CONNECTING INPUT TO COMPREHENSION: FIRST LANGUAGE ACQUISITION OF ACTIVE TRANSITIVES AND SUFFIXAL PASSIVES BY KOREAN-SPEAKING PRESCHOOL CHILDREN

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ABSTRACT

A central issue in language acquisition is the contribution of input to the development of linguistic knowledge. In this dissertation project, I investigate the developmental trajectories of two constructions that express transitive events in Korean—active transitives and suffixal passives—for Korean-speaking preschool children. Three major grammatical factors affect interpretation of Korean sentences: *word order* through the relative position of arguments in a sentence, *case marking* via designated markers attached to arguments, and *voice* by way of verbal morphology. Each factor induces particular comprehension heuristics (i.e., a strategic way, acquired probabilistically through exposure, that a comprehender employs in the course of comprehension). Literature on the interaction of the three factors in the acquisition of the two construction types remains relatively thin, particularly for distributional properties of the relevant input and the (asymmetric) contributions of these factors to children's comprehension.

Throughout the dissertation, I made use of corpus analysis through Natural Language Processing techniques and picture selection experiments in order to investigate this issue. I first conducted a semi-automatic analysis of caregiver input using the entire Korean child-directed speech data in the CHILDES database. Four major findings were reported as follows:

(1) Of the core constructional patterns with no omission of arguments and case marking, the canonical active transitive occurred far more frequently than its scrambled counterpart, and passives in general were extremely rare, regardless of canonicity.

(2) Of the three passive types found in Korean—suffixal (p. 3, (5)), lexical (p. 3, (6)), and paraphrastic (p. 4, (7)), the suffixal passive was the most frequent of all instances of the passive (with or without argument / case marking omission).
(3) The degree of association between individual markers and thematic roles in constructional patterns expressing a transitive event was asymmetric: the nominative case marker was a very strong cue for agenthood (and vice versa), the accusative case marker was a moderately good cue for themehood (and vice versa), and the dative marker was not likely to occur with the agent (and vice versa).
(4) When two overt arguments are attested in active transitives, the NOM-marked argument tends to occur before its ACC-marked counterpart.

I also carried out a series of picture selection experiments, by devising a novel methodology in which parts of test sentences were obscured by way of acoustic masking with child-friendly contexts. Given the experimental setting (i.e., reversible stimuli with two animate arguments), it was found that three factors—word order, case marking, and voice—interacted with one another in children's comprehension of the two constructions in the following ways:

(1) The word-order-related heuristic (Agent-First) operates reliably only in conjunction with other grammatical cues such as the presence of a second argument and case marking.
(2) The case-marking-related heuristics (NOM-as-Agent; ACC-as-Theme), which apply locally to a single noun, work more reliably for comprehension than the word-order-related heuristic (Agent-First).

(3) The voice-related heuristics (Theme-First; DAT-as-Agent) are less influential in comprehension than the word order and case marking heuristics, which frequently override them.

Children's performance in this experiment was interpreted in combination with input properties and postulated features of a child processor. By and large, characteristics of each comprehension heuristic mirrored properties of caregiver input, which suggests a close connection between what children are exposed to and how knowledge related to these factors emerges and grows. Despite the scope of investigation (i.e., patterns expressing transitive events with animate agents and themes), the nature of input provided a reasonably clear indication that children develop particular heuristics in relation to each factor and apply them to comprehension. This finding aligns well with usage-based and emergentist approaches to language development, pointing towards a substantial contribution of input to child language development.

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LIST OF ABBREVIATIONS

The following abbreviations are used to label the linguistic terms employed in this dissertation.

ACC = accusative case marker

CASE = case marker (unspecified)

DAT = dative marker

NOM = nominative case marker

PRS = present tense marker

PSV = passive marker

PST = past tense marker

SE = sentence ender

V_{act} = verb (active)

V_{psv} = verb (passive)

† = scrambled pattern

A grey symbol with strikethrough (e.g., ~~NOM~~) = an item obscured by acoustic masking.

CHAPTER I

INTRODUCTION

A central issue in language acquisition is the contribution of input to the development of linguistic knowledge. One view posits a limited impact because learners are pre-programmed to follow innate principles of grammar (*nativism*; e.g., Crain, 1991). A second approach argues for the core role of input, together with domain-general learning capacities, as a nucleus in driving the course of language development (the *usage-based approach*; e.g., Tomasello, 2003). An alternative idea, rejecting the existence of innate grammar whilst at the same time weakening the role of input for learning, suggests that language development involves interactions between input-based external pressures and efficiency-related internal pressures (*emergentism*; e.g., O'Grady, 2005). Previous studies have shown the clear relationship between input properties and developmental trajectories for language (e.g., Abbot-Smith & Behrens, 2006; Cameron-Faulkner, Lieven, & Tomasello, 2003; Chan, Lieven, & Tomasello, 2009; Choi, 1999), supporting the major assumption of the usage-based approach (Ambridge, Kidd, Rowland, & Theakston, 2015; Behrens, 2009; Wulff, 2013), but input-only explanations may fall short of capturing a full picture of language development (e.g., O'Grady, 2015a).

Researchers pursuing the usage-based and emergentist approaches propose two accounts as to how language learners develop language knowledge from concrete items towards abstract representations. One account, *gradual abstraction*, claims that children's initial language knowledge is formed conservatively around specific lexical items such as a verb, and that abstract constructions are built up in a piecemeal fashion on the basis of previously constructed lexical frames (e.g., Akhtar, 1999; Ibbotson & Tomasello, 2009; Theakston, Ibbotson,

Freudenthal, Lieven, & Tomasello, 2015; Tomasello, 1992). The other account, *early abstraction*, argues that children can acquire both abstract representations and item-specific frames early on, and that linking the two types of knowledge is contingent upon language exposure (e.g., Rowland, Chang, Ambridge, Pine, & Lieven, 2012; Saffran, Aslin, & Newport, 1996). Despite extensive documentation in support of each account in English, little attention has been paid to clearly articulating how the two accounts fit into learners' development in the case of languages that are typologically different from English.

My dissertation project probes a key question concerning input-output relations in language acquisition. Specifically, I investigate the developmental trajectories involving two constructions that express transitive events in Korean—active transitives and suffixal passives—for Korean-speaking preschool children through corpus analysis and behavioural experiments. Three major grammatical factors affect interpretation of Korean sentences: *word order* through the relative position of arguments in a sentence, *case marking* via designated markers attached to arguments, and *voice* by way of verbal morphology. Each factor induces particular comprehension heuristics.[1] Literature on the interaction of the three factors in the acquisition of the two construction types remains relatively thin, with myriad unanswered questions with respect to distributional properties of the relevant input and the (asymmetric) contributions of these factors to children's comprehension.

The rest of this dissertation proceeds as follows. Chapter 2 provides a review of issues in language development, focusing on the status of input in the two approaches to linguistic development. Chapter 3 provides an overview of the three grammatical factors on which I

[1] The term *heuristic* refers to a speculative formula which serves as a guide for problem-solving, obtained by exploration of possibilities. Throughout the dissertation, I use an operational definition for this term: a strategic way, acquired probabilistically through exposure, in which a learner maps form onto function (and vice versa).

concentrate and the corresponding comprehension heuristics in Korean, along with cross-linguistic observations relating to developmental aspects of these factors. Chapter 4 reports on an automatic analysis of caregiver input in Korean child corpora, by focusing on the two constructions and individual case markers. Chapter 5 introduces methodological details of a picture selection experiment, along with specific research questions and predictions on the experiment. Chapters 6 to 8 report children's performance on the experiment by pattern type and age group. Chapter 9 discusses implications of results from the experiment and connects the results to input properties found in Chapter 4, intertwined with the (theoretical / linguistic) background and findings from the previous research laid out in Chapters 2 and 3. Finally, Chapter 10 concludes the dissertation with a brief summary and suggestions for future research.

Throughout the entire dissertation, I limit the scope of my discussion to five points. First, I explore issues in comprehension, not production. Second, I investigate phenomena pertaining to Korean, with its nominative-accusative system of case. Third, I focus on a particular type of two-participant event and constructions relating to this event type (active transitives and suffixal passives). Fourth, I control for animacy: all arguments in the constructions that I examine are animate. Lastly, I will direct my attention primarily to matters of morphosyntax; prosody is not the primary concern here.[2]

[2] See Benavides-Varela and Gervain (2017) for the discussion on the role of prosody in early language development.

CHAPTER II

ISSUES IN LANGUAGE DEVELOPMENT

2.1. The status of input in language development

The contribution of input to linguistic development has long been one of the most divisive and contentious areas of inquiry within the field of language acquisition research. One approach, dubbed *nativism*, posits the restricted impact of input on language development since key features of the grammar are determined in advance by inborn principles, some of which allow limited parametric variation with options that can be selected at different points in the developmental process (e.g., Chomsky, 1999; Crain, 1991; Crain, Thornton, & Murasugi, 2009; Lidz & Williams, 2009; White, 2003). These claims are supported mainly by so-called 'the poverty of stimulus' argument: learners can have linguistic knowledge which is not available or sufficiently frequent in the input to guarantee learning or to limit the range of generalisation as well (e.g., Crain, 1991; Hornstein & Lightfoot, 1981; Lasnik & Uriagereka, 2002; Lidz & Gagliardi, 2015; Marcus, 1993).

However, the poverty-of-stimulus assumption is controversial, in part because learners typically experience a vast amount of exposure to their language (e.g., Ambridge, Kidd et al., 2015; Lieven, 2010; Theakston, Lieven, Pine, & Rowland, 2001). Cross-linguistic and individual differences also exist across all stages of learning (e.g., Bavin, 1995; Bates, Dale, & Thal, 1995; Berman, 1985; Dąbrowska, 2012, 2013; Dąbrowska & Street, 2006; Demuth, 1989; Lieven, 1997; Slobin & Bever, 1982). Moreover, learners can avoid overgeneralisation errors through various sources such as indirect negative evidence (e.g., Demetras, Post, & Snow, 1986; Saxton, 2000) and statistical learning (e.g., Alishahi & Stevenson, 2008; Ambridge, Bidgood, Twomey,

Pine, Rowland, & Freudenthal, 2015; Bannard, Lieven, & Tomasello, 2009; Boyd & Goldberg, 2011; Goldberg & Robenalt, 2015, 2016; Lupyan & Christiansen, 2002; Monaghan & Christiansen, 2008; Perfors, Tenenbaum, Griffith, & Xu, 2011; Perfors, Tenenbaum, & Regier, 2011; Reali & Christiansen, 2005, 2007; Stefanowitsch, 2008). This kind of paradigm shift in language development is gaining momentum by way of usage-based and emergentist approaches.

2.1.1. Usage-based approach

A *usage-based* approach argues for the core role of input, in conjunction with non-linguistic forces from cognitive and psychological factors, as a nucleus in shaping language. This approach favours the idea that speakers' actual experience with language shapes their cognitive representations of language (e.g., Behrens, 2009; Tomasello, 2003). A massive collection of linguistic items stored in learners' memory yields clusters of form-function pairings (i.e., constructions; Goldberg, 1995) with varying levels of abstraction (Goldberg, 2013),[1] which are greatly affected by frequency of occurrence and distributional properties (e.g., Abbot-Smith & Tomasello, 2006; Tomasello, 2003). Learners develop more complex, abstract, and even novel linguistic systems by extracting similarities across these clusters (Dąbrowska, 2008a; Goldberg, 2019; Langacker, 1987), and some of the clusters are strengthened enough to defeat the other possible candidates (Bates & MacWhinney, 1989; Hilpert & Diessel, 2017). In this way, language as a structured inventory of linguistic repertoires emerges and grows as a function of concrete language use and domain-general learning capacities.

[1] This account puts emphasis on a low-level schema particularly in early language development (cf. Dąbrowska, 2008a), but whether the degree to which a low-level schema is concrete or abstract is debatable; see Section 2.2 for the discussion on this issue.

Indeed, there is considerable evidence that supports the impact of language input on various domains of language such as comprehension (e.g., Ambridge, Bidgood et al., 2015; Arnon & Snider, 2010; Bidgood, Ambridge, Pine, & Rowland, 2014; Bybee, 1999; Dąbrowska, 2008a; DeLong, Urbach, & Kutas, 2005; Reali & Christiansen, 2007), production (e.g., Griffin & Bock, 1998; Janssen & Barber, 2012; Runnqvist, Gollan, Costa, & Ferreira, 2013), and processing (e.g., Brehm, Jackson, & Miller, 2019; Hale, 2001; Levy, 2008; Siyanova-Chanturia, Conklin, & van Heuven, 2011; Wells, Christiansen, Race, Acheson, & MacDonald, 2009).

The role of input as a key for designing language is also evident in language development. Humans are borne with built-in sense of frequency distribution and central tendencies (e.g., Ellis, 2002; Wulff, 2010), and this sensitivity to frequency modulates the degree to which (non-)linguistic resources are engaged in language development from childhood up to adulthood (e.g., Ambridge, Kidd et al., 2015). A good deal of research confirms the contributive role of language input in the acquisition of the first language (e.g., Abbot-Smith & Tomasello, 2006; Akhtar, 1999; Behrens, 2006; Dąbrowska, 2008a; Dąbrowska & Tomasello, 2008; Diessel, 2007; Goldberg, Casenhiser, & Sethuraman, 2004; Robenalt & Goldberg, 2015; Tomasello, 1992, 2000, 2003, 2009), second language (e.g., Ellis & Ferreira-Junior, 2009a, 2009b; Ellis, 2012; Ellis, O'Donnell, & Römer, 2015; Kyle, 2016; Kyle & Crossley, 2017; McDonough & Kim, 2009; McDonough & Nekrasova-Becker, 2014; Nakamura, 2012; Robenalt & Goldberg, 2016; Wulff, 2013; Year & Gordon, 2009), and miniature / artificial languages (e.g., Casenhiser & Goldberg, 2005; Perek & Goldberg, 2017; Wonnacott, Boyd, Thomson, & Goldberg, 2012).

A line of corpus-based research substantiates the direct connection between language input and the development of particular linguistic systems (e.g., Behrens, 2006; Cameron-Faulkner, Lieven, & Tomasello, 2003; Rowland, Pine, Lieven & Theakston, 2003; Stoll, Abbot-

Smith & Lieven, 2009). For example, Cameron-Faulkner et al. (2003) show that half of the English-speaking caregivers' utterances from the Child Language Data Exchange System (CHILDES) database consist of simple, item-based phrases mostly with two words, and that child utterances tend to mimic these phrases in proportion to the caregivers' use of the target phrases. By comparing English (restrictive word order and little morphology) to Russian (flexible word order and rich morphology) and to German (in between English and Russian), Stoll et al. (2009) add to the cross-linguistic evidence for the relation between the way that maternal input is structured and the types of child production in the beginning stage of language development. Experimental work further supplements the close relationship between input and output by showing that multiword frequency in child language corpora determines the speed and accuracy of children's performance in a repetition task (Bannard & Matthews, 2008) and that their mastery of how to encode agents and themes is contingent upon the nature of the language that they hear around them (Chan et al., 2009).

Along with the heavy emphasis on the role of input in language development, the usage-based approach underlines that various factors affect the learning process simultaneously, which can promote (and sometimes hinder) frequency effects. For example, learners benefit from a one-to-one mapping between form and function, not just from the absolute frequency of individual form or function, when it comes to accuracy and speed of learning (e.g., Cameron-Faulkner, Lieven, & Theakston, 2007; Slobin, 1985). A linguistic environment in which a target item is situated, as well as the type and the token frequency of that item, may stand a better chance to explain the course of language development (e.g., gradual mastery of the Polish case inflection system which is sensitive both to frequency and to neighbourhood variables: Dąbrowska, 2008a; frequency of verb use contingent upon construction types: Goldberg et al., 2004; weaker verb-in-

construction entrenchment by accumulating knowledge about verb use across constructions: Dittmar, Abbot-Smith, Lieven, & Tomasello, 2014). The degree to which the current stimulus is informative enough to correspond to the prior experience of language use also modulates learners' performance (e.g., a reduced rate of success in scrambled or non-canonical patterns compared to prototypical patterns: Dittmar, Abbot-Smith, Lieven, & Tomasello, 2008; performance affected by the reduction of cues necessary for the composition of the target structure: Shin & Deen, 2019; Stromswold, Pinker, & Kaplan, 1985). Domain-general factors such as abstraction, analogy, entrenchment, and statistical pre-emption also engage in every phase of learning (e.g., Ambridge, Bidgood et al., 2015; Braine & Brooks, 1995; Diessel, 2015; Ellis, 2006; Goldberg, 1995; Hilpert & Diessel, 2017; Langacker, 1987; Robenalt & Goldberg, 2015; Stefanowitsch, 2011; Theakston, 2004; Tomasello, 2009; Tummers, Heylen, & Geeraerts, 2005).

In sum, the usage-based approach addresses the course of learning as interactions of frequency and cognitive-psychological factors. Language knowledge develops gradually, and the relative strength reflects to a considerable degree the frequency of occurrence and distributional properties that language learners have encountered.

2.1.2. Emergentist approach

An *emergentist* approach holds that language development involves an interplay of the input-based external pressure and the efficiency-related internal pressure. This approach assumes that language development results from the interaction of simpler and basic forces such as physiology, perception, pragmatics, social interaction, and working memory (O'Grady, 2005), and that learning occurs by way of the mechanisms that are required for real-time processing

(O'Grady, 2008). The processor seeks to reduce the burden of working memory so that the cost of processing is lowered (e.g. Hawkins, 2004, 2014; O'Grady, 2005). This attempt leads to mapping form onto meaning and vice versa quickly and efficiently (e.g., O'Grady, 2013), and also resolving dependencies (lexical requirements) at the earliest opportunity (e.g., O'Grady, 2015b). During the course of learning, the processor creates a processing routine for the sake of computational efficiency, which is affected both by input frequency and by processing cost (O'Grady, 2015a).

