-araw ang pusa sa malinis na kwarto.*
	Patient voice Patient-initial	*Kinakagat ang pusa araw-araw ng unggoy sa malinis na kwarto.*
7.2. 'The cat is biting a monkey every day in the clean room.'		
	Agent voice Agent-initial	*Kumakagat ang pusa araw-araw ng unggoy sa malinis na kwarto.*
	Agent voice Patient-initial	*Kumakagat ng unggoy araw-araw ang pusa sa malinis na kwarto.*
	Patient voice Agent-initial	*Kinakagat ng pusa araw-araw ang unggoy sa malinis na kwarto.*
	Patient voice Patient-initial	*Kinakagat ang unggoy araw-araw ng pusa sa malinis na kwarto.*
8. *Tira* 'Shoot'		
8.1. 'The cat is shooting a monkey this Monday in the shallow river.'		
	Agent voice Agent-initial	*Tumitira ang pusa ngayong Lunes ng unggoy sa mababaw na ilog.*
	Agent voice Patient-initial	*Tumitira ng unggoy ngayong Lunes ang pusa sa mababaw na ilog.*

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Table B.1 – *Continued from previous page*

Item	Condition	Sentence
	Patient voice Agent-initial	*Tinitira ng pusa ngayong Lunes ang unggoy sa mababaw na ilog.*
	Patient voice Patient-initial	*Tinitira ang unggoy ngayong Lunes ng pusa sa mababaw na ilog.*
8.2. 'The monkey is shooting a cat this Monday in the shallow river.'		
	Agent voice Agent-initial	*Tumitira ang unggoy ngayong Lunes ng pusa sa mababaw na ilog.*
	Agent voice Patient-initial	*Tumitira ng pusa ngayong Lunes ang unggoy sa mababaw na ilog.*
	Patient voice Agent-initial	*Tinitira ng unggoy ngayong Lunes ang pusa sa mababaw na ilog.*
	Patient voice Patient-initial	*Tinitira ang pusa ngayong Lunes ng unggoy sa mababaw na ilog.*
9. *Sagip* 'Rescue'		
9.1. 'The turtle is rescuing a monkey this afternoon in the shallow river.'		
	Agent voice Agent-initial	*Sumasagip ang pagong ngayong hapon ng unggoy sa mababaw na ilog.*
	Agent voice Patient-initial	*Sumasagip ng unggoy ngayong hapon ang pagong sa mababaw na ilog.*
	Patient voice Agent-initial	*Sinasagip ng pagong ngayong hapon ang unggoy sa mababaw na ilog.*

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Table B.1 – *Continued from previous page*

Item	Condition	Sentence
	Patient voice Patient-initial	*Sinasagip ang unggoy ngayong hapon ng pagong sa mababaw na ilog.*
9.1. 'The monkey is rescuing a turtle this afternoon in the shallow river.'		
	Agent voice Agent-initial	*Sumasagip ang unggoy ngayong hapon ng pagong sa mababaw na ilog.*
	Agent voice Patient-initial	*Sumasagip ng pagong ngayong hapon ang unggoy sa mababaw na ilog.*
	Patient voice Agent-initial	*Sinasagip ng unggoy ngayong hapon ang pagong sa mababaw na ilog.*
	Patient voice Patient-initial	*Sinasagip ang pagong ngayong hapon ng unggoy sa mababaw na ilog.*
10. *Gamot* 'Cure'		
10.1. 'The monkey is curing a turtle this Monday in the clean room.'		
	Agent voice Agent-initial	*Gumagamot ang unggoy ngayong Lunes ng pagong sa malinis na kwarto.*
	Agent voice Patient-initial	*Gumagamot ng pagong ngayong Lunes ang unggoy sa malinis na kwarto.*
	Patient voice Agent-initial	*Ginagamot ng unggoy ngayong Lunes ang pagong sa malinis na kwarto.*
	Patient voice Patient-initial	*Ginagamot ang pagong ngayong Lunes ng unggoy sa malinis na kwarto.*