In this account, frequency of occurrence is still important for language development, but it is located in the processor-working memory interface. The processor is highly sensitive to frequency information: computational efficiency is enhanced through the routines which are frequently attested in actual language use and thus automatised in their operations (O'Grady, 2013). Indeed, there is a strong correlation between language use and processing cost. For instance, a canonical word order pattern, which is more frequent than its corresponding scrambled one, is dominant in language use and also processed faster than the scrambled pattern (e.g., Frenck-Mestre, Kim, Choo, Ghio, Herschensohn, & Koh, 2018; Suzuki, 2013; Tamaoka, Asano, Miyaoka, & Yokosawa, 2014; Witzel, & Witzel, 2016).

There are situations, however, in which input cannot solely explain the course of language acquisition. This is the place where the processor guides language learners towards particular ways of development. As O'Grady (2015a) notes, for example, English-speaking children manifest an asymmetry in the comprehension of pronouns, showing higher rate of success in reflexive pronouns by the age of three than in plain pronouns, and sometimes mis-interpret plain pronouns as reflexive pronouns (see also Chien & Wexler, 1990; Conroy, Takahashi, Lidz, & Phillips, 2009 for the related reports on children's performance in the two

pronoun types). Frequency does not offer a clear explanation for this particular asymmetry: only 17 instances of reflexive pronouns were found in the child-directed speech to Adam, Eve, and Sarah in the CHILDES database whereas 1,836 instances of plain pronouns were observed in the same database. A promising explanation comes from the efficiency-related internal pressure. A plain pronoun requires consideration of discourse to search for an antecedent, but a reflexive pronoun only needs a local antecedent within the same clause. This 'local' nature of reflexive pronoun interpretation leads to less processing cost than the case of plain pronouns, thereby favouring early mastery of reflexive pronouns (see also O'Grady, Lee, & Kwak, 2009; O'Grady, Nakamura, & Ito, 2008 for more cases in relation to the role of the processing pressure as a primary source for guiding language development).

The implication of efficiency-related considerations suggests that the gap between exposure to language use and learners' language knowledge can be bridged with the aid of an efficiency-driven processor that directs the learners to particular options that may not be evident from information available in the input.

2.2. Development of language knowledge: gradual abstraction vs. early abstraction

Within the usage-based and emergentist approaches, two accounts provide competing explanations as to how learners develop linguistic knowledge from concrete frames to abstract representations.

2.2.1. Gradual abstraction

The *gradual abstraction* account claims that language learners' initial representations are organised around specific lexical items such as a verb, and that abstract constructions are built up

in a piecemeal fashion on the basis of previously constructed lexical schemata (e.g., Akhtar, 1999; Langacker, 2000; Theakston et al., 2015; Goldberg, 2006; Tomasello, 1992, 2000). In this respect, the early language learners become 'conservative' (e.g., Tomasello, 2003), and the mastery of the target language knowledge requires a significant amount of time (e.g., Ibbotson & Tomasello, 2009) and even lasts up to adulthood (e.g., Dąbrowska, 2008b). A basic prediction of this account is that the initial syntactic representation that the learners form is based on a lexical frame with a relatively fixed, frequent element and flexible slots around that element. For example, an early schema of an active transitive construction involving the verb *kick* would be the concrete verb (*kick*) with an actor (*kicker*) followed by an undergoer (*kickee*). This lexically-specific schema is assumed to provide a stepping-stone for the learners to bootstrap their learning into more abstract representations (e.g., Theakston et al., 2015).

There is good empirical evidence for the gradual abstraction account to language development. A seminal study by Tomasello (1992), a diary report of one young English-speaking child's earliest language development, suggested that children initially use verbs as they have heard them previously in English. He showed that the child in the study paired arguments and syntactic markings mostly on a verb-by-verb basis, and that patterns and morphological markers acquired from one verb were not immediately generalised to other verbs until the age of three (see also Tomasello, 2003, 2009). The idea that children initially focus on specific item-based, lexical specificity is known as *the verb island hypothesis*. Subsequent research revealed that a verb is not the only item to serve as the fixed reference point for the entire pattern; a pronoun or a morphological marker can work in the same way (e.g., Childers & Tomasello, 2001; Lieven & Tomasello, 2008). Nonetheless, a consistent message in the literature on this account is that an initial frame is created around a specific lexical item.

The conservatism involving learners' willingness to transfer their knowledge to new items observed in language learners is evidenced by experimental findings.[2] For example, Akhtar (1999) articulated the role of item-specific frames in the early stage of language development through a series of picture description tasks. After being exposed to a non-SVO pattern containing a nonce verb (e.g., *Big Bird the car gopping*), young English-speaking children aged two to three employed the novel order with the nonce verbs but returned to the correct SVO order when they were given familiar verbs. In contrast, 4-year-old children used the correct SVO order reliably, irrespective of the nature of the verbs. Children's varied performance by age suggests the characteristics of the initial organisation of grammatical knowledge as replication of representations which are modelled with individual lexical items that they encounter frequently. A longitudinal, cross-linguistic study by Ninio (1999) strengthens this case by showing that young children, one acquiring English and the others Hebrew, induce general combinatory rules for how to combine new verbs and create a syntactic frame from knowledge about the individual verbs that they have acquired. Importantly, the speed of learning was in proportion to the extent of knowledge about how the verbs were used in a certain pattern (i.e., *the pathbreaking verb hypothesis*). This strategy of association—a fixed, concrete item (e.g., a verb) around an environment with flexible slots (e.g., a transitive construction) is further supported by recent corpus studies in L1 (e.g., Goldberg et al., 2004) and L2 (e.g., Ellis & Ferreira-Junior, 2009a, 2009b; Ellis et al., 2015), echoing the core idea of the gradual abstraction account.

[2] Findings from these 'weird word order paradigm' studies were disputed by a line of research (e.g., Franck, Millotte, & Lassotta, 2011; Franck & Lassotta, 2012; Franck, Millotte, Posada, & Rizzi, 2013) that adopts the same paradigm and yet shows young children's observance of word order facts in their native language, suggesting early emergence of abstract knowledge about word order.

2.2.2. Early abstraction

Alternatively, *early abstraction* argues that learners can acquire both abstract structural representations and item-specific schemata very early and simultaneously, and that linking the two types of knowledge is contingent upon language exposure (e.g., Rowland et al., 2012; Saffran et al., 1996). This account regards early language learners as ardent generalisers on the basis of the input to which they have been exposed (e.g., Naigles, Hoff, Vear, Tomasello, Brandt, Waxman, Childers, & Collins, 2009), assuming faster learning of word- and sentence-level representations from the start (e.g., Bencini & Valian, 2008; Casenhiser & Goldberg, 2005). This expedited rate of learning anticipates the emergence of abstract syntactic knowledge, which is independent of item-based (mostly verb-based) frames, from the very early stage of language development (e.g., Brusini, Dehaene-Lambertz, Dutat, Goffinet, & Christophe, 2016; Perfors, Tenenbaum, & Regier, 2011; cf. Gertner, Fisher, & Eisengart, 2006). However, children's early acquisition of abstract knowledge about sentential representations does not necessarily entail immediate full mastery, nor their reliable use of that knowledge during language activities (cf. *graded abstraction*; Abbot-Smith, Lieven, & Tomasello, 2008). A great amount of exposure to language use for a certain amount of time is still required for the maturation of that knowledge.

A good deal of research supports the idea of the rapid acquisition of abstract representations in early language development. To illustrate, Rowland et al. (2012) showed that even English-speaking children aged three to four primed English double object datives, and that the degree of priming after listening to the same pattern involving the same verb became larger as age increased. They attributed the findings to the possibility that abstract structural representations are built first in development, independently of verb-specific frames, but associating these representations and particular verbs takes time since this process requires

exposure to verb-by-verb links attested through individual verb use. In a similar vein, Rowland, Noble, and Chan (2014; experiment 2) provide additional evidence for this account through an investigation of Welsh-speaking 3-year-old children's comprehension of prepositional datives in Welsh. In a forced-choice comprehension task, children employed word order information (frequent, canonical word order marking) more reliably than the position of a postposition dedicated only to indicating the recipient. They concluded that, as there is no competing construction for datives in Welsh whereas two related patterns compete in English (a double object dative construction vs. a prepositional dative construction), Welsh-speaking children's abstract knowledge about word order could be displayed more clearly than that of English-speaking children.

The early emergence of abstract knowledge advocated by this account is also supported by syntactic bootstrapping, that is, the use of syntactic frames to narrow down (or constrain) verb semantics (Naigles, 1990; Naigles, Gleitman, & Gleitman, 1993; cf. *the structure-mapping view* in Fisher, 1996; but see Naigles, Bavin, & Smith, 2005 for the learning of a verb with contextual independence as well). There is robust confirmation that shows that young children can employ this strategy, ranging from corpus analysis (e.g., Naigles & Hoff-Ginsberg, 1995; Lee & Naigles, 2005) to experiments using novel verbs (e.g., Fisher, 2002; Gertner et al., 2006; Matsuo, Kita, Shinya, Wood, & Naigles, 2012; Suzuki & Kobayashi, 2017; Yuan, Fisher, & Snedeker, 2012) or existing verbs which are not compatible with certain constructional frames (e.g., Göksun, Küntay, & Naigles, 2008; Lee & Naigles, 2008). Particularly in perception, this knowledge seems to be detectable very early in the speech of toddlers (e.g., Benavides-Varela & Gervain, 2017; Gervain, Nespor, Mazuka, Horie, & Mehler, 2008; Marcus, Vijayan, Rao, & Vishton, 1999), and the active use of this distributional cue may even misguide young children's

interpretation of a sentence (e.g., Gentner & Fisher, 2012; Naigles, 1990; Noble, Rowland, & Pine, 2011).

Further evidence suggests that early abstraction is not limited to distributional cues such as the number of arguments. Dąbrowska and Tomasello (2008) appeal to the early abstraction account through a combination of intervention and elicitation of constructions involving the instrumental case in Polish, which is infrequent in the input and idiosyncratic in use. They reported that children aged two to three could to some degree access a linguistic generalisation about the relationship between a noun and other elements in a sentence involving the instrumental case during the training sessions, above the level of verb-specific frames. They also pointed out that children's performance improved as age increased, suggesting that knowledge of the target construction may be acquired relatively early but becomes complete only after children accumulate a considerable amount of experience with usage (see also Dąbrowska, 2005 for a similar report on the early emergence but late mastery of the Polish genitive inflection). These observations are in conformity with the major arguments of the early abstraction account, extending the range of its application up to morphological marking.

CHAPTER III

CHILD LANGUAGE DEVELOPMENT IN KOREAN

Despite the extensive documentation of the role of input and the validity of each account to the development of linguistic knowledge in major European languages such as English and German, relatively little attention has been paid to these issues in other languages. This dissertation focuses on Korean, particularly with respect to the interpretation of thematic roles of arguments—a core task that a child must achieve for sentence comprehension (Strotseva-Feinschmidt, Schipke, Gunter, Brauer, & Friederici, 2019).

3.1. General characteristics of Korean

Korean is a Subject-Object-Verb language with overt case marking by dedicated markers. These structural cues allow for scrambling of pre-verbal arguments as long as that reordering preserves the original intention with no ambiguity (1a-b)[1].

(1a) Active transitive: canonical

kyengchal-i totwuk-ul cap-ass-ta.

police-NOM thief-ACC catch-PST-SE

'The police caught the thief.'

(1b) Active transitive: scrambled

totwuk-ul kyengchal-i cap-ass-ta.

thief-ACC police-NOM catch-PST-SE

'The police caught the thief.'

[1] Sometimes, it is possible to place arguments post-verbally:
"In colloquial speech, the predicate-final constraint is often relaxed, with some non-predicate elements being uttered after the predicate for 'after-thought' clarification, amplification of information, or emphasis." (Sohn, 1999, p. 295)
This dissertation considers only verb-final sentences hereafter.

Korean allows the omission of almost all elements in a sentence if the omitted information can be inferred from the context. This omission applies to a marker (2), an argument and a marker altogether (3), and even a predicate (4)

(2) Omission of a marker

kyengchal-i totwuk(~~-ul~~) cap-ass-ta.

police-NOM thief(~~-ACC~~) catch-PST-SE

'The police caught the thief.'

(3) Omission of an argument and a marker

A: kyengchal-i mwues-ul hay-ss-e?

police-NOM what-ACC do-PST-SE

'What did the police do?'

B: (~~kyengchal-i~~) totwuk-ul cap-ass-e.

(~~police-NOM~~) thief-ACC catch-PST-SE

'(~~The police~~) caught the thief.'

(4) Omission of a predicate

A: nwu-ka cap-hi-ess-e?

who-NOM catch-PSV-PST-SE

'Who was caught?'

B: totwuk-i (~~cap-hi-ess-e~~).

thief-NOM (~~catch-PSV-PST-SE~~)

'The thief (~~was caught~~).'

The omission of case marking is less restricted than that of an argument (Chung, 1994). The optionality of certain case markers such as the nominative case marker *-i/ka*, the accusative case marker *-(l)ul*, and the dative marker *-eykey/hanthey* is observed particularly in colloquial speech when no ambiguity arises (Sohn, 1999).

There are three types of passive constructions in Korean: suffixal, lexical, and periphrastic (Sohn, 1999; Song & Choe, 2007; but see Yeon, 2015). A suffixal passive is formed by attaching passive morphology (*-i, -hi, -li,* or *-ki*) to a verb stem with a nominative-marked subject indicating a theme and a dative-marked oblique indicating an agent as in (5).

(5) Suffixal passive

totwuk-i	kyengchal-hanthey	cap-hi-ess-ta.
thief-NOM	police-DAT	catch-PSV-PST-SE

'The thief was caught by the police.'

The dative marker *-hanthey* is used more frequently than *-eykey* in colloquial and casual contexts. A lexical passive (6) involves no passive marker on a verb, but the meaning of the verb (e.g., *mac-* 'be hit') is one of affectedness. Moreover, case marking is the same as for the suffixal passive, confirming its status as a passive.

(6) Lexical passive

Chelswu-ka	Minho-eykey	mac-ass-ta.
Chelswu-NOM	Minho-DAT	get.hit-PST-SE

'Chelswu was/got hit by Minho.'

In a periphrastic passive (7), the theme is expressed by the nominative case marker but the agent is expressed mostly by *-ey uyhay*, rather than by the dative marker. The form of this type of

passive includes a combination of a suffix *-e*/*a* and the inchoative verb *ci-* 'to become' after the verb stem.

(7) Periphrastic passive

chayk-i	Chelswu-ey uyhay	ccic-eci-ess-ta.
book-NOM	Chelswu-by	tear-become.PSV-PST-SE

'The book was torn by Chelswu.'

Although there is no data on the frequency of the three types of passives, it has been suggested that all the types of passives are rare in the input, and that the occurrence of the lexical and the periphrastic passives is extremely rare in child-directed speech (e.g., Lee & Lee, 2008). The suffixal passive becomes the representative passive type that is most likely to be encountered and comprehended by Korean-speaking children. I thus put special emphasis on the suffixal passive hereafter.

3.2. Three grammatical factors for sentence comprehension in Korean

Language relies on various grammatical devices to indicate relational information about who did what to whom (e.g., Candan, Küntay, Yeh, Cheung, Wagne, & Naigles, 2012). In Korean, three major grammatical factors affect the interpretation of this kind of information: *word order*, *case marking*, and *voice*. In what follows, I explicate each factor with respect to cross-linguistic observations about the role of the three factors for children's understanding of thematic roles of arguments and developmental trajectories involving these factors in Korean.

3.2.1. Word order

Word order, or the linear arrangement of arguments, concerns the relative position of the arguments in a sentence (e.g., Dryer, 2013a). This factor involves canonicity, which is determined mostly by whether one order of sentential components is more frequently used, thus dominant, than the others (e.g., Dryer, 2013b; Greenberg, 1963). The canonical word order refers to a pattern which is attested most frequently in a language, thus occupying an unmarked way of delivering thematic roles of arguments. Any deviation from this typical composition of thematic role ordering is classified as the scrambled word order. Word order patterns of this type signal variation of information structure such as topicalisation and focalisation (e.g., Bailyn, 2001; Miyagawa, 1996; Shin, 2007; Tomlin, 1986) and require more processing resources than the corresponding canonical pattern (e.g., Frenck-Mestre et al., 2018; Hwang, 2008; Kaiser & Trueswell, 2004; Kim, Koizumi, Ikuta, Fukumitsu, Kimura, Iwata, Watanave, Yokoyama, Sato, Horie, & Kawashima, 2009; Witzel & Witzel, 2016).

3.2.1.1. Cross-linguistic observations on the role of word order for children's understanding of thematic roles of arguments

Learning the basic word order regularities in a language seems to emerge early in childhood. Evidence shows that young children respect the relative order of words in a sentence (e.g., Benavides-Varela & Gervain, 2017; Brown, 1973; Candan et al., 2012; Slobin & Bever, 1982) and they can become familiar with the word order facts even in an artificial grammar very quickly (e.g., Marcus, Vijayan, Rao, & Vishton, 1999). This early acquisition of word order is sometimes taken to reflect a bias to map structure to meaning (Fisher, 2002) or a parsing

heuristic (e.g., Pozzan & Trueswell, 2015). Regardless of its origin, the bottom line is that word order is a property that a child employ for comprehension from very early.

Early studies claimed that young children employed a fixed word order strategy in which they stick to one universal order of arguments, regardless of their native languages (e.g., Bever, 1970; Roeper, 1973; Slobin, 1966). However, this idea was revised in subsequent research: children's predilection for a particular word order is dependent on canonicity which is greatly affected by the frequency of occurrence that they have encountered in their native languages. A classic study by Slobin and Bever (1982) supported this revised argument through cross-linguistic comparisons (English, Italian, Serbo-Croatian, and Turkish). In a series of act-out tasks, they found that children failed to respond to non-canonical sentences in their particular languages. They attributed children's poor performance in the unusual word order patterns to the predominance of the canonical word order as a preliminary cue for sentence comprehension and processing in the initial stage of language development. They further argued for the core role of linguistic experience (e.g., adult speech) in the construction of the canonical sentence schema. A good deal of research lends additional support to the contribution of the canonical word order to children's interpretation of a sentence (e.g., Clark, 2003; Guasti, 2016; Hirsh-Pasek & Golinkoff, 1996) and the impact of frequency on the acquisition of word order facts (e.g., Chan et al., 2009; Rowland et al., 2014).

The most powerful comprehension strategy that children acquire with respect to word order is dubbed the A*gent-First* heuristic. When they encounter arguments of a canonical active transitive sentence sequentially from the left to the right, the first argument is likely to be an agentive subject. Repeated exposure to this association provides a prototype in relation to thematic role ordering, which leads learners to adopt a heuristic that maps the first argument onto

agenthood. Numerous studies report children's heavy reliance on the Agent-First heuristic in sentence comprehension. This emerges early on (e.g., Bates & MacWhinney, 1982; Bever, 1970; Gertner, Fisher, & Eisengart, 2006; Fisher, Jin, & Scott, 2019; Gertner & Fisher, 2012; Sinclair & Bronckart, 1972; cf. Chang, Dell, & Bock, 2006). Its strength also leads children down the garden-path of certain constructions such as passives (e.g., Abbot-Smith, Chang, Rowland, Ferguson, & Pine, 2017; Huang, Zheng, Meng, & Snedeker, 2013; Shin & Deen, 2019). Moreover, it influences speakers' judgment and processing patterns even for adults (e.g., Imamura, Sato, & Koizumi, 2016; Lee, 1989; Tamaoka, Asano, Miyaoka, & Yokosawa, 2014; Witzel & Witzel, 2016; cf. Goldin-Meadow, So, Özyürek, & Mylander, 2008). These reports suggest the universality of the Agent-First heuristic across languages and age.

3.2.1.2. Developmental trajectory involving word order in Korean

Although Korean has relatively flexible word order, the canonical word order for active transitives is assumed to manifest agent-before-theme ordering as in (1a), repeated as (8a) (e.g., Im, 2007; Shin, 2006). When comprehenders encounter a sentence with a scrambled word order (1b; repeated as 8b), they must understand that scrambling creates the reverse thematic role ordering (i.e., theme-before-agent), which poses a challenge for a listener to interpret the thematic role of each argument (e.g., Lee, 1989; cf. Witzel & Witzel, 2016).

(8a) Active transitive: canonical

kyengchal-i totwuk-ul cap-ass-ta.

police-NOM thief-ACC catch-PST-SE

'The police caught the thief.'

(8b) Active transitive: scrambled

totwuk-ul kyengchal-i cap-ass-ta.

thief-ACC police-NOM catch-PST-SE

'The police caught the thief.'

The expected challenge involving canonicity is also found in children's comprehension. A canonical active transitive is more reliably interpreted than its scrambled counterpart (e.g., Kim & Song, 2015; Kim, Sung, & Yim, 2017; cf. Özge, Kornfilt, Münster, Knoeferle, Küntay, & Snedeker, 2016). Children tend to interpret the initial argument in a sentence as the agent, regardless of its actual thematic role, until the age of four (e.g., Cho, 1982; Chung, 1994; Kim, O'Grady, & Cho, 1995; No, 2009), which shows their reliance on the Agent-First heuristic as a base for comprehension. Their strong reliance on the Agent-First heuristic also leads to poor performance in a passive sentence (5; repeated as 9) where the theme argument occupies the first word order slot (e.g., Kim et al., 2017; Shin & Deen, 2019; cf. Abbot-Smith et al., 2017).

(9) Suffixal passive

totwuk-i	kyengchal-hanthey	cap-hi-ess-ta.
thief-NOM	police-DAT	catch-PSV-PST-SE

'The thief was caught by the police.'

Despite ample evidence from corpus analysis and behavioural experiments that Korean-speaking children adopt the Agent-First heuristic (e.g., Cho, 1982; Jin et al., 2015; Kim et al., 2017), reports on why they follow this comprehension heuristic (particularly within a transitive event) are considerably fewer. One possible source for this predisposition is the linguistic environment to which children are normally exposed: input skewed towards the canonical active (e.g., Cho, 1982; No, 2009; cf. Rowland et al., 2014) may shape the strong preference for the agent-first interpretation. Alternatively, this heuristic may originate from a non-grammatical

cognitive bias by placing an entity that engages more strongly in an action in the early phase of an information flow (e.g., Bornkessel-Schlesewsky & Schlesewsky, 2009; Fisher et al., 2019). All these possibilities align with the cross-linguistic observations in light of children's use of word-order-related knowledge, but the precise motivation of the Agent-First heuristic in comprehension for Korean-speaking children should be investigated empirically.

3.2.2. Case marking[2]

Case marking indicates the thematic roles of arguments via designated markers attached to nominal arguments. This factor serves as a local cue because it applies not to the whole sentential frame but rather to a single noun (Slobin, 1982; Wittek & Tomasello, 2005). In languages with flexible word order, case marking becomes another informative cue for interpreting grammatical information about an argument in a sentence (e.g., de Hoop & Malchukov, 2008; Fedzechkina, Newport, & Jaeger, 2017; Hawkins, 2004; Kim, 1999; Kurumada & Jaeger, 2015), which is also crucial in language development (e.g., Göksun, Küntay, & Naigles, 2008; Lupyan & Christiansen, 2002; Strotseva-Feinschmidt et al., 2019; Wittek & Tomasello, 2005). However, idiosyncrasies involving case marking such as distributional irregularity (e.g., Dąbrowska, 2008) and many-to-many mapping between form and function (e.g., Choo & Kwak, 2008; Dąbrowska & Tomasello, 2008) creates difficulty in calculating the precise thematic roles of arguments on the basis of morphological marking attached to a noun.

[2] Throughout the manuscript, I assume case marking as an indicator (not an assigner) of thematic roles, based mostly on probabilistic information about form-function pairings involving individual markers.

3.2.2.1. Cross-linguistic observations on the role of case marking for children's understanding of thematic roles of arguments

One important task for children acquiring case marking languages is to cope with morphological marking in organising the basis of sentence comprehension. Previous studies showed that children do employ case-marking-related knowledge actively. For example, Goksun et al. (2008) found that, in a series of act-out tasks, Turkish-speaking children used an accusative case marker for causative interpretation in active transitives and even in intransitives (i.e., morphosyntactic bootstrapping). In a similar vein, Suzuki and Kobayashi (2017) showed through the intermodal preferential looking paradigm that young Japanese-speaking children could link novel verbs presented in (in)transitive frames to (non-)causative events, suggesting that case markers in Japanese may help to identify grammatical information about arguments to predict verb's transitivity. Further support for children's use of case marking information is found in an eye-tracking study by Özge et al. (2016): German-speaking children understood the thematic role of the first noun on the basis of case marking facts, and they created expectations about the role of the next nominal incrementally by using information about case marking. It is thus clear that children learning case marking languages are attentive to these local cues for the interpretation of the thematic roles of arguments and for the prediction of upcoming utterances.

However, the mastery of case marking systems is challenging for children. Dąbrowska (2005) found that Polish-speaking 2-year-old children could use the genitive case inflection, with one of the most irregular case marking paradigms in Polish, but that the ability to consistently supply the correct form was not accomplished until the age of 10. In other words, children do use case marking productively from early on, but its mastery requires a considerable amount of time (cf. Dąbrowska & Tomasello, 2008). Moreover, it seems that children's orientation to case

marking information is asymmetric depending on the type of case markers. For instance, Suzuki (2013) showed that an accusative case marker triggers more processing cost than a nominative case marker in Japanese, suggesting relative difficulty with the accusative case marker in comprehension. A similar report comes from an event-related potential study by Schipke, Knoll, Friederici, and Oberecker (2012). They found that, whereas German-speaking 3-year-old children could not employ information about nominative and accusative case reliably in sentence comprehension although they distinguished one from the other, 6-year-olds started to use an accusative case marker in the comprehension of an object-first sentence (despite increased effort to revise their initial interpretation of thematic role ordering) (see also Strotseva-Feinschmidt et al., 2019). Children are thus required to refine their case marking systems through continued exposure over a significant period of time.

3.2.2.2. Developmental trajectory involving case marking in Korean

Three types of case markers are critical for active transitives and suffixal passives in Korean. First, the nominative case marker (NOM) *-i*/*ka* (*-i* after a consonant) indicates primarily a nominal that designates the instigator of an action (10a) (Sohn, 1999)[3]. The NOM also indicates a theme in the passives (10b).

(10a) NOM for the agent

Yengswu-ka an-ass-ta.

Yengswu-NOM hug-PST-SE

'Yengswu hugged (someone).'

(10b) NOM for the theme

Yengswu-ka an-ki-ess-ta.

Yengswu-NOM hug-PSV-PST-SE

'Yengswu was hugged.'

[3] The NOM also applies to a non-agentive argument, indicating various functions (e.g., a direct object of certain (psychological) verbs, a focused possessor) (Choo & Kwak, 2008; Sohn, 1999).

Next, the accusative case marker (ACC) *-(l)ul* (*-ul* after a consonant) indicates that the nominal to which it is attached is the undergoer of an action (Sohn, 1999). The indication of the theme is the prototypical function of the ACC (11).

(11) ACC for the theme

Yengswu-lul an-ess-ta.

Yengswu-ACC hug-PST-SE

'(I) hugged Yengswu.'

Lastly, a dative marker (DAT)[4] indicates basically that a nominal is a recipient (12a) (Sohn, 1999). This category has variants in its form and the environment in which it occurs: *-eykey* in written / formal contexts, *-hanthey* in spoken / casual contexts, *-kkey* for an honorific recipient, and *-tele*/*poko* only for 'telling' verbs in colloquial settings (Choo & Kwak, 2008). *-eykey*/*hanthey* also indicates the agent in the passive (12b)[5]:

(12a) DAT for the recipient

Yengswu-hanthey cwu-ess-ta.

Yengswu-DAT give-PST-SE

'(I) gave (it) to Yengswu.'

(12b) DAT for the agent

Yengswu-hanthey an-ki-ess-ta.

Yengswu-DAT hug-PSV-PST-SE

'(I) was hugged by Yengswu.'

[4] For the sake of consistency in discussion, I classify the DAT as a type of case marking.

[5] *-ey* is also used to denote the agent in a passive, but only for an inanimate agent (Sohn, 1999). I limit the scope of discussion on the passive with an animate agent, so the use of *-ey* will be excluded hereafter.

The earlier literature has dealt with the acquisition of the three markers in two regards. One places more emphasis on the NOM and the ACC in the active compared to the NOM and the DAT in the passive. A good deal of research explored how Korean-speaking children employ the NOM and the ACC in comprehension (e.g., Jin et al., 2015; Kim et al., 2017; Lee, Kim, & Song, 2013) and production (e.g., Cho, 1982; Chung, 1994) of the active. Surprisingly, very few studies address the developmental aspects of the NOM and the DAT in the passive.

The other is the emergence and growth of knowledge about the NOM and the ACC within the active. It was found that children use these markers from the age of two or three but that their understanding of case marking is not complete until the age of four (e.g., Cho, 1982; Chung, 1994; Clancy, 1995; Lee et al., 2013; No, 2009), which is consistent with reports across languages (e.g., Göksun et al., 2008; Özge et al., 2016; Strotseva-Feinschmidt et al., 2019). Evidence shows that children acquire the NOM as an indicator of the subject in a sentence as early as 18 to 20 months old (e.g., Bae, 1997; Cho, 1982; Lee, 2004; Lee, Jang, Choi, & Lee, 2008), and that the NOM-marked argument is employed typically as the actor of an event (Clancy, 1995; Kim, 1997; Lee & Cho, 2009; No, 2009). Children acquire the NOM earlier and use it more reliably than the ACC (e.g., Jin et al., 2015; see also Bae, 1997; Cho, 1982; Chung, 1994; Kim, 1997 for production), which suggests an asymmetry with respect to the developmental order of the two markers. Despite a good deal of research on the role of the NOM in production, there have been relatively few experimental studies on Korean-speaking children's use of the NOM in comprehension (Jin et al., 2015; Kim et al., 2017; Lee et al., 2013), and in particular, the status of the NOM in relation to the other two grammatical factors involving sentence comprehension in Korean (cf. Shin & Deen, 2019).

The individual markers invite particular heuristics for comprehension. To illustrate, the strong association between the NOM and agenthood in a transitive event yields a *NOM-as-Agent* heuristic, which leads a comprehender to interpret the NOM-attached argument as the agent. The ACC is mostly linked to the undergoer of the event, and this produces the *ACC-as-Theme* heuristic such that an argument marked by the ACC is interpreted as the theme in the active transitive. The DAT also engages in separate heuristics, but these are applied either to a three-participant event (in the ditransitive construction and thus not relevant in this dissertation) or to the passive (together with verbal morphology; see Section 3.2.3.2).

The motivation of the NOM-as-Agent heuristic seems to be clear: repeated exposure to the NOM-agent pairing. Input with respect to the active transitive is more heavily skewed towards subject-first than object-first patterns (e.g., Im, 2007; Shin, 2006), and the NOM is attached to the subject in the subject-first patterns, most of which indicate the agent. The frequent alignment between the NOM and the agent as the subject in a sentence would thus encourage children to get a fix on the pairing that maps form (NOM) onto function (indication of the agent) (cf. Kim et al., 2017).

In contrast, the motivation and nature of the other two case marking heuristics are under-studied. Experimental results suggest that knowledge of the ACC emerges around the age of three (e.g., Jin et al., 2015) and continues to grow in strength until the age of six or seven (e.g., Kim et al., 2017), which is consistent with cross-linguistic observations (e.g., Dittmar et al., 2008; Strotseva-Feinschmidt et al., 2019). However, unlike the case of the NOM, there is no clear investigation in light of how the ACC and the DAT introduce the corresponding heuristics in comprehension, and more importantly, how these heuristics affect comprehension. I presume

properties of input would also explain these heuristics to some extent, but this is a pure speculation at this stage.

3.2.3. Voice: verbal morphology for passive

The category of *voice* concerns the mapping relationship between thematic roles and grammatical relations, particularly the subject relation. With reference to an active voice, a passive voice involves a restructuring process in which the element that would otherwise have been the subject (the agent) is downgraded and the element that would otherwise have been the direct object (the theme) is upgraded.[6] Typically, the subject in an active pattern is linked to the agent, and the subject in a passive pattern is linked to the theme; the agent in the passive is instead mapped onto an oblique. This demotion of the agent has the effect of defocusing it, the primary function of the passive (e.g., Shibatani, 1985), and also leads its application to be infrequent (Haspelmath, 1990).

A core feature for the passive voice is the existence of verbal morphology. In other words, a passive construction should involve passive morphology, usually in the form of affixation on the verb (Haspelmath, 1990; Siewierska, 2013). As the verbal morphology associated with the passive is assumed to be an essential part of this construction, I put special emphasis on the role of verbal morphology in terms of the passive voice in comprehension hereafter.

[6] Despite the close relationship between the two voice types (active and passive), the assumption that a passive is defined only by reference to its related active seems to be questionable. For example, a passive can have no active counterpart (e.g., an indirect passive in Japanese: Siewierska, 1984; metaphorical extension of verb semantics in Korean: Lee, 1993) or does not share the same propositional meaning as its corresponding active (e.g., lexical passives in Korean: Sohn, 1999).

3.2.3.1. Cross-linguistic observations on the role of voice for children's understanding of thematic roles of arguments

The passive voice poses a challenge in acquisition for children. The apparent delay in the acquisition of the passive has been well-attested across languages (e.g., English: Borer & Wexler, 1987; de Villiers & de Villiers, 1973; Fox & Grodzinsky, 1998; Nguyen & Snyder, 2017; Japanese: Sano, Endo, & Yamakoshi, 2001; Mandarin: Huang et al., 2013; Spanish: Pierce, 1992; to name a few). Various proposals have been made to account for the reasons behind the delay such as difficulty involving movement of arguments in the passive (e.g., Borer & Wexler, 1987), lack of thematic role transmission in relation to the arguments in the passive (e.g., Fox & Grodzinsky, 1998), low frequency of occurrence of the passive attested in input (e.g., Brooks & Tomasello, 1999), limitations of a linguistic parser in processing the passive (e.g., Trueswell, Kaufman, Hafri, & Lidz, 2012), amongst others. Here I focus on the last two possibilities, the scarcity of the passive voice input and the nature of a child processor, for the challenge of acquiring the passive.

Input frequency is a plausible source for the (late) acquisition of the passive. It is well-known that late acquisition of the passive often co-occurs with its rarity in the input (e.g., Brooks & Tomasello, 1999). In contrast, children who speak languages with relatively higher use of the passive in input such as Inuktitut (e.g., Allen & Crago, 1996), Kiswahili / Kigiriama (e.g., Alcock, Rimba, & Newton, 2012), Sesotho (e.g., Demuth, 1989; Demuth, Moloi, & Machobane, 2010), and Zulu (e.g., Suzman, 1987) acquire it before the age of three. The relationship between input frequency and the development of the passive suggests that the amount of exposure is a crucial factor that promotes (or limits) the acquisition of this construction for children. Indeed, a series of intervention studies support this possibility by showing children's improved

understanding of the passive in response to enhanced input on the passive in languages where it is acquired late in general (e.g., Bencini & Valian, 2008; Brooks & Tomasello, 1999; Messenger, Branigan, McLean, & Sorace, 2012; Vasilyeva, Huttenlocher, & Waterfall, 2006). It is thus reasonable to assume that input exerts a great influence on the acquisition of the passive.

The other possible source, the nature of a child processor, concerns the fact that children often fail to revise their initial parsing. The passive involves an unusual mapping between thematic roles and grammatical relations (cf. O'Grady & Lee, 2005), and this atypical association is normally signalled by verbal morphology. The processor's job in this respect is to perceive the mismatch between thematic roles and grammatical relations in the passive and infer the correct thematic roles of each argument. However, studies on children's comprehension of the passive have shown that revising the initial interpretive commitment is difficult for children (e.g., Deen et al., 2018; Huang et al., 2013; Shin & Deen, 2019; see also Choi & Trueswell, 2010 for locative/genitive interpretation in Korean; Göksun et al., 2008 for causative morphology in Turkish; Lidz, Gleitman, & Gleitman, 2003 for the same morphology type in Kannada). Therefore, on top of language-internal factors, processing limitations may affect how children go about interpreting passive sentences in those cases where they are encountered.