Continued on next page

Table B.1 – *Continued from previous page*

Item	Condition	Sentence
10.2. 'The turtle is curing a monkey this Monday in the clean room.'		
	Agent voice Agent-initial	*Gumagamot ang pagong ngayong Lunes ng unggoy sa malinis na kwarto.*
	Agent voice Patient-initial	*Gumagamot ng unggoy ngayong Lunes ang pagong sa malinis na kwarto.*
	Patient voice Agent-initial	*Ginagamot ng pagong ngayong Lunes ang unggoy sa malinis na kwarto.*
	Patient voice Patient-initial	*Ginagamot ang unggoy ngayong Lunes ng pagong sa malinis na kwarto.*
11. *Pili* 'Choose'		
11.1. 'The pig is choosing a chicken every morning in the muddy field.'		
	Agent voice Agent-initial	*Pumipili ang baboy tuwing umaga ng manok sa maputik na bukid.*
	Agent voice Patient-initial	*Pumipili ng manok tuwing umaga ang baboy sa maputik na bukid.*
	Patient voice Agent-initial	*Pinipili ng baboy tuwing umaga ang manok sa maputik na bukid.*
	Patient voice Patient-initial	*Pinipili ang manok tuwing umaga ng baboy sa maputik na bukid.*
11.2. 'The chicken is choosing a pig every morning in the muddy field.'		

Continued on next page

Table B.1 – *Continued from previous page*

Item	Condition	Sentence
	Agent voice Agent-initial	*Pumipili ang manok tuwing umaga ng baboy sa maputik na bukid.*
	Agent voice Patient-initial	*Pumipili ng baboy tuwing umaga ang manok sa maputik na bukid.*
	Patient voice Agent-initial	*Pinipili ng manok tuwing umaga ang baboy sa maputik na bukid.*
	Patient voice Patient-initial	*Pinipili ang baboy tuwing umaga ng manok sa maputik na bukid.*
12. *Tawag* 'Call'		
12.1. 'The chicken is calling a pig every Saturday in the high mountain.'		
	Agent voice Agent-initial	*Tumatawag ang manok tuwing Sabado ng baboy sa mataas na bundok.*
	Agent voice Patient-initial	*Tumatawag ng baboy tuwing Sabado ang manok sa mataas na bundok.*
	Patient voice Agent-initial	*Tinatawag ng manok tuwing Sabado ang baboy sa mataas na bundok.*
	Patient voice Patient-initial	*Tinatawag ang baboy tuwing Sabado ng manok sa mataas na bundok.*
12.2. 'The pig is calling a chicken every Saturday in the high mountain.'		
	Agent voice Agent-initial	*Tumatawag ang baboy tuwing Sabado ng manok sa mataas na bundok.*

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Table B.1 – *Continued from previous page*

Item	Condition	Sentence
	Agent voice Patient-initial	*Tumatawag ng manok tuwing Sabado ang baboy sa mataas na bundok.*
	Patient voice Agent-initial	*Tinatawag ng baboy tuwing Sabado ang manok sa mataas na bundok.*
	Patient voice Patient-initial	*Tinatawag ang manok tuwing Sabado ng baboy sa mataas na bundok.*
13. *Salo* 'Catch'		
13.1. 'The cat is catching a dog tonight in the clean house.'		
	Agent voice Agent-initial	*Sumasalo ang pusa ngayong gabi ng aso sa maayos na bahay.*
	Agent voice Patient-initial	*Sumasalo ng aso ngayong gabi ang pusa sa maayos na bahay.*
	Patient voice Agent-initial	*Sinasalo ng pusa ngayong gabi ang aso sa maayos na bahay.*
	Patient voice Patient-initial	*Sinasalo ang aso ngayong gabi ng pusa sa maayos na bahay.*
13.2. 'The dog is catching a cat tonight in the clean house.'		
	Agent voice Agent-initial	*Sumasalo ang aso ngayong gabi ng pusa sa maayos na bahay.*
	Agent voice Patient-initial	*Sumasalo ng pusa ngayong gabi ang aso sa maayos na bahay.*