3.2.3.2. Developmental trajectory involving voice in Korean

The canonical active transitive in Korean (1; repeated as 13) typically occurs with the NOM-marked agent, followed by the ACC-marked theme (when fully marked). The verb carries no dedicated active morphology. On the other hand, the canonical suffixal passive (5; revisited 14) occurs with the NOM-marked theme, followed by the DAT-marked agent. The verb carries passive morphology as one of the four passive suffixes: *-i, -hi, -li,* and *-ki*.

(13) Canonical active transitive

kyengchal-i totwuk-ul cap-ass-ta.

police-NOM thief-ACC catch-PST-SE

'The police caught the thief.'

(14) Canonical suffixal passive

totwuk-i kyengchal-hanthey cap-hi-ess-ta.

thief-NOM police-DAT catch-PSV-PST-SE

'The thief was caught by the police.'

Findings from previous research on Korean-speaking children's acquisition of suffixal passives are not conclusive. Children aged up to four are not adept at comprehending and producing the passive in general (e.g., Ha, 1999; Lee & Lee, 2008; Kim, 2009; Kim et al., 2017; Yi, 2000), which brings us back to the aforementioned challenge that the passive poses across languages. However, divergence of performance exists in children after the age of four, depending on task types and verb types. For example, 5-6-year-old children performed at-chance in comprehension in a picture selection task (Kim et al., 2017) but their production of the passive could be primed (Kim, 2010). Five-year-old children performed better in the passive with an accomplishment verb than in the passive with a stative verb, but 6-year-olds performed equally well in the passive with both verb types (Lee & Lee, 2008). These mixed reports on children's performance on the passive make it difficult to have a clear understanding of developmental aspects pertaining to the passive.

Although the prior studies revealed the age effect in acquiring the passive, no study has touched upon the role of verbal morphology in the (late) acquisition of suffixal passives in Korean. Passive morphology serves as a key disambiguation point: it is only this suffix that lets a comprehender know that the NOM-marked argument is not the agent (but the theme), and that the DAT-marked argument is the agent instead. The sensitivity to passive morphology is thus crucial for successful comprehension of the passives in Korean. However, this morphology for the passive is rarely attested in input due to the scarcity of the passive in usage. Moreover, the passive suffixes are morphologically irregular (e.g., Yeon, 2015), are unproductive since they apply only to a limited set of verbs (e.g., Lee & Lee, 2008; Sohn, 1999), and overlap with verbal morphology used for morphological causative (e.g., Sohn, 1999; Song, 2015). Furthermore, a verb in Korean serves as a checker, rather than a guide, for parsing due to verb-finality (Choi, 2011; Choi & Tureswell, 2010; cf. Trueswell et al., 2012). It is thus anticipated that verbal morphology would be less influential in the interpretation of the passive than the other two factors (word order and case marking), and that it takes time for children to employ passive morphology for comprehension at a reliable rate.

Voice involves two comprehension heuristics in relation to the other factors. First, voice activates the *Theme-First* heuristic by placing the theme before the agent, which competes with the Agent-First heuristic. Second, voice facilitates a *DAT-as-Agent* heuristic by signalling that the DAT, which is used normally to indicate the recipient, indicates the agent in the passive, competing with the NOM-as-Agent heuristic. These voice heuristics, however, emerge later in development because they are attested rarely in the input, they always operate in conjunction with one of the other two factors (and are thus complex to apply), and they are tied to passive morphology which is used only for revision of the previous interpretation.

All the possibilities raised here should be tested empirically. To the best of my knowledge, there has been no study that precisely measures individual and interactive roles of word order, case marking, and voice for Korean-speaking children's comprehension of the two contrastive types of constructions (active transitive and suffixal passive). A classic study in relation to the main interest in this dissertation was conducted by Stromswold et al. (1985). They manipulated the use of three surface-level passive cues in English (the auxiliary *is*, the verbal morphology *-ed*, and the preposition *by*) through the omission of these cues (Table 3-1) during a series of act-out tasks targeting English-speaking children aged two to five.

Table 3-1. Eight sentence types in Stromswold et al. (1985)

Condition	# of cues	Example
Baseline: full active	0	The cow pushes the pig.
Insertion of *verb+ed*	1	The cow pushed the pig.
Insertion of *is*	1	The cow is pushes the pig.
Insertion of *by*	1	The cow pushes by the pig.
Insertion of *is verb+ed*	2	The cow is pushed the pig.
Insertion of *verb+ed by*	2	The cow pushed by the pig.
Insertion of *is by*	2	The cow is pushes by the pig.
full passive	3	The cow is pushed by the pig.

Note. Examples from Stromswold et al. (1985: 128); underline and additional explanation added

They found an asymmetry in the children's use of the three cues. The children employed an active sentence schema (agent-action-theme) as a default bias. If a sentence deviated from the basic schema, they treated it as less active contingent upon the number of the passive cues available. Interestingly, of the passive cues, the preposition *by* was the most powerful for children (and even adults) for understanding the passive (cf. Ziegler, Bencini, Goldberg, & Snedeker, 2019).

Despite the importance of Stromswold et al. (1985), the implications of the study are rather limited because we are not certain whether children's responses were affected by the number of cues or by (the types of) errors in those conditions—the majority of conditions in their experiment involved unacceptable sentences. Moreover, there was no consideration of input properties, which are necessary for a complete understanding of children's responses to the presence/absence of cues from grammatical factors.

3.3. Summary: three factors and corresponding heuristics for sentence comprehension in Korean

In sum, the three factors (word order; case marking; voice) involve comprehension of active transitives and suffixal passives in Korean. Each factor bears particular heuristics, some of which compete with each other in the interpretation of thematic roles of arguments in a sentence, as presented in Table 3-2.

Table 3-2. Three factors and corresponding heuristics for sentence comprehension in Korean

Factor	Heuristics	Description	How it works
Word order	Agent-First	Interpret the first argument as the agent	Requires computation of the relative position of each argument in a sentence
Case marking	NOM-as-Agent	Interpret the NOM-marked argument as the agent	Applies locally to a single noun
	ACC-as-Theme	Interpret the ACC-marked argument as the theme	
Voice (verbal morphology)	Theme-First	Interpret the first argument as the theme	Operates in conjunction with passive morphology
	DAT-as-Agent	Interpret the DAT-marked argument as the agent	

There has been no study that tests the aforementioned predictions regarding the interactive role of the three factors for comprehension or the relative strength of the heuristics based on the three factors in the course of comprehension, in combination with properties in input.

CHAPTER IV

CORPUS ANALYSIS OF CAREGIVER INPUT

The use of corpora to study frequency effects and distributional properties as a proxy for the input that children receive is now common in the language acquisition literature (e.g., Abbot-Smith & Behrens, 2006; Cameron-Faulkner, Lieven, & Tomasello, 2003; Lieven, Salomo, & Tomasello, 2009; Rowland, Pine, Lieven, & Theakston, 2003; Shirai, 1998; Stoll, Abbot-Smith & Lieven, 2009; Theakston, Ibbotson, Freudenthal, Lieven, & Tomasello, 2015; Theakston, Maslen, Lieven, & Tomasello, 2012). A few studies on Korean join the literature by showing a close relation between caregiver input and child production (e.g., Cho, 1982; Chung, 1994) and developmental aspects (e.g., Choi, 1999; Lee & Cho, 2009). However, implications from the literature seem to be diluted because of a lack of clarity on the quantity of the data analysed and the accessibility of the data. Moreover, data analysis has been done mostly by hand, which make it demanding to deal with large-scale child corpora in Korean. One promising remedy for these issues is to apply Natural Language Processing (NLP) to corpus analysis: the recent advancement of NLP techniques allows us to handle big data with much less effort and more compatibility with language-specific challenges.

This chapter provides a summary of the findings and limitations of previous studies on Korean child corpora, language-specific challenges in automatic processing of corpus data in Korean, and results of (semi-)automatic extraction of the target constructions (active transitives and suffixal passives) and their related patterns from Korean caregiver input in CHILDES database with enhanced POS-tagging.

4.1. Research on child corpora in Korean

Corpus-mediated research on Korean child corpora goes back to the 1980s. Cho (1982) offers the first official report on this topic by exploring developmental aspects pertaining to word order and case marking in Korean. The analysis of spontaneous speech of three children and their mothers that she collected showed a correlation between the mothers' and the children's utterances in word order: SV and OV were the dominant patterns that the two interlocutors employed. She also found an asymmetry involving case marking: whereas use of the nominative case marker was more common than omission of the marker, use of the accusative case marker was less common than omission of that marker. The children followed these characteristics such that they acquired the nominative case marker earlier than the accusative case marker in general. A similar topic was investigated by Chung (1994), focusing more on erroneous patterns of case marking, by collecting audio-tapes and diary notes from four children and their parents. She reported discrete stages of how the children acquired individual case markers and word order facts, claiming that children in this age group prefer word order over case marking for the indication of grammatical functions of arguments in a sentence.

A seminal study by Choi (1999) addressed the issue of acquisition of verb-argument constructions for young Korean-speaking children through corpus analysis. She collected data from two children and their mothers through written reports and video recordings of spontaneous interaction. Analysis of the data revealed that the children initially acquired argument structures which were tied to specific verbs, supporting the verb-island hypothesis (Tomasello, 1992). It was also found that, after a short period of this lexically-specific stage, the children manifested verb-argument constructions systematically and consistently from around two years after birth (e.g., transitive verbs with objects; intransitive verbs with subjects). More crucially, the study

showed that characteristics that the children manifested were anchored by the nature of the caregiver input, which highlights the role of child-directed speech that encodes the preferred association between a particular verb and a particular argument structure construction that caregivers favour.

A few more studies further report various aspects of child language development through corpus analysis. For example, Lee (2004) collected data from two children and their mothers and explored how the children employed grammatical morphemes to indicate a subject/topic[1]. Her analysis showed the notable production rate of the nominative case marker and the topic marker when 2-year-old children indicated the subject/topic, with varying degrees of individual differences in the course of acquisition, and suggested an influence of the mothers' utterances on the children's use of the topic marker as a contrast function. Lee and Cho (2009) focused more on children's production of the subject / topic markers over time. They analysed the pre-existing child corpora from various researchers and showed developmental stages before the age of four as to how these markers emerged based on the functions that the markers manifest.

Despite the importance of the previous research, there remain two major concerns regarding research practice. One is that the size of corpora that the researchers investigated was never reported.[2] As Table 4-1 illustrates, no study mentioned how many utterances were analysed for their investigation.

[1] Lee (2004) did not distinguish between the topic and the subject in her study.

[2] Adding up the totals for all the subtypes of sentences reported in a study does not help to bypass this issue because the totals do not represent the entire amount of data collected or analysed in the study. We do not know whether findings of the study are drawn from the majority of the entire data or only a small portion of the data. This not only weakens the credibility of the study's findings but also makes it difficult to apply informative corpus-internal measurement (e.g., association strength) to the reported data.

Table 4-1. Information about corpora used in previous studies on Korean

	Caregiver	Child / age range	Duration / frequency	Size
Cho (1982)	M	Alicia / 2;2–2;9	1-hour recording / biweekly	NS
	M	Paul / 2;7–3;2		
	M	Anne / 2;10–3;5		
Chung (1994)	M & F	Hyuck / 1;0–3;0	occasional video recording until 1;6 biweekly; 0.5-to-0.75-hour audio recording until 2;5 monthly; 0.75-to-1-hour audio recording from 2;6	NS
	M	MJ / 1;10–2;9	biweekly; 0.75-hour audio recording	
	NA	SK / 1;11–2;4	diary notes only	
	NA	CK / 1;0–2;4	diary notes only	
Choi (1999)	M	JS & TN / 1:1–2:5	every three to four weeks; 0.5-hour recording until 1;6 & 1-hour recording from 1;7	NS
	M			
Lee (2004)	M	JK & JW / 2;0–2;10	1-hour recording / biweekly	NS
	M			
Lee & Cho (2009)	M	AL / 2:2–2:9	bi-weekly	NS
	MNS	AN / 2:10–3:5	bi-weekly	
	NS	C / 2:0–2:2	weekly	
	M, GM, & N	HS / 1:8–2:11	weekly	
	NA	JK / 0:1–3:0	weekly and bi-weekly	
	NS	CK / 1:3–3:11	every day in principle	
	M	JW / 2:0–3:3	bi-weekly	
	NS	PL / 2:7–3:2	bi-weekly	
		Y / 1:3–3:11	every day in principle Hour of recording not reported in all cases	

Note. F = father; GM = grandmother; M = mother; N = nanny; NA = not applicable; NS = not stated.

Despite the information about the duration and the frequency of data collection, this does not ensure the representativeness and generalisability of the findings from these studies. This aspect renders the credibility of what previous studies reported somewhat dubious. Moreover, all the

corpora used in these studies are privately held and thus not easily available to other scholars. Researchers mostly use their own data or request corpora from researchers with whom they are acquainted. This characteristic circumscribes the reproducibility of procedures and results to a great extent.

4.2. Language-specific challenges in automatic processing of active transitives and suffixal passives in Korean

With respect to active transitives and suffixal passives, at least three challenges arise in automatic processing of Korean corpora. First, identification of these constructions is tricky since core elements for the constructions such as case marking and verbal morphology are sometimes mis-tagged and/or ignored in the current way of corpus analysis in Korean. To illustrate, the open-to-public pipelines[3] do not distinguish clearly between the nominative case marker *-i* and a suffix *-i* which appears after a consonant (e.g., *caykyeng-i* is often analysed as a combination of a proper noun and the nominative case marker, but *-i* in this case is not the case marker but the suffix). They are also poor at recognising verbal morphology, largely due to imperfect tokenisation from the outset (e.g., *ssuye* 'to be used' is tokenised as *ssui-e*, not *ssu-i-e*, and this results in tagging the verb *ssu-* and the passive morphology *-i* altogether as a single verb root, ignoring information about passive morphology). Indeed, similar pitfalls are observed in the Sejong corpus, which is the popular open-access dataset for Korean and is also widely used as a mother corpus for the development of NLP tools. To overcome this shortcoming, I enhance the

[3] A pipeline (in NLP) is defined as a series of steps where the output of one step feeds to the input of the next step. Normally, the pipeline is composed of a tokeniser, a tagger, a parser, and other specific functions which are required for data processing.

child corpora used in this project with regard to tokenisation and proper tagging of case marking and verbal morphology to better capture the constructional patterns in which I am interested.

The next challenge has to do with the determination of canonicity involving these constructions. One way to meet this challenge is to utilise information about relative positions of individual markers in a sentence. Given the assumption that composition of a sentence in child corpora is mostly simple (i.e., mono-clause), we may determine the canonicity of a sentence by way of comparing the numeric location of an initial marker to that of a non-initial one. In a Python environment, a text is treated as a sequence of characters (i.e., strings) numbered sequentially from the left end. As an illustration, the text *hello* consists of five strings in the Python environment, 0 being assigned to *h* and 4 to *o*. Strings can then be searched and compared on the basis of these reference numbers. This characteristic allows us to determine the canonicity of a sentence by extracting information about the relative locations of each marker (expressed as the reference numbers of the strings) as long as the sentence has dedicated markers at the designated place. For instance, in the pattern *noun-**DAT** noun-**NOM** verb-psv*, the DAT has smaller reference numbers than the NOM, which indicates that the DAT occurs earlier than the NOM. The pattern finder thus classifies this pattern as the scrambled suffixal passive. If one of the markers is omitted, we can still use information about the relative positions of the other marker and the case-less noun. Take the pattern *noun-~~NOM~~ noun-**ACC** verb* as an example: the ACC occurs after any noun, and this characteristic allows the ACC to have larger numeric values than any noun has, which allows this pattern to be classified as the canonical active transitive. There are very few cases in naturalistic conversation where two markers are dropped in the two constructions (e.g., Chung, 1994), so I do not consider this possibility for now.

A further challenge, omission of arguments, is a major difficulty in automatic processing of Korean corpora in general. Several methodological proposals have been made such as consideration of dependency relations (e.g., Choi & Palmer, 2011), application of case frames (e.g., Kim & Ock, 2015), and development of a dictionary with information about the argument structure of particular verbs (e.g., Lee & Choi, 2013). However, the rates of accuracy reported from these studies, all of which targeted general-purpose corpora, vary (from around 70 to 95 per cent), and most importantly, there is no empirical report on the application of these proposals to child corpora in Korean. In my dissertation, rather than developing a new system for this task, I find patterns in a semi-automatic way, sorting out possible candidates automatically first and extracting precise patterns manually.

4.3. Methods: Pattern-finding

4.3.1. Target corpus and focus of analysis

As caregiver input, all the Korean child-directed speech data currently available in the CHILDES database[4] (MacWhinney, 2000) were used. This dataset is currently the largest, open-access child corpus in Korean, which consists of 81,593 lines (320,068 eojeol[5]) targeting four children whose ages range from 1;3 to 3;10 (Table 4-2).

[4] https://childes.talkbank.org/browser/index.php?url=EastAsian/Korean/

[5] An eojeol is defined as a unit with white space on both sides that serves as the minimal unit of sentential components (Lee, 2011). It therefore corresponds roughly to what we call a (tokenised) word in English.

Table 4-2. Information about corpora: CHILDES database

Name of corpus	Caregiver	Child / age range	Time of collection (year)	Quantity (lines)
Jiwon	M & F	Jiwon / 2;0–2;3	1992	10,602
Ryu	GM, GF, & M	Jong / 1;3–3;5	2009–2011	28,657
	GM, M, & F	Joo / 1;9–3;10	2010–2011	27,071
	M	Yun / 2;3–3;9	2009–2010	15,263

Note. F = father; GM = grandmother; GF: grandfather; M = mother.

The four construction types were of main interest in this analysis: active transitives (1a-b) and suffixal passives (2a-b) with canonical and non-canonical word order. I also investigated cases involving omission of required arguments and/or markers for each pattern.

(1a) Canonical active transitive construction

kyengchal-i totwuk-ul cap-ass-ta.

police-NOM thief-ACC catch-PST-SE

'The police caught the thief.'

(1b) Scrambled active transitive construction

totwuk-ul kyengchal-i cap-ass-ta.

thief-ACC police-NOM catch-PST-SE

'The police caught the thief.'

(2a) Canonical suffixal passive construction

totwuk-i kyengchal-hanthey cap-hi-ess-ta.

thief-NOM police-DAT catch-PSV-PST-SE

'The thief was caught by the police.'

(2b) Scrambled suffixal passive construction

kyengchal-hanthey totwuk-i cap-hi-ess-ta.

police-DAT thief-NOM catch-PSV-PST-SE

'The thief was caught by the police.'

In addition to the main construction types, I extracted lexical[6] and periphrastic passives to provide an empirical report on the frequency of occurrence involving the three types of passives in Korean caregiver input. In addition, I examined the use of individual markers (NOM, ACC, and DAT) with respect to active transitives and suffixal passives.

4.3.2. Procedure

CLAN, a default program provided by CHILDES for data analysis and editing, is not supported for Korean, so the analysis was conducted through Python programming in a semi-automatic way. As a pre-processing step, the raw child-directed speech data (with typos and spacing errors corrected) were entered into the existing Pythonic pipeline for general-purpose corpora—*UDPipe* (Straka & Straková, 2017)—from tokenisation up to XPOS (i.e., a language-

[6] Examples of the lexical passive were from Sohn (1999): *mac-* 'to be hit', *tangha-* 'to undergo', *pat-* 'to receive (an action), to suffer', and *toy-* 'to become' when it is combined with a verbal noun (e.g., *sayong-toy-ta* 'to be used').

specific POS tag set; the Sejong tag set by Kim, Kang, & Hong, 2007)[7] and UPOS (i.e., the universal POS tag set; Petrov, Das, & McDonald, 2012) tagging. After I explored the processed data, I found serious problems such as improper tokenisation (3a), mis-tagging (3b), a nonsensical relation between XPOS and UPOS (3c), and inconsistency in tagging (3d).

(3a) Improper tokenisation

있었어 → 있었+ 어 VERB[8] VV+EF[9]

ississe → ississ+e

(*ississe* should be *iss*+*ess*+*e* 'exist+PST+SE' and thus VV+EP+EF)

(3b) Mis-tagging

아빠네 → 아빠네 NUM MM

appaney → appaney

(*appaney* should be *appa*+*ney* 'father+SE', which should also be VERB and NNG+EF)

(3c) Nonsensical relation between XPOS and UPOS

배운단다 → 배운단다 ADJ VV+EF

paywuntanta → paywu-n-tanta ('learn-PRS-SE')

(Apart from the tokenisation problem, VV+EF should be VERB, not ADJ)

[7] I followed the Sejong tag set because this is representative and particularly influential in Korean. The system has 45 labels under 7 categories, and employs relatively detailed classification for the postpositions and dependency-related items by function, which captures linguistic characteristics of Korean fairly well. The basic unit of POS tagging in this system is a morpheme within an eojeol.

[8] Codes for UPOS tagging: ADJ = adjective; ADV = adverb; NOUN = noun; NUM = number; PUNCT = punctuation; VERB = verb

[9] Codes for XPOS tagging: EC = ending, connector; EF = ending, final; EP = ending, pre-final; MAG = adverb, general; MM = modifier; NNG = noun, general; SF = punctuation; VV = verb.

(3d) Inconsistency in tagging

기침 → 기침 NOUN NNG

VERB NNG+NNG

kichim → kichim (‘cough’)

(The same word returned the two different XPOS-UPOS pairs)

Since the performance of the existing pipeline was not satisfactory for the task of pattern-finding, I revised the tagged data manually to ensure that each morpheme and word was assigned to an appropriate tag. During this revision, I focused on correcting tokenisation and tag information about case marking and verbal morphology, which are often mis-analysed in the currently available pipelines for Korean. I further excluded utterances whose length was less than 16 strings (e.g., # *text* = 까꿍 까꿍.), which resulted in 69,498 lines (285,350 eojeols) for the actual analysis.

The tagged data were then submitted to a pattern-finding process.[10] All the information about individual morphemes and their corresponding tags in one sentence was transformed into a sequence of strings in an eojeol-by-eojeol manner, as illustrated in (4).

(4) Example of a sentence for pattern-finding

안/안/MAG/ADV 받아/받+아/VV+EC/VERB 먹었지요/먹+었+지요/VV+EP+EF ./SF/PUNCT

Note. One eojeol string consists of an eojeol, a sequence of morphemes, XPOS tags corresponding to each morpheme, and a UPOS tag corresponding to the entire eojeol.

[10] See the GitHub page for the entire Python codes that I used for pattern-finding.

The transformed sentences were inputted to an automatic search process whereby the two constructions by canonicity and patterns relating to these constructions were extracted (see Appendix A for the key Python codes for this task). To illustrate, a canonical active transitive was searched through the following steps: sorting out utterances with a verb (VERB) and more than one noun (NOUN); extracting sentences both with JKS (for the NOM) and with JKO (for the ACC); and outputting instances where JKS precedes JKO as a *.txt* file. Every list of sentences for each extraction was also checked manually to ensure the accuracy of the results. Patterns in which main verbs appeared sentence-initially or sentence-medially were excluded at this stage.

In addition to raw frequency information about each pattern, I calculated Δ*P*, a unidirectional statistics for association strength that estimates the degree to which a cue co-occurs with an outcome (e.g., Allan, 1980; Ellis, 2006; Gries, 2013; see also Desagulier, 2016 for the in-depth review of various association strength measures). A Δ*P* score, which ranges from -1 to 1, is computed on the basis of a contingency table (Table 4-3), following the mathematical formula (5), where the probability of the outcome is conditioned upon that of the cue.

Table 4-3. Association strength: Δ*P*

	Outcome	¬ Outcome
Cue	a	b
¬ Cue	c	d

Note. ¬ stands for 'not'.

(5) $\Delta P_{(\text{outcome} \mid \text{cue})} = p(\text{outcome} \mid \text{cue}) - p(\text{outcome} \mid \neg \text{cue}) = a/(a+b) - c/(c+d)$

For the interpretation of individual ΔP scores, the closer $\Delta P_{(\text{outcome} \mid \text{cue})}$ is to 1, the more likely the cue co-occurs with the outcome; the closer $\Delta P_{(\text{outcome} \mid \text{cue})}$ is to -1, the more unlikely the cue co-occurs with the outcome. I applied this technique to the two constructions and the individual case markers in order to better ascertain the status of these constructions and case marking in expressing a transitive event.

4.4. Results

4.4.1. Active transitives and suffixal passives

Table 4-4 presents the frequency of occurrence of active transitives and suffixal passives by canonicity with no omission of arguments and case marking in the caregiver input.

Table 4-4. Frequency of active transitives and suffixal passives in caregiver input (no omission of arguments or case marking)

	Active transitive			Suffixal passive		
	#	%[1)]	%[2)]	#	%[1)]	%[2)]
Canonical	1,757	97.02	2.53	2	0.11	< 0.01
Scrambled	51	2.82	0.07	1	0.06	< 0.01

Note. 1) and 2) were calculated out of the four constructional patterns (1,811 instances) and the entire size of the data investigated (69,498 instances), respectively.

There was a substantial difference in the frequency of occurrence of active transitives by canonicity: the canonical pattern (1,757 instances) occurred far more frequently than the scrambled pattern (51 instances). The suffixal passive was extremely rare in its use, occurring two instances in the canonical pattern and one instance in the scrambled pattern. The

asymmetries across these constructions and those within the active transitive parallel previous findings from the general-purpose corpora (e.g., Shin, 2006).

Δ*P* scores of the two constructions (Table 4-5) reveal varying degrees of association that a transitive event and the individual constructional patterns manifest in the caregiver input.

Table 4-5. Δ*P* scores: Active transitives and suffixal passives for a transitive event in caregiver input (no omission of argument or case marking)

	Canonical active transitive	Scrambled active transitive	Canonical suffixal passive	Scrambled suffixal passive
$\Delta P_{(B\|A)}$	0.999	0.975	0.974	0.974
$\Delta P_{(A\|B)}$	0.979	0.028	0.001	0.000

Note. A = individual construction; B = transitive event.

As calculated in $\Delta P_{(B|A)}$, the four patterns served as equally strong cues to introduce a transitive event, showing more than a score of 0.97 across the board. However, the reversed direction $\Delta P_{(A|B)}$ showed that a transitive event was most likely by far to be expressed as the canonical active transitive and least likely to be encoded as the passive. The strong bi-directionality between the canonical active transitive and a transitive event suggests that, of the four candidates, the canonical active transitive is the default construction for expressing this type of event. In contrast, the asymmetric strength of association that the other three patterns demonstrated with respect to a transitive event indicate that, although they could be used to express a transitive event, their use is not preferred over that of the canonical active transitive.

Table 4-6 presents frequency information about all the patterns, with varying degrees of omission of sentential components, for a transitive event in the caregiver input. As for the active patterns, whereas the ACC tended to be omitted more often than the NOM within the patterns

with two overt arguments (268 + 6 instances vs. 19 instances), the theme-ACC pairing appeared more frequently than the agent-NOM pairing when the patterns retained only one overt argument (935 instances vs. 1,938 instances). When two arguments were attested in the active transitive, the NOM-marked argument occurred initially (1,757 + 268 = 2,025 instances) more than non-initially (51 + 6 = 57 cases). In contrast, the ACC-marked argument showed the reverse tendency, appearing non-initially (1,757 + 19 = 1,776 cases) more than initially (51 cases). The passive patterns were rare in the input compared to the active ones (4,974 instances vs. 423 instances), but the number of passive patterns with only one case-marked argument was relatively large (407 + 13 instances).

Table 4-6. Frequency of patterns for a transitive event in caregiver input

Type	Example	Frequency (#)
Canonical active transitive	police-NOM thief-ACC catch	1,757
Canonical active transitive, no ACC	police-NOM thief-~~ACC~~ catch	268
Canonical active transitive, no NOM	police-~~NOM~~ thief-ACC catch	19
Scrambled active transitive	thief-ACC police-NOM catch	51
Scrambled active transitive, no ACC	thief-~~ACC~~ police-NOM catch	6
Scrambled active transitive, no NOM	thief-ACC police-~~NOM~~ catch	0
Active transitive, actor-NOM only[1)]	police-NOM catch	935
Active transitive, undergoer-ACC only[1)]	thief-ACC catch	1,938
Canonical suffixal passive	thief-NOM police-DAT catch-psv	2
Canonical suffixal passive, no DAT	thief-NOM police-~~DAT~~ catch-psv	0
Canonical suffixal passive, no NOM	thief-~~NOM~~ police-DAT catch-psv	0
Scrambled suffixal passive	police-DAT thief-NOM catch-psv	1
Scrambled suffixal passive, no DAT	police-~~DAT~~ thief-NOM catch-psv	0
Scrambled suffixal passive, no NOM	police-DAT thief-~~NOM~~ catch-psv	0
Suffixal passive, undergoer-NOM only[1)]	thief-NOM catch-psv	407
Suffixal passive, actor-DAT only[1)]	police-DAT catch-psv	13
SUM		5,397

Note. 1) does not involve canonicity as it is undeterminable with only one overt argument.

Table 4-7 presents frequency of case-less patterns expressing a transitive event in the caregiver input. Note that these patterns involve no overt case marking attached to argument(s) and so interpretation of thematic roles of argument(s) can be ambiguous. I sorted out these ambiguous instances under the 'Undetermined' category.

Table 4-7. Frequency of case-less patterns for a transitive event in caregiver input

Pattern	Thematic role	Frequency
$N_{\not{CASE}}V_{act}$	Agent	53
	Theme	1,155
	Undetermined	40
$N_{\not{CASE}}V_{psv}$	Agent	0
	Theme	20
	Undetermined	0
$N_{\not{CASE}}N_{\not{CASE}}V_{act}$	Agent-theme	3
	Theme-agent	0
	Undetermined	0
SUM		1,268

Regarding the one-argument active pattern without case marking, the number of instances where the sole argument expresses the theme (i.e., the ACC is omitted) outnumbered the number of instances where that argument expresses the agent (i.e., the NOM is omitted). As for the corresponding passive pattern, all the instances fell into a case in which the argument expresses the theme (i.e., the NOM is omitted). There were only three instances that consist of two overt arguments without case marking altogether, all of which fell into the agent-theme ordering.

4.4.2. Passive constructions by type

Table 4-8 presents frequency information about the three passive types in the caregiver input, including instances of patterns with or without omission of arguments and case marking.

Table 4-8. Frequency of three passive types in caregiver input

	Suffixal	Lexical	Periphrastic
Frequency	657[1)]	61	258

Note. 1) includes all the passive patterns investigated above (see Table 4-6), including patterns with no argument or with markers other than the NOM and the DAT (e.g., *-(u)lo*, *-ey*) as well.

Of the three types, the suffixal passive was the most frequent, and the difference between the frequency of the suffixal passive and that of the other two passive types was significant: $\chi^2(1) = 494.73$, $p < .001$ for the suffixal passive and the lexical passive; $\chi^2(1) = 173.99$, $p < .001$ for the suffixal passive and the periphrastic passive. The periphrastic passive followed, manifesting a significance difference with the lexical passive: $\chi^2(1) = 121.66$, $p < .001$.

4.4.3. Individual case markers

4.4.3.1. NOM

Table 4-9 presents frequency information about the NOM based on the thematic role associated with it and whether / where the case-marked argument appears in the patterns extracted from the caregiver input. The NOM was used as an indication of the agent (935 + 2,025 + 57 = 3,017 instances) more than an indication of the theme (407 + 2+ 1 = 410 instances). This marker was also used overtly (935 + 2,025 + 57 + 407 + 2 + 1 = 3,427 instances) more than it was omitted (53 + 22 + 20 = 95 instances). Within the one-argument patterns, the marker was present (935 instances for the agent; 407 instances for the theme) considerably more than it was absent (53 instances for the agent; 20 instances for the theme). In the two-argument active transitive patterns, the marker was used initially (2,025 instances) more than non-initially (57 instances).

Table 4-9. Frequency of NOM in caregiver input

Thematic role	Appeared?	Where?	Pattern type	Frequency (#)
Agent	Yes	Initially	One-argument	935
			Two-argument, canonical	2,025
		Non-initially	Two-argument, scrambled	57
	No	Initially	One-argument	53
			Two-argument, canonical	22
		Non-initially	Two-argument, scrambled	0
Theme	Yes	Initially	One-argument	407
			Two-argument, canonical	2
		Non-initially	Two-argument, scrambled	1
	No	Initially	One-argument	20
			Two-argument, canonical	0
		Non-initially	Two-argument, scrambled	0

ΔP scores for the NOM were then calculated, which is shown in Table 4-10.

Table 4-10. ΔP scores: NOM

Type	Active		Passive	
	$\Delta P_{(\text{AGENT} \mid \text{NOM})}$	$\Delta P_{(\text{NOM} \mid \text{AGENT})}$	$\Delta P_{(\text{THEME} \mid \text{NOM})}$	$\Delta P_{(\text{NOM} \mid \text{THEME})}$
Score	0.853	0.856	-0.868	-0.905

The ΔP scores substantiate the strong bi-directional association between the NOM and the agent in the context of a transitive event. The NOM was an extremely reliable cue for the agent role ($\Delta P_{(\text{AGENT} \mid \text{NOM})}$) and vice versa ($\Delta P_{(\text{NOM} \mid \text{AGENT})}$). In contrast, the NOM was very unlikely to introduce the theme ($\Delta P_{(\text{THEME} \mid \text{NOM})}$) and vice versa ($\Delta P_{(\text{NOM} \mid \text{THEME})}$). This reveals the strong reliability of the NOM for the agent and vice versa in child-directed speech.

4.4.3.2. ACC

Table 4-11 presents frequency information about the ACC based on whether and where the case-marked argument appears in the patterns extracted from the caregiver input. The ACC was used overtly (1,938 + 51 + 1,776 = 3,765 instances) more than it was omitted (1,155 + 6 + 271 = 1,432 instances). Within one-argument patterns, this marker was present (1,938 instances) more than it was omitted (1,155 instances). However, its omission in one-argument patterns occurred proportionally more than that of the NOM. Thus, the rate at which the ACC was dropped (0.373) was much higher than the rate at which the NOM (indicating the agent) was dropped (0.054). In the two-argument active transitive patterns, the ACC was used non-initially (1,776 instances) more than initially (51 instances).

Table 4-11. Frequency of ACC in caregiver input

Thematic role	Appeared?	Where to appear?	Pattern type	Frequency (#)
Theme	Yes	Initially	One-argument	1,938
			Two-argument, scrambled	51
		Non-initially	Two-argument, canonical	1,776
	No	Initially	One-argument	1,155
			Two-argument, scrambled	6
		Non-initially	Two-argument, canonical	271

Note. Since the focus of analysis was patterns involving a transitive event, I excluded any ditransitive pattern.

Based on this information, Δ*P* scores of the ACC were calculated in Table 4-12.

Table 4-12. Δ*P* scores: ACC

Type	$\Delta P_{(\text{THEME} \mid \text{ACC})}$	$\Delta P_{(\text{ACC} \mid \text{THEME})}$
Score	0.350	0.670

The ΔP scores show that the association between the ACC and the theme within a transitive event was moderately reliable: the ACC was a good cue for the theme role ($\Delta P_{(\text{THEME} \mid \text{ACC})}$) and vice versa ($\Delta P_{(\text{ACC} \mid \text{THEME})}$) but not extremely strong as in the case of the NOM and the agent. This is due to the high omission rate for the ACC compared to the case of the NOM, by increasing the impact of '¬ cue' on calculation of ΔP (see Table 4-3 and the formula (5)).