Continued on next page

Table B.1 – *Continued from previous page*

Item	Condition	Sentence
	Patient voice Agent-initial	*Sinasalo ng aso ngayong gabi ang pusa sa maayos na bahay.*
	Patient voice Patient-initial	*Sinasalo ang pusa ngayong gabi ng aso sa maayos na bahay.*
14. *Karga* 'Carry'		
14.1. 'The dog is carrying a cat every night in the dark street.'		
	Agent voice Agent-initial	*Kumakarga ang aso gabi-gabi ng pusa sa madilim na kalye.*
	Agent voice Patient-initial	*Kumakarga ng pusa gabi-gabi ang aso sa madilim na kalye.*
	Patient voice Agent-initial	*Kinakarga ng aso gabi-gabi ang pusa sa madilim na kalye.*
	Patient voice Patient-initial	*Kinakarga ang pusa gabi-gabi ng aso sa madilim na kalye.*
14.2. 'The cat is carrying a dog every night in the dark street.'		
	Agent voice Agent-initial	*Kumakarga ang pusa gabi-gabi ng aso sa madilim na kalye.*
	Agent voice Patient-initial	*Kumakarga ng aso gabi-gabi ang pusa sa madilim na kalye.*
	Patient voice Agent-initial	*Kinakarga ng pusa gabi-gabi ang aso sa madilim na kalye.*

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Table B.1 – *Continued from previous page*

Item	Condition	Sentence
	Patient voice Patient-initial	*Kinakarga ang aso gabi-gabi ng pusa sa madilim na kalye.*
15. *Baril* 'Shoot'		
15.1. 'The mouse is shooting a cow today in the tiny park.'		
	Agent voice Agent-initial	*Bumabaril ang daga ngayong araw ng baka sa maliit na parke.*
	Agent voice Patient-initial	*Bumabaril ng baka ngayong araw ang daga sa maliit na parke.*
	Patient voice Agent-initial	*Binabaril ng daga ngayong araw ang baka sa maliit na parke.*
	Patient voice Patient-initial	*Binabaril ang baka ngayong araw ng daga sa maliit na parke.*
15.2. 'The cow is shooting a mouse today in the tiny park.'		
	Agent voice Agent-initial	*Bumabaril ang baka ngayong araw ng daga sa maliit na parke.*
	Agent voice Patient-initial	*Bumabaril ng daga ngayong araw ang baka sa maliit na parke.*
	Patient voice Agent-initial	*Binabaril ng baka ngayong araw ang daga sa maliit na parke.*
	Patient voice Patient-initial	*Binabaril ang daga ngayong araw ng baka sa maliit na parke.*

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Table B.1 – *Continued from previous page*

Item	Condition	Sentence
16. *Habol* 'Chase'		
16.1. 'The cow chases a mouse every day in the colorful garden.'		
	Agent voice Agent-initial	*Humahabol ang baka araw-araw ng daga sa makulay na hardin.*
	Agent voice Patient-initial	*Humahabol ng daga araw-araw ang baka sa makulay na hardin.*
	Patient voice Agent-initial	*Hinahabol ng baka araw-araw ang daga sa makulay na hardin.*
	Patient voice Patient-initial	*Hinahabol ang daga araw-araw ng baka sa makulay na hardin.*
16.2. 'The mouse chases a cow every day in the colorful garden.'		
	Agent voice Agent-initial	*Humahabol ang daga araw-araw ng baka sa makulay na hardin.*
	Agent voice Patient-initial	*Humahabol ng baka araw-araw ang daga sa makulay na hardin.*
	Patient voice Agent-initial	*Hinahabol ng daga araw-araw ang baka sa makulay na hardin.*
	Patient voice Patient-initial	*Hinahabol ang baka araw-araw ng daga sa makulay na hardin.*

Appendix C

Chapter 4

C.1 Eye-tracking data

Table C.1

Summary of the fixed effects in the Bayesian model of the participants' accuracy in Study 2, including means, 95% uncertainty intervals, and P(b<0) which refers to the probability that the true parameter value is less than 0.

Comparison	Mean	Upper	Lower	$P(b<0)$
Verb				
Intercept	-0.05	-0.19	0.11	.73
Age(5:7)	1.65	0.14	3.14	.02
Age(children:adults)	-0.79	-3.32	1.64	.74
Voice	0.32	-2.43	3.05	.40

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Table C.1 – *Continued from previous page*