4.4.3.3. DAT

Whereas there were 269 instances in which the DAT indicates a recipient (in actives), there were only 16 instances in which the DAT marked an agent (in the passive). Although the active patterns involving the DAT are ditransitives (and therefore do not count as relevant patterns expressing a simple transitive event), I added these patterns only here because the DAT is often used as an indicator of a recipient in the active and thus a potential competitor of the agent-DAT pairing in the passive.

I calculated ΔP scores for the DAT (Table 4-13), and it was found that the marker was not likely to be associated with the agent ($\Delta P_{(\text{AGENT} \mid \text{DAT})}$) or vice versa ($\Delta P_{(\text{DAT} \mid \text{AGENT})}$).

Table 4-13. ΔP scores: DAT

Type	$\Delta P_{(\text{AGENT} \mid \text{DAT})}$	$\Delta P_{(\text{DAT} \mid \text{AGENT})}$
Score	-0.410	-0.066

4.5. Discussion

Four main findings were noted. First, there was an asymmetry in the frequency of active transitives and suffixal passives: the canonical active transitive occurred far more frequently than

the scrambled one, and the suffixal passive was extremely rare, irrespective of canonicity. This finding confirms the previous reports on the dominance of the agent-before-theme ordering in caregiver input (e.g., Cho, 1982), which lends empirical support to the Agent-First heuristic. This finding also adds to the evidence that the passive is rare in child-directed speech in Korean.

Second, of the three passive types, the suffixal passive was the most frequent in all passives (with or without omission of argument / case marking). To the best of my knowledge, this is the first empirical report (with concrete numbers) on the frequency of the three types of passives in child-directed speech in Korean. Based on this finding, it is thus expected that at least until the age of three, children are exposed to extremely few instances of the passives, of which the suffixal passive is the most frequent.

Third, the degree of association between individual case markers and the corresponding thematic roles within a transitive event diverged. The NOM was a very strong cue to introduce agenthood (and vice versa), the ACC was a moderately good cue to invite themehood (and vice versa), and the DAT was not likely to occur with the agent (and vice versa). The agent-NOM and the theme-ACC pairings were reliable, with the individual markers predicting the corresponding thematic roles and vice versa, which constitute the basis of the two case marking heuristics (NOM-as-Agent; ACC-as-Theme). In particular, of the two possible functions for the NOM—the agent (in the active) and the theme (in the passive), the former is predominant. This finding could help explain why children utilise the NOM as an indicator of the agent from very early on (e.g., Jin et al., 2015; Kim et al., 2017), expediting the NOM-as-Agent heuristic. If this tendency found in caregiver input holds for children's comprehension, we should expect stronger reliance on the NOM-as-Agent heuristic to enhance the Agent-First heuristic relating to word order or to weaken

the Theme-First or the DAT-as-Agent heuristics relating to voice (which operate only in conjunction with passive morphology).

Fourth, within active transitives, the distribution of arguments marked by the NOM and the ACC by position was asymmetric. When two overt arguments were attested in the active transitive, the NOM-marked and the ACC-marked arguments tend to appear initially and non-initially, respectively. This tendency indicates the association between each case-marked argument and the particular position where it occurs. If this affects children's comprehension, we should anticipate an interplay with respect to where case-marked arguments occur in a sentence and how children apply the case-marking heuristics, yielding better rates of accuracy in patterns where each case-marked argument is attested in a typical position than in patterns where arguments appear in an atypical position. This possibility should be tested empirically.

CHAPTER V

EXPERIMENTAL SET-UP: PICTURE SELECTION

Word order, case marking, and voice co-exist in a sentence, jointly affecting interpretation of thematic roles of arguments in a sentence. Little research has systematically pursued how children employ information about these factors by way of the corresponding comprehension heuristics. Four specific research questions were made for this issue:

1. What is the role of the Agent-First heuristic in guiding comprehension?
2. What is the role of the NOM-as-Agent and the ACC-as-Theme heuristics in guiding comprehension?
3. What is the role of the Theme-First and the DAT-as-Agent heuristics in guiding comprehension?
4. Is one of these heuristics stronger than the others in guiding comprehension?

With these in mind, a series of picture selection tasks were conducted. This chapter describes the methodology for the experiment.

5.1. Participants

Korean-speaking children aged 3 and 4 years old (3-4-year-olds; 3;0–4;11, n = 30, mean age: 4;1) and 5 and 6 years old (5-6-year-olds; 5;0–6;11, n = 23, mean age: 5;11), who were monolingual, were recruited from a preschool in Seoul, Korea. The exact number of children who participated in each experimental session was different because some of them were absent

on particular experiment dates or did not pass the training session (see Table B-1 in Appendix B for the number of participants in the individual experimental sessions). Adult native speakers of Korean (n = 20, 20s-to-30s, mean age: 27.2) were also recruited from two universities as a control group. No participant reported any learning disabilities.[1]

5.2. Stimuli

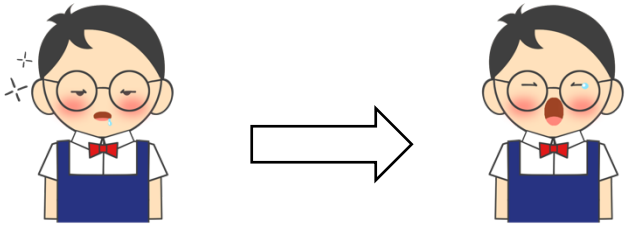
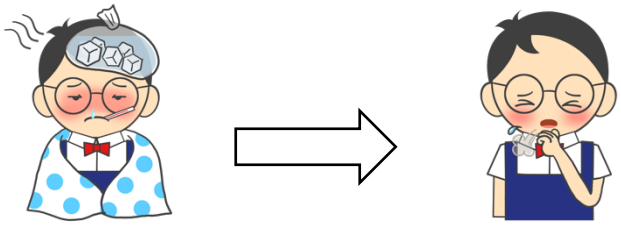
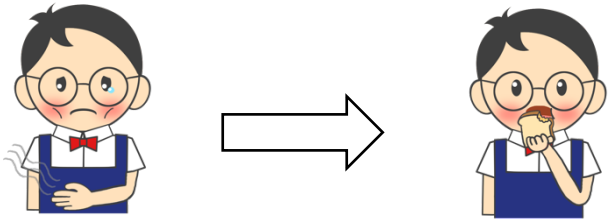
5.2.1. Creation by pattern

Actives transitives and suffixal passives[2] were created by using animals as agents and themes (see Table B-2 in Appendix B for the list of the test sentences). In order to tease apart the individual impacts of the three factors on the comprehension of the two constructions, I obscured parts of the test sentences, which yielded various patterns within the designated constructions. For this purpose, three novel, child-friendly contexts were devised (Table 5-1): one involved the main character becoming sleepy and yawning occasionally; another involved a situation where the main character got sick and kept coughing; the other involved the main character getting hungry and eating food with chewing sounds. In each context, participants heard sentences with some of the parts obscured by acoustic masking (i.e., yawning, coughing, or chewing). I provided verbal explanations on the context in Korean, along with the pictures on the screen.

[1] I relied on the diagnosis of the child participants' language problem/impairments by way of records of standard tests conducted by the preschool.

[2] I assumed that all the allomorphs of case marking and verbal morphology involving the two constructions in Korean behave identically and so I did not distinguish amongst them. They are phonologically and lexically conditioned (Sohn, 1999; Yeon, 2015), bringing no change in syntactic composition of these constructions. Therefore, I did not control for the number of the allomorph types which appeared in the test sentences throughout the experiments. I acknowledge that there may be differences with respect to the frequency of occurrence involving the allomorphy, which awaits future investigation.

Table 5-1. Context for obscuring parts of test sentences

		Contextual set-up	
Yawning	Pictures presented		
	Verbal explanation	Look! He is sleepy.	He will tell us something although he is yawning. Let's help him with learning Korean, shall we?
Coughing	Pictures presented		
	Verbal explanation	Look! He is sick.	He will tell us something although he is coughing. Let's help him with learning Korean, shall we?
Chewing	Pictures presented		
	Verbal explanation	Look! He is hungry.	He will tell us something although he is eating. Let's help him with learning Korean, shall we?

5.2.1.1. Canonical active transitive patterns

Four patterns were created in this construction type: one with no case marker (baseline), as in (1a), another with only the first marker retained (case marking retention: NOM), as in (1b) or the second marker retained (case marking retention: ACC), as in (1c), and the other with all the markers present (case marking retention: NOM & ACC), as in (1d). Since the baseline pattern

does not have case marking to indicate the thematic role of arguments, this pattern can be interpreted as agent-first or theme-first. Structural characteristics of these patterns are presented in Table 5-2.

(1a) Baseline ($N_{\cancel{CASE}}N_{\cancel{CASE}}V_{act}$)

talamcwi*cough* kkwulpel*cough* chilhay-yo

squirrel*cough* honeybee*cough* paint-SE

'The squirrel paints the honeybee.' or 'The honeybee paints the squirrel.'

(1b) Case marking retention: NOM ($N_{NOM}N_{\cancel{CASE}}V_{act}$)

kkwulpel-i talamcwi*yumyum* chilhay-yo.

honeybee-NOM squirrel*yumyum* paint-SE

'The honeybee paints the squirrel.'

(1c) Case marking retention: ACC ($N_{\cancel{CASE}}N_{ACC}V_{act}$)

kkwulpel*cough* talamcwi-lul chilhay-yo.

honeybee*cough* squirrel-ACC paint-SE

'The honeybee paints the squirrel.'

(1d) Case marking retention: NOM & ACC ($N_{NOM}N_{ACC}V_{act}$)

kkwulpel-i talamcwi-lul chilhay-yo.

honeybee-NOM squirrel-ACC paint-SE

'The honeybee paints the squirrel.'

Table 5-2. Schematic display of individual patterns: 1a to 1d

	CANONICAL	NOM	ACC	ACTIVE
1a	N/A	–	–	+
1b	+	+	–	+
1c	+	–	+	+
1d	+	+	+	+

Note. N/A stands for 'not applicable'.

5.2.1.2. Scrambled active transitive patterns

Three patterns were created in this construction type: one with only the first marker audible (case marking retention: ACC), as in (2a), another with only the second marker audible (case marking retention: NOM), as in (2b), and the other with all the markers present (case marking retention: ACC & NOM), as in (2c). Structural characteristics of these patterns are presented in Table 5-3.

(2a) Case marking retention: ACC ($^{\dagger}N_{ACC}N_{\cancel{CASE}}V_{act}$)

talamcwi-lul kkwulpel*yumyum* chilhay-yo.

squirrel-ACC honeybee*yumyum* paint-SE

'The honeybee paints the squirrel.'

(2b) Case marking retention: NOM ($^{\dagger}N_{\cancel{CASE}}N_{NOM}V_{act}$)

talamcwi*cough* kkwulpel-i chilhay-yo.

squirrel*cough* honeybee-NOM paint-SE

'The honeybee paints the squirrel.'

(2c) Case marking retention: ACC & NOM ($^{\dagger}N_{ACC}N_{NOM}V_{act}$)

talamcwi-lul kkwulpel-i chilhay-yo.

squirrel-ACC honeybee-NOM paint-SE

'The honeybee paints the squirrel.'

Table 5-3. Schematic display of individual patterns: 2a to 2c

	CANONICAL	NOM	ACC	ACTIVE
2a	–	–	+	+
2b	–	+	–	+
2c	–	+	+	+

5.2.1.3. Canonical suffixal passive patterns

Four patterns were created in this construction type: one with no case marker (voice add-on), as in (3a), another with only the first marker audible (voice add-on & case marking retention: NOM), as in (3b) or the second marker audible (voice add-on & case marking retention: DAT), as in (3c) audible, and the other with all the markers present (voice add-on & case marking retention: NOM & DAT), as in (3d). Since the voice add-on pattern does not have case marking to indicate the thematic role of the arguments, this pattern can be interpreted as agent-first or theme-first. Structural characteristics of these patterns are presented in Table 5-4.

(3a) Voice add-on ($N_{\cancel{CASE}}N_{\cancel{CASE}}V_{psv}$)

kangaci*cough* koyangi*cough* cha-i-eyo

dog*cough* cat*cough* kick-PSV-SE

'The dog is kicked by the cat.' or 'The cat is kicked by the dog.'

(3b) Voice add-on & case marking retention: NOM ($N_{NOM}N_{\cancel{CASE}}V_{psv}$)

koyangi-ka kangaci*yumyum* cha-i-eyo.

cat-NOM dog*yumyum* kick-PSV-SE

'The cat is kicked by the dog.'

(3c) Voice add-on & case marking retention: DAT ($N_{\cancel{CASE}}N_{DAT}V_{psv}$)

koyangi*cough* kangaci-hanthey cha-i-eyo.

cat*cough* dog-DAT kick-PSV-SE

'The cat is kicked by the dog.'

(3d) Voice add-on & case marking retention: NOM & DAT ($N_{NOM}N_{DAT}V_{psv}$)

koyangi-ka kangaci-hanthey cha-i-eyo.

cat-NOM dog-DAT kick-PSV-SE

'The cat is kicked by the dog.'

Table 5-4. Schematic display of individual patterns: 3a to 3d

	CANONICAL	NOM	DAT	ACTIVE
3a	N/A	–	–	–
3b	+	+	–	–
3c	+	–	+	–
3d	+	+	+	–

Note. N/A stands for 'not applicable'.

5.2.1.4. Scrambled suffixal passive patterns

Three patterns were created in this construction type: one with only the first marker audible (voice add-on & case marking retention: DAT), as in (4a), another with only the second marker audible (voice add-on & case marking retention: NOM), as in (4b), and the other with all the markers present (voice add-on & case marking retention: DAT & NOM), as in (4c). Structural characteristics of these patterns are presented in Table 5-5.

(4a) Voice add-on & case marking retention: DAT ($^{\dagger}N_{DAT}N_{\cancel{CASE}}V_{psv}$)

kangaci-hanthey	koyangi*yumyum*	cha-i-eyo.
dog-DAT	cat*yumyum*	kick-PSV-SE

'The cat is kicked by the dog.'

(4b) Voice add-on & case marking retention: NOM ($^{\dagger}N_{\cancel{CASE}}N_{NOM}V_{psv}$)

kangaci*cough*	koyangi-ka	cha-i-eyo.
dog*cough*	cat-NOM	kick-PSV-SE

'The cat is kicked by the dog.'

(4c) Voice add-on & case marking retention: DAT & NOM ($^{\dagger}N_{DAT}N_{NOM}V_{psv}$)

kangaci-hanthey	koyangi-ka	cha-i-eyo.
dog-DAT	cat-NOM	kick-PSV-SE

'The cat is kicked by the dog.'

Table 5-5. Schematic display of individual patterns: 4a to 4c

	CANONICAL	NOM	DAT	ACTIVE
4a	–	–	+	–
4b	–	+	–	–
4c	–	+	+	–

5.2.1.5. One-argument patterns

A total of six patterns were created, two of which lacked case marking with acoustic masking, namely baseline, as in (5a), and voice add-on, as in (5b). The remainder involved one marker on the sole argument: case marking retention, NOM, as in (5c); case marking retention, ACC, as in (5d); voice add-on and case marking retention, NOM, as in (5e); and voice add-on and case marking retention, DAT, as in (5f). Since the baseline and the voice add-on patterns do not have case marking to indicate the thematic role of the argument, the argument's thematic role in these patterns can be interpreted as the agent or the theme. Structural characteristics of these patterns are presented in Table 5-6.

(5a) Baseline ($N_{\cancel{CASE}}V_{act}$)

kkwulpel-*yawn* chilhay-yo.

honeybee-*yawn* paint-SE

'The honeybee paints.' (agent) or 'paints the honeybee' (theme)

(5b) Voice add-on ($N_{\cancel{CASE}}V_{psv}$)

koyangi-*yawn* cha-i-eyo.

cat-*yawn* kick-PSV-SE

'The cat is kicked.' (theme) or 'is kicked by the cat' (agent)

(5c) Case marking retention: NOM ($N_{NOM}V_{act}$)

kkwulpel-i chilhay-yo.

honeybee-NOM paint-SE

'The honeybee paints.'

(5d) Case marking retention: ACC ($N_{ACC}V_{act}$)

talamcwi-lul chilhay-yo.

squirrel-ACC paint-SE

'paints the squirrel.'

(5e) Voice add-on & case marking retention: NOM ($N_{NOM}V_{psv}$)

koyangi-ka cha-i-eyo.

cat-NOM kick-PSV-SE

'The cat is kicked.'

(5f) Voice add-on & case marking retention: DAT ($N_{DAT}V_{psv}$)

kangaci-hanthey cha-i-eyo.

dog-DAT kick-PSV-SE

'is kicked by the dog.'

Table 5-6. Schematic display of individual patterns: 5a to 5f

	CANONICAL	NOM	ACC	DAT	ACTIVE
5a	N/A	–	–	–	+
5b	N/A	–	–	–	–
5c	N/A	+	–	–	+
5d	N/A	–	+	–	+
5e	N/A	+	–	–	–
5f	N/A	–	–	+	–

Note. N/A stands for 'not applicable'.

In sum, the target patterns for the experiment are presented in Table 5-7.

Table 5-7. Summary of patterns by condition

Condition	Word order	Case marking	Voice	Pattern	Example
Baseline	-	no	active	$N_{\not CASE}N_{\not CASE}V_{act}$	dog*cough* cat*cough* kick
Case marking retention	canonical	yes (1st)	active	$N_{NOM}N_{\not CASE}V_{act}$	dog-NOM cat*yumyum* kick
		yes (2nd)		$N_{\not CASE}N_{ACC}V_{act}$	dog*cough* cat-ACC kick
		yes		$N_{NOM}N_{ACC}V_{act}$	dog-NOM cat-ACC kick
Scrambled case marking retention	scrambled	yes (1st)	active	$^{\dagger}N_{ACC}N_{\not CASE}V_{act}$	dog-ACC cat*yumyum* kick
		yes (2nd)		$^{\dagger}N_{\not CASE}N_{NOM}V_{act}$	dog*cough* cat-NOM kick
		yes		$^{\dagger}N_{ACC}N_{NOM}V_{act}$	dog-ACC cat-NOM kick
Voice add-on	-	no	passive	$N_{\not CASE}N_{\not CASE}V_{psv}$	dog*cough* cat*cough* kick-psv
Voice add-on & case marking retention	canonical	yes (1st)	passive	$N_{NOM}N_{\not CASE}V_{psv}$	dog-NOM cat*yumyum* kick-psv
		yes (2nd)		$N_{\not CASE}N_{DAT}V_{psv}$	dog*cough* cat-DAT kick-psv
		yes		$N_{NOM}N_{DAT}V_{psv}$	dog-NOM cat-DAT kick-psv
Scrambled voice add-on & case marking retention	scrambled	yes (1st)	passive	$^{\dagger}N_{DAT}N_{\not CASE}V_{psv}$	dog-DAT cat*yumyum* kick-psv
		yes (2nd)		$^{\dagger}N_{\not CASE}N_{NOM}V_{psv}$	dog*cough* cat-NOM kick-psv
		yes		$^{\dagger}N_{DAT}N_{NOM}V_{psv}$	dog-DAT cat-NOM kick-psv

Table 5-7. Summary of patterns by condition (cont'd)

Condition	Word order	Case marking	Voice	Pattern	Example
One-argument baseline	-	no	active	$N_{\text{~~CASE~~}}V_{act}$	dog*yawn* kick
One-argument voice add-on			passive	$N_{\text{~~CASE~~}}V_{psv}$	dog*yawn* kick-psv
One-argument case marking retention		yes	active	$N_{NOM}V_{act}$	dog-NOM kick
				$N_{ACC}V_{act}$	dog-ACC kick
One-argument voice add-on & case marking retention			passive	$N_{NOM}V_{psv}$	dog-NOM kick-psv
				$N_{DAT}V_{psv}$	dog-DAT kick-psv

5.2.2. Recording, editing, and norming

All test sentences were recorded by a male native speaker of Korean. He did not know the intention of these sentences. Sentences without acoustic masking were recorded in a soundproof booth using the open-source software *Audacity* (version 2.1.3; available at https://www.audacityteam.org/). The sampling frequency was 44,100Hz. The whole canonical-scrambled pair was recorded again if the length of each sentence deviated more than 100 ms or if the pitch of one sentence was noticeably different from the other in the pair. The acoustic masking effects (yawning; coughing; chewing) were recorded separately from the sentences. After recording the sentences, I created all the rest of the test sentences with acoustic masking by using the same software. At every instance of recording, I used 100-ms intervals for individual eojeols within a sentence. Each sentence was played twice with an intervening 1000-ms interval. Figure 5-1 illustrates the structure of the final test sentence for the experiment.

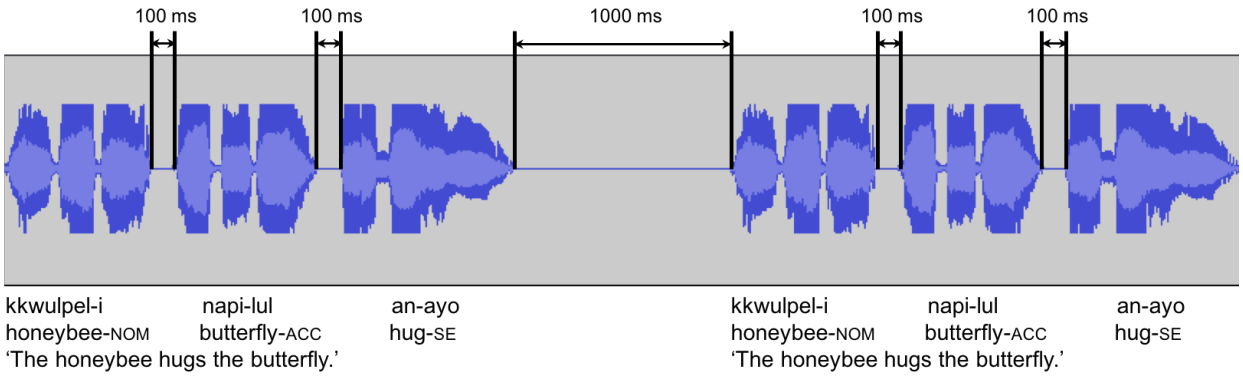


Figure 5-1. Structure of a recorded sentence ($N_{NOM}N_{ACC}V_{act}$)

Test sentences were normed in the following steps. The first norming was conducted to check the naturalness of these sentences (without acoustic masking). Ten native speakers of Korean rated the acceptability of these sentences, along with 24 ungrammatical ones, with a 4-point Likert scale through an online survey platform. Before the actual norming, I mentioned that all the nouns used in the sentences were animals since they would be used to create stories for children. Each sentence was presented individually on a screen in random order. I set the cut-off mean score as 3 out of 4 because their judgment of the sentences was made without any context. Results showed that no test sentence was rated to be below 3 (see Table B-4 in Appendix B for the mean score and the standard deviation).

The second norming was intended to check whether the test sentences could be used in combination with the corresponding pictures. Another 10 native speakers of Korean rated the acceptability of each sentence on the basis of the corresponding picture presented in the same screen with a 4-point Likert scale through the same online survey platform. They were also asked to leave comments on the reason for the judgment and any suggestion to improve the pictures. On top of the target sentence-picture pairs, I added 12 sentences which did not match the paired pictures and 24 ungrammatical sentences to afford the raters chances of 'safe rejection'. The cut-

off mean score was 3.4 out of 4. Results showed that no test sentence was rated below 3.4 (see Table B-5 in Appendix B for the mean score and the standard deviation) except for the one instance ('honeybee-NOM squirrel-ACC paint'; 3.3 out of 4). However, since the relatively low acceptance rate of this sentence was due to the fact that the colour information was not stated in the sentence (based on the comments made by the participants), I decided not to discard it.

The third norming was conducted to see how natural the recorded sentences were and whether the recorded sentences represented the intended meaning of the corresponding pictures with the sentences. A pair of a picture and the corresponding recorded sentence was presented in one PowerPoint slide. Three native speakers of Korean were asked to judge the naturalness of each recording and also to rate the acceptability of the recordings of each sentence based on the corresponding picture with a 4-point Likert scale. They were also asked to give a reason for the judgment if needed. Results showed that all the recordings were natural (see Table B-6 in Appendix B for the mean score and the standard deviation) and that they were appropriate for the intended meaning of the pictures. The relatively lower rate of inferability in the conditions with acoustic masking was expected, since information about case marking was obscured.

5.3. Procedure

5.3.1. Overall flow

Experimental sessions were composed of sessions which shared the same acoustic masking effects: no-masking, yawning, coughing, and chewing. To bypass any possible effect of the order of the session on participants' performance, I mixed the order of the session after they conducted the no-masking session as the first experimental session. Particularly for the children, I allowed a

minimum interval between conditions as three days: after finishing one session, they had to wait for at least three days before the next session.

I split all the test sentences into two sub-lists by session. Participants were given one of the lists in a session randomly, and subsequently received a different sub-list from what they did in the previous session.

5.3.2. Individual session

All experimental sessions were conducted via *Psychopy* (version 1.85.2; Peirce, 2007). In each session, every test sentence was accompanied by a pair of pictures involving the same action but reversed thematic roles, and a sentence corresponding to the target picture was presented aurally. Participants were asked to join the main character in learning Korean and helping him; the actual task was to listen to what the main character said and to choose the picture that matched the utterance by pressing big arrows posted on the keyboard.

A training stage with three practice items (subject-verb, object-verb, and verb-only sentences) was provided before the main experiment stage to familiarise participants with the procedure and the task environment. The main experiment proceeded only if they succeeded on all the three items. In every testing phase, two pictures were presented first, and the recorded sentence was played 3000 ms after the pictures were presented. Sets of test items and the corresponding pair of two pictures were presented in random order. In order to block responses which were careless or too quickly produced, the keyboard was activated right after a test sentence was presented twice.

I provided participants with positive feedback, regardless of whether their choices were correct or wrong. One session took approximately 10 minutes. After each session was complete,

children were given a sticker as an additional compensation for their participation (on top of the normal monetary compensation to their parents).

5.4. Analysis

Responses were coded as 0 (incorrect) or 1 (correct) for all patterns that permitted only one interpretation. However, the scoring for the patterns lacking case marking altogether ($N_{\not CASE}N_{\not CASE}V_{act}$, $N_{\not CASE}N_{\not CASE}V_{psv}$, $N_{\not CASE}V_{act}$, and $N_{\not CASE}V_{psv}$), which can in principle be interpreted in more than one way, was based on the high likelihood of agent-first interpretation (0: theme-first; 1: agent-first). The mean accuracy of response (and the mean proportion of agent-first response in $N_{\not CASE}N_{\not CASE}V_{act}$, $N_{\not CASE}N_{\not CASE}V_{psv}$, $N_{\not CASE}V_{act}$, and $N_{\not CASE}V_{psv}$) was compared statistically across the conditions within each group and across the groups within each condition.

To see how a mean score deviated from the chance level (50%), I employed binomial distribution (Skellam, 1948). This distribution, also known as the flip-coin distribution, comprises the probabilities associated with the number of outcomes in a binomial experiment where each trial involves only two mutually exclusive outcomes—a success and a failure (Howell, 2010). Independence of trials is the key assumption of this distribution, and this was achieved by randomising the sequence of individual test sentences as well as pseudo-randomising the order of sessions and sub-lists that participants received. Whether participants' performance was below- or above-chance level was calculated through an R code (6) where x, y, z stand for the number of correct observation, the entire number of trials, and probability (0.5 in this case), respectively.

(6) `dbinom(x, y, z)`

For the statistical comparison of mean scores across the conditions and across the groups, all the data were fitted to logistic mixed-effects models using the *lme4* package (Bates, Maechler, Bolker, & Walker, 2015) in R (R Core Team, 2019), with condition (for comparisons within the same group) or group (for comparisons within the same condition) as fixed effects (contrast-coded and centred) and with participant and sentence as random effects. The models included the maximal random effects structure with random intercepts and random slopes for all the effects (cf. Barr, Levy, Scheepers, & Tily, 2013).[3] This kind of modelling assumes independence of data, but it bypasses the issue of homoscedasticity and sphericity in general (e.g., Jaeger, 2008; Quené & Van den Bergh, 2008), which relaxes concerns about the assumptions for statistical analysis to a great extent. The key R codes for analyses are presented as follows.

(7a) Between-condition analysis

```
lmem_condition = glmer(response ~ conditionCtr + (1 | participant) + (1 |
sentence), data = data_between_condition_within_group, family = binomial())
```

(7a) Between-group analysis

```
lmem_group = glmer(response ~ groupCtr + (1 | participant) + (1 | sentence),
data = data_between_group_within_condition, family = binomial())
```

[3] To my knowledge, there is no clear consensus on how precisely researchers should report on statistical analysis when it comes to a mixed effects model. I decided to use basic information which is essential to interpret results as an in-text report (not as a separate table), considering brevity in description, the focus of statistical analysis (pair-wise comparisons), and the number of tables in the current manuscript. I tested the statistical model with various options, including and excluding parts of components involving random effects, and found that differences in the models yielded no change in statistical interpretation. I thus decided to keep the model informative but simple, by reducing the correlation in each random effect.

5.5. Prediction

RQ 1: What is the role of the Agent-First heuristic in guiding comprehension?

The agent-before-theme ordering was dominant in caregiver input (see the findings from corpus analysis in Chapter 4), and so it is expected that children's comprehension should be guided strongly by the Agent-First heuristic. Children should demonstrate a higher rate of agent-first response in the active transitive pattern with case marking obscured altogether ($N_{\not CASE}N_{\not CASE}V_{act}$). If children rely on this heuristic as a strong base for comprehension, they should retain a high rate of agent-first response in the corresponding passive pattern with case marking obscured altogether ($N_{\not CASE}N_{\not CASE}V_{psv}$) despite the existence of passive morphology. If this heuristic operates independently of the other factors, children should exhibit the agent-first interpretation reliably for the one argument patterns with case marking obscured ($N_{\not CASE}V_{act}$; $N_{\not CASE}V_{psv}$).

RQ 2: What is the role of the NOM-as-Agent and the ACC-as-Theme heuristics in guiding comprehension?

The associations between the individual markers (NOM; ACC) and their corresponding functions (indication of the agent and the theme, respectively) were reliable in caregiver input (see the ΔP scores involving case marking in Chapter 4). I thus predict that case-marking-related knowledge should be employed reliably for comprehension, such that it leads children to consistently interpret the argument marked by the NOM as the agent and the one marked by the ACC as the theme. Moreover, children's comprehension should not be influenced by whether case-marked arguments are attested initially or non-initially.[4] If this hypothesis is correct,

[4] Previous reports on children's comprehension of the active transitive attributed their performance largely to whether word order and case marking provide coherent or conflicting information about thematic role ordering. Since I am not aware of any study on how case-marking-related knowledge (formalised as the two heuristics) is manifested contingent upon where the relevant arguments occur, I assess this null hypothesis first.

children should demonstrate similar rates of success in either the canonical or the scrambled active transitive patterns, as well as the one-argument patterns with case marking. I also anticipate that, based on the strong association between the NOM and the agent, the NOM-as-Agent heuristic should significantly affect comprehension of the passive, reducing rates of success in the suffixal passive patterns with the NOM present (since a comprehender has to recalibrate what the NOM indicates, together with passive morphology).

RQ 3: What is the role of the Theme-First and the DAT-as-Agent heuristics in guiding comprehension?

The degree to which voice heuristics are employed in comprehension should be proportionate to age, due to the extreme rarity of the occurrence of the passive in caregiver input (considering the dominance in use of the active) and the intricacies involving passive morphology. In other words, voice-related knowledge should be indecisive and/or detrimental for 3-4-year-olds' comprehension but influential for 5-6-year-olds' comprehension. The impact of these heuristics on comprehension should be observable only for children aged five to six, with better rates of success in these patterns than 3-4-year-olds' performance.

RQ 4: Is one of these heuristics stronger than the others in guiding comprehension?

Of the three types of heuristics, I predict that the voice-related heuristics should have the least impact on comprehension in general. Particularly for the 5-6-year-olds, the voice heuristics should be less influential than word order and case marking heuristics. This is because voice-related knowledge emerges later in development (as claimed in previous research; Section 3.2.3.2), which is attributed to the rarity of the passive voice in the input and a child processor's

limited ability to revise an initial initial interpretive commitment, together with intricacies involving passive morphology. This should lead to success in the scrambled suffixal passive pattern with the DAT obscured ($^{\dagger}N_{\not CASE}N_{NOM}V_{psv}$) where the Theme-First heuristic competes with the Agent-First heuristic. It should also lead to improved accuracy rates in the canonical suffixal passive pattern with the NOM obscured ($N_{\not CASE}N_{DAT}V_{psv}$) in comparison to the same patterns with the NOM present ($N_{NOM}N_{\not CASE}V_{psv}$ and $N_{NOM}N_{DAT}V_{psv}$).

Regarding the heuristics relating to word order (Agent-First) and case marking (NOM-as-Agent; ACC-as-Theme), I predict that children should reliably employ the case marking heuristics prior to the word order heuristic due to their local application to a single argument (thus computationally easier than word order facts; cf. Wittek & Tomasello, 2005). This characteristic should guide the children to perform better on the one-argument active patterns when case marking is attested than when it is obscured. This should also lead children to demonstrate a higher level of agent-first interpretation in $N_{NOM}V_{act}$ than in $N_{\not CASE}N_{\not CASE}V_{act}$ in comparison to $N_{\not CASE}V_{act}$.

The next three chapters provide the results of the experiment conducted to investigate children's comprehension of active transitives and suffixal passives.

CHAPTER VI

KOREAN-SPEAKING CHILDREN'S COMPREHENSION OF CASE-LESS PATTERNS

This chapter offers the results of the four case-less patterns ($N_{\not CASE}N_{\not CASE}V_{act}$; $N_{\not CASE}V_{act}$; $N_{\not CASE}N_{\not CASE}V_{psv}$; $N_{\not CASE}V_{psv}$). These patterns have no case marker to indicate the precise thematic role of an argument, which allows us to assess three aspects of comprehension by age:

1) the role of word-order-related knowledge (the Agent-First heuristic)
2) the role of voice-related knowledge (the Theme-First heuristic in this case)
3) the interplay/competition between the two types of knowledge

For the same reason (i.e., the absence of case marking), the participants' choice between two pictures (sharing the same transitive event) in these patterns does not indicate whether they select the correct picture for a particular stimulus (i.e., accuracy of response), but does indicate their interpretation of thematic role ordering of the stimulus (i.e., rate of agent-first or theme-first response). For the consistency of statistical comparisons and discussion in this chapter, I report the mean rates of *agent-first* response in each pattern.

6.1. Active patterns

The active transitive pattern with case marking obscured altogether ($N_{\not CASE}N_{\not CASE}V_{act}$) can in principle be interpreted as either the canonical pattern (agent-theme) or the scrambled pattern (theme-agent). If the Agent-First heuristic affects the participants' comprehension of this pattern strongly, their choice after listening to a stimulus should be a picture in which the agent in the

picture corresponds to the first noun in the stimulus. As Table 6-1 illustrates, the expected choice is thus the picture on the right, with the dog (the first argument in the stimulus) as the agent.

Table 6-1. Example of picture selection: $N_{\text{CASE}}N_{\text{CASE}}V_{act}$

Picture		
Stimulus	kangaci*cough* koyangi*cough* cha-yo dog*cough* cat*cough* kick-SE 'The dog kicks the cat.' or 'The cat kicks the dog.'	
Expected selection (if the Agent-First heuristic applies)		⇑

Table 6-2 presents the rates of the participants' agent-first response in $N_{\text{CASE}}N_{\text{CASE}}V_{act}$ (the baseline condition; see Section 5.2.1.1 for the condition types) by age group.