Comparison	Mean	Upper	Lower	$P(b<0)$
Word order	-1.65	-3.72	0.36	.95
Age(5:7)*Voice	-0.60	-1.85	0.81	.82
Age(5:7)*Word order	0.36	-0.96	1.67	.30
Age(children:adults)*Voice	0.66	-2.91	4.12	.35
Age(children:adults)* Word order	0.78	-2.46	4.16	.31
Voice*Word order	1.07	-0.71	2.88	.12
Age(5:7)*Voice*Word order	1.35	-0.53	3.23	.08
Age(children:adults)* Voice*Word order	-0.57	-3.29	2.08	.66
NP1				
Intercept	0.14	-0.03	0.31	.04
Age(5:7)	0.42	-1.28	2.07	.30
Age(children:adults)	1.93	-0.70	4.72	.08
Voice	0.12	-2.43	2.69	.46
Word order	0.74	-1.39	2.91	.24
Age(5:7)*Voice	0.14	-1.65	1.84	.43
Age(5:7)*Word order	0.12	-1.97	2.10	.46
Age(children:adults)*Voice	-1.81	-4.64	1.04	.90
Age(children:adults)* Word order	1.60	-0.98	4.31	.11
Voice*Word order	-0.19	-2.36	1.90	.56
Age(5:7)*Voice*Word order	0.33	-1.28	1.92	.34

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Table C.1 – *Continued from previous page*

Comparison	Mean	Upper	Lower	$P(b<0)$
Age(children:adults)* Voice*Word order	0.00	-2.40	2.24	.50
Temporal adverb				
Intercept	0.79	0.58	0.99	<.001
Age(5:7)	1.77	0.22	3.31	0.01
Age(children:adults)	7.57	5.3	9.9	<.001
Voice	-1.8	-4.15	0.74	0.92
Word order	4.07	2.1	6.06	<.001
Age(5:7)*Voice	0.49	-1.03	2	0.26
Age(5:7)*Word order	2.12	0.75	3.42	<.001
Age(children:adults)*Voice	0.67	-1.58	2.85	0.28
Age(children:adults)* Word order	-2.93	-5.07	-0.82	0.99
Voice*Word order	1.76	-0.18	3.68	0.04
Age(5:7)*Voice*Word order	0.19	-1.19	1.63	0.39
Age(children:adults)* Voice*Word order	-0.9	-2.84	1.01	0.84
NP2				
Intercept	1.08	0.84	1.32	<.001
Age(5:7)	2.12	0.43	3.87	0.01
Age(children:adults)	10.57	8.25	13.06	<.001
Voice	-2.71	-4.94	-0.47	>.99

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Table C.1 – *Continued from previous page*

Comparison	Mean	Upper	Lower	$P(b<0)$
Word order	4.06	1.68	6.18	<.001
Age(5:7)*Voice	-0.38	-1.93	1.07	0.7
Age(5:7)*Word order	1.4	-0.21	2.97	0.04
Age(children:adults)*Voice	1.49	-0.79	3.73	0.1
Age(children:adults)* Word order	-4.18	-6.33	-1.98	>.99
Voice*Word order	3.06	1.19	5.09	<.001
Age(5:7)*Voice*Word order	0.36	-1.1	1.79	0.31
Age(children:adults)* Voice*Word order	-2.7	-4.71	-0.63	>.99
Spatial adverb				
Intercept	1.18	1	1.37	<.001
Age(5:7)	2.33	0.71	4.09	<.001
Age(children:adults)	10.86	8.15	13.46	<.001
Voice	-2.85	-4.8	-0.86	>.99
Word order	4.8	2.78	7	<.001
Age(5:7)*Voice	-1.08	-2.73	0.6	0.9
Age(5:7)*Word order	-0.17	-1.6	1.32	0.59
Age(children:adults)*Voice	1.69	-0.55	3.96	0.07
Age(children:adults)* Word order	-2.74	-4.95	-0.53	0.99
Voice*Word order	2.94	1.03	4.76	<.001
Age(5:7)*Voice*Word order	-0.37	-1.53	0.83	0.72

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Table C.1 – *Continued from previous page*

Comparison	Mean	Upper	Lower	$P(b<0)$
Age(children:adults)* Voice*Word order	-2.65	-4.51	-0.82	>.99

Declaration of authorship

I hereby certify that this dissertation is my original work, except where due acknowledgement has been made. It has not been submitted previously, in whole or in part, to qualify for any other academic award. The content of the dissertation is the result of work which has been carried out since the official commencement date of the approved research program. Any editorial work, paid or unpaid, carried out by a third party is acknowledged. Lastly, ethics procedures and guidelines have been followed.

Rowena Garcia

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