Table 6-2. Agent-first response by group: Baseline condition

Condition	Case marking	Pattern (example)	Mean % (SD)		
			3-4-year-old	5-6-year-old	Adult[1]
Baseline	No	$N_{\text{CASE}}N_{\text{CASE}}V_{act}$ (dog*cough* cat*cough* kick)	66.67 (0.48)	77.27 (0.42)	90.00 (0.30)

[1] I additionally present the performance for the adult participants as a reference point for the children's performance, but comparing the adults' performance to the children's is not the focal issue in this dissertation. I rather focus on the children's performance itself, by conducting between-group and between-condition comparisons. The adults' performance will be mentioned if needed.

The children in both age groups showed an above-chance preference for the agent-first interpretation. A between-group comparison (66.67% for the 3-4-year-olds vs. 77.27% for the 5-6-year-olds) showed no statistical significance. Overall, their response rates indicate that the Agent-First heuristic guided the children's comprehension of this pattern.

In the case of the one-argument active pattern with case marking obscured ($N_{\text{CASE}}V_{act}$), the first and the sole argument can in principle be interpreted as either the agent or the theme. If the Agent-First heuristic affects the participants' comprehension of this pattern automatically, their choice after listening to a stimulus should be a picture in which the agent corresponds to the only nominal in the stimulus. As Table 6-3 illustrates, the expected choice is thus the picture on the right, with the dog (corresponding to the only argument in the stimulus) as the agent.

Table 6-3. Example of picture selection: $N_{\text{CASE}}V_{act}$

Picture		
Stimulus	kangaci*yawn* cha-yo dog*yawn* kick-SE 'The dog kicks (the cat).' or '(The cat) kicks the dog.'	
Expected selection (if the Agent-First heuristic applies)		⇑

Table 6-4 presents the rates of the participants' agent-first response in $N_{\text{CASE}}V_{act}$ (the one-argument, baseline condition; see Section 5.2.1.1 for the condition types) by age group.

Table 6-4. Agent-first response by group: One-argument, baseline condition

Condition	Case marking	Pattern (example)	Mean % (SD)		
			3-4-year-old	5-6-year-old	Adult
One-argument, baseline	no	$N_{\not CASE}V_{act}$ (dog*yawn* kick)	42.59 (0.50)	60.42 (0.49)	66.67 (0.48)

The 3-4-year-olds were at-chance in this pattern, showing no preference for the interpretation of the nominal's thematic role. In contrast, the 5-6-year-olds were above-chance in this pattern (although weak), showing a slight preference for the agent-first interpretation. No statistical difference was found, however, in the rates of agent-first response between the 3-4-year-olds and the 5-6-year-olds. Interestingly, the rate of agent-first response in this pattern for the adult controls was 67 per cent at most, with no statistical difference in comparison to the 5-6-year-olds' rate of response. A comparison of the children's performance in this pattern with that in $N_{\not CASE}N_{\not CASE}V_{act}$ showed a significant drop in the agent-first response rate only for the 3-4-year-olds, $\beta = -0.992$, $SE = 0.379$, $p = .009$.

In sum, the children in both age groups failed to employ the Agent-First heuristic strongly for the comprehension of the pattern with only one case-less noun, even though the pattern is intended to describe a transitive event with two participants present in the pictures.

6.2. Passive patterns

The suffixal passive pattern with case marking obscured altogether ($N_{\not CASE}N_{\not CASE}V_{psv}$) can be interpreted as either the canonical pattern (theme-agent) or the scrambled pattern (agent-theme). If the Agent-First heuristic strongly affects the participants' comprehension of this pattern, their choice after listening to a stimulus should be a picture in which the agent corresponds to the first argument in the stimulus. Alternatively, if the Theme-First heuristic (together with passive

morphology; see Section 3.2.3.2 for the explanation about how each heuristic operates in comprehension) strongly affects their comprehension of this pattern, their choice should be a picture in which the theme corresponds to the first argument in the stimulus. Table 6-5 illustrates the expected selection that depends on the types of heuristics involving this pattern.

Table 6-5. Example of picture selection: $N_{\cancel{CASE}}N_{\cancel{CASE}}V_{psv}$

Picture		
Stimulus	kangaci*cough* koyangi*cough* cha-i-eyo dog*cough* cat*cough* kick-PSV-SE 'The dog is kicked by the cat.' or 'The cat is kicked by the dog.'	
Expected selection (if the Agent-First heuristic applies)		⇑
Expected selection (if the Theme-First heuristic applies)	⇑	

Table 6-6 presents the rates of the participants' agent-first response in $N_{\cancel{CASE}}N_{\cancel{CASE}}V_{psv}$ (the voice add-on condition; see Section 5.2.1.1 for the condition types) by age group.

Table 6-6. Agent-first response by group: Voice add-on condition

Condition	Case marking	Pattern (example)	Mean % (SD)		
			3-4-year-old	5-6-year-old	Adult
Voice add-on	No	$N_{\cancel{CASE}}N_{\cancel{CASE}}V_{psv}$ (dog*cough* cat*cough* kick-psv)	54.55 (0.50)	42.42 (0.50)	15.00 (0.36)

The 3-4-year-olds were at-chance in this condition. Compared to their performance in the active transitive pattern without case marking ($N_{\not CASE}N_{\not CASE}V_{act}$; 67%), the rate of agent-first response in $N_{\not CASE}N_{\not CASE}V_{psv}$ decreased to the at-chance level. However, the difference in performance between the two patterns was not statistically significant. In contrast to the 3-4-year-olds' performance, the 5-6-year-olds were weakly below-chance in $N_{\not CASE}N_{\not CASE}V_{psv}$ ($p = .046$), showing a slight preference for the theme-first interpretation. A comparison of their performance in this pattern to the corresponding active transitive pattern ($N_{\not CASE}N_{\not CASE}V_{act}$; 77%) yielded statistical significance, $\beta = -1.536$, $SE = 0.401$, $p < .001$.

In sum, the children in both age groups showed reduced rates of agent-first response in $N_{\not CASE}N_{\not CASE}V_{psv}$ compared to its active transitive version ($N_{\not CASE}N_{\not CASE}V_{act}$), but the difference was significant only for the 5-6-year-olds.

In the case of the one-argument passive pattern with case marking obscured ($N_{\not CASE}V_{act}$), the first and the sole argument can be interpreted as either the agent or the theme. If the Agent-First heuristic automatically affects the participants' comprehension of this pattern, their choice after listening to a stimulus should be a picture in which the agent corresponds to the only nominal in the stimulus. In contrast, if the Theme-First heuristic (together with passive morphology) affects their comprehension of this pattern strongly, their choice should be a picture in which the theme corresponds to the only nominal in the stimulus. Table 6-7 illustrates the expected selection that depends on the types of heuristics involving this pattern.

Table 6-7. Example of picture selection: $N_{\not CASE}V_{psv}$

Picture		
Stimulus	kangaci*yawn* cha-i-eyo dog*cough* kick-PSV-SE 'The dog is kicked (by the cat).' or '(The cat) is kicked by the dog.'	
Expected selection (if the Agent-First heuristic applies)		⇑
Expected selection (if the Theme-First heuristic applies)	⇑	

Table 6-8 shows the rates of the participants' agent-first response in $N_{\not CASE}V_{psv}$ (the one-argument, voice add-on condition; see Section 5.2.1.1 for the condition types) by age group.

Table 6-8. Agent-first response by group: One-argument, voice add-on condition

Condition	Case marking	Pattern (example)	Mean % (SD)		
			3-4-year-old	5-6-year-old	Adult
One-argument, voice add-on	No	$N_{\not CASE}V_{psv}$ (dog*yawn* kick-psv)	59.26 (0.50)	33.33 (0.48)	10.00 (0.30)

The 3-4-year-olds were weakly above-chance in $N_{\not CASE}V_{psv}$ (p = .043), showing a slight preference for the agent-first interpretation. However, there was no statistical significance in performance between this pattern and its corresponding active pattern ($N_{\not CASE}V_{act}$; 43%). The 5-6-year-olds were below-chance in $N_{\not CASE}V_{psv}$, showing a strong preference for the theme-first interpretation. This rate of response differed statistically from the performance on the

corresponding active pattern ($N_{\not CASE}V_{act}$; 60%), $\beta = -1.412$, $SE = 0.500$, $p = .005$, and from the 3-4-year-olds' response rate in $N_{\not CASE}V_{psv}$, $\beta = -1.068$, $SE = 0.413$, $p = .010$.

In sum, the two age groups performed differently in this condition, with the 5-6-year-olds more likely to demonstrate the theme-first interpretation (namely, the canonical thematic role ordering of the passive) than the 3-4-year-olds did.

6.3. Summary of findings

The four case-less patterns were designed to assess the role of word-order-related knowledge (the Agent-First heuristic) and voice-related knowledge (the Theme-First heuristic), and the interaction of these two types of knowledge for children's comprehension involving a transitive event. Their performance in the two active patterns ($N_{\not CASE}N_{\not CASE}V_{act}$; $N_{\not CASE}V_{act}$) revealed that both groups of children employed the Agent-First heuristic as a base for comprehension. To our surprise, however, this heuristic did not seem to function independently of other grammatical cues such as the presence of another argument. As for the passive patterns ($N_{\not CASE}N_{\not CASE}V_{psv}$; $N_{\not CASE}V_{psv}$), an age effect was found: amongst the two age groups, only the 5-6-year-olds employed the Theme-First heuristic (particularly in $N_{\not CASE}V_{psv}$).

CHAPTER VII

KOREAN-SPEAKING CHILDREN'S COMPREHENSION OF ACTIVE TRANSITIVES

This chapter provides the results of the experiment conducted to investigate children's comprehension of active transitives with varying degrees of omission of argument and case marking. These patterns involve two particular grammatical cues: the number of arguments, and case marking. This characteristic provides a testbed for investigating an interplay between word-order-related knowledge (the Agent-First heuristic) and case-marking-related knowledge (the NOM-as-Agent and the ACC-as-Theme heuristics) by age. Because at least one case marker is present in these patterns for the indication of a thematic role of an argument, all scores in this chapter indicate mean rates of accuracy.

7.1. Canonical patterns

Table 7-1 presents the participants' performance on the case marking retention condition[1] (see Section 5.2.1.1 for the condition types) by age group. The children in both age groups were above-chance in their adoption of the agent-first interpretation. In particular, their performance in the active transitive pattern with all case marking present ($N_{NOM}N_{ACC}V_{act}$) increased significantly in comparison to the corresponding pattern with case marking obscured altogether ($N_{CASE}N_{CASE}V_{act}$; 67% for the 3-4-year-olds; 77% for the 5-6-year-olds): $\beta = 0.999$, $SE = 0.391$, $p = .011$ for the 3-4-year-olds; $\beta = 1.680$, $SE = 0.744$, $p = .024$ for the 5-6-year-olds. However,

[1] Statistical comparisons between the baseline condition ($N_{CASE}N_{CASE}V_{act}$; indicating the mean rate of agent-first response; see Chapter 6) and this condition (indicating the mean rate of accuracy) were based on the assumption that all the patterns follow the agent-before-theme ordering and thus corresponded to the agent-first interpretation. Nevertheless, caution is required in direct comparisons across these conditions as the nature of the scores in the two conditions was not exactly the same.

each age group demonstrated a difference in their interpretive preferences in the partial case marking patterns. Whereas the 3-4-year-olds showed no statistical difference in their response in these patterns compared to $N_{\not CASE}N_{\not CASE}V_{act}$, the 5-6-year-olds showed a statistical difference only between $N_{\not CASE}N_{\not CASE}V_{act}$ (77%) and $N_{NOM}N_{\not CASE}V_{act}$, $\beta = 2.422$, $SE = 0.915$, $p = .008$.

Table 7-1. Correct response by group: Case marking retention conditions

Condition	Case marking	Pattern (example)	Mean % (SD)		
			3-4-year-old	5-6-year-old	Adult
Case marking retention	Yes (1st only)	$N_{NOM}N_{\not CASE}V_{act}$ (dog-NOM cat*yumyum* kick)	78.79 (0.41)	96.97 (0.17)	98.33 (0.13)
	Yes (2nd only)	$N_{\not CASE}N_{ACC}V_{act}$ (dog*cough* cat-ACC kick)	78.67 (0.41)	84.06 (0.37)	98.33 (0.13)
	Yes	$N_{NOM}N_{ACC}V_{act}$ (dog-NOM cat-ACC kick)	84.44 (0.36)	94.20 (0.24)	100.00 (0.00)

In sum, the retention of case marking enhanced the children's agent-first interpretation, but the extent of the effect differed between the two age groups.

7.2. Scrambled patterns

Table 7-2 shows the participants' accuracy rates in the scrambled case marking retention condition (see Section 5.2.1.1 for the condition types) by age group. The 3-4-year-olds were at-chance in the scrambled pattern with only the ACC present ($^{\dagger}N_{ACC}N_{\not CASE}V_{act}$) but above-chance in the other two scrambled patterns with the NOM present ($^{\dagger}N_{\not CASE}N_{NOM}V_{act}$ and $^{\dagger}N_{ACC}N_{NOM}V_{act}$). The difference in accuracy was significant only in between $^{\dagger}N_{ACC}N_{\not CASE}V_{act}$ and $^{\dagger}N_{ACC}N_{NOM}V_{act}$, $\beta = 1.174$, $SE = 0.432$, $p = .007$. The 5-6-year-olds demonstrated a similar tendency in general: they were at-chance in $^{\dagger}N_{ACC}N_{\not CASE}V_{act}$ but above-chance in the other two patterns with the NOM present. Across the three patterns, no statistical difference was found in

accuracy in the maximal random effects models, but F2 analyses (only with item as a random effect) showed marginal significance between $^{\dagger}N_{ACC}N_{\not CASE}V_{act}$ and the other two scrambled patterns, $\beta = 0.653$, $SE = 0.363$, $p = .072$.

Table 7-2. Correct response by group: Scrambled case marking retention conditions

Condition	Case marking	Pattern (example)	Mean % (SD)		
			3-4-year-old	5-6-year-old	Adult
Scrambled case marking retention	Yes (1st only)	$^{\dagger}N_{ACC}N_{\not CASE}V_{act}$ (dog-ACC cat*yumyum* kick)	54.55 (0.50)	56.06 (0.50)	93.33 (0.25)
	Yes (2nd only)	$^{\dagger}N_{\not CASE}N_{NOM}V_{act}$ (dog*cough* cat-NOM kick)	68.00 (0.47)	71.01 (0.46)	98.33 (0.13)
	Yes	$^{\dagger}N_{ACC}N_{NOM}V_{act}$ (dog-ACC cat-NOM kick)	77.78 (0.42)	71.01 (0.46)	100.00 (0.00)

In order to see if the position of case-marked arguments occur influences comprehension of active transitives, additional comparisons were conducted between the canonical/scrambled patterns with only one case marker present ($N_{NOM}N_{\not CASE}V_{act}$ vs. $^{\dagger}N_{\not CASE}N_{NOM}V_{act}$; $N_{\not CASE}N_{ACC}V_{act}$ vs. $^{\dagger}N_{ACC}N_{\not CASE}V_{act}$). For the 3-4-year-olds, no statistical difference was found in the patterns with only the NOM present (79% in $N_{NOM}N_{\not CASE}V_{act}$; 68% in $^{\dagger}N_{\not CASE}N_{NOM}V_{act}$), but they performed differently in the patterns with only the ACC present (79% in $N_{\not CASE}N_{ACC}V_{act}$; 55% in $^{\dagger}N_{ACC}N_{\not CASE}V_{act}$): $\beta = –1.155$, $SE = 0.408$, $p = .005$. In contrast, the 5-6-year-olds showed statistical difference in both comparisons: 97% in $N_{NOM}N_{\not CASE}V_{act}$ and 71% in $^{\dagger}N_{\not CASE}N_{NOM}V_{act}$ ($\beta = –3.201$, $SE = 1.104$, $p = .004$); 84% in $N_{\not CASE}N_{ACC}V_{act}$ and 56% in $^{\dagger}N_{ACC}N_{\not CASE}V_{act}$ ($\beta = –2.435$, $SE = 0.975$, $p = .012$).

To sum up, the children in both age groups showed higher rates of success in patterns involving the NOM than in those with only the ACC present. Moreover, the degree to which the

children manifested a sensitivity to the two types of case marking was contingent upon age and the relative position of the case-marked argument in a sentence.

7.3. One-argument patterns

Table 7-3 presents the participants' performance in the one-argument case marking retention conditions (see Section 5.2.1.1 for the condition types) by age group.

Table 7-3. Correct response by group: One-argument case marking retention conditions

Condition	Case marking	Pattern (example)	Mean % (SD)		
			3-4-year-old	5-6-year-old	Adult
One-argument case marking retention	Yes	$N_{NOM}V_{act}$ (dog-NOM kick)	94.44 (0.23)	97.10 (0.17)	93.33 (0.25)
		$N_{ACC}V_{act}$ (dog-ACC kick)	92.22 (0.27)	97.10 (0.17)	100.00 (0.00)

Note that, in the one-argument pattern with case marking obscured ($N_{CASE}V_{act}$; see Section 6.2), the 3-4-year-olds were at-chance (43%), showing their interpretation of the sole case-less argument towards neither the agent nor the theme, and 5-6-year-olds were slightly above-chance (60%), showing a weak preference for the agent-first interpretation. When the case marking information became available ($N_{NOM}V_{act}$ and $N_{ACC}V_{act}$), both age groups demonstrated at-ceiling performance. That is, the rates of accuracy improved with the assistance of case marking.

Regarding the preference for the agent-first interpretation, the children in both age groups showed significant increase in $N_{NOM}V_{act}$ in comparison to $N_{CASE}V_{act}$: $\beta = 3.132$, $SE = 0.536$, $p < .001$ for the 3-4-year-olds, and $\beta = 3.273$, $SE = 0.884$, $p < .001$ for the 5-6-year-olds. The same kind of significant enhancement was also found in between $N_{NOM}V_{act}$ and $N_{CASE}N_{CASE}V_{act}$: $\beta =$

2.176, $SE = 0.569$, $p < .001$ for the 3-4-year-olds, and $\beta = 2.331$, $SE = 0.838$, $p < .001$ for the 5-6-year-olds.

7.4. Summary of results

Results from the active transitive patterns shed light on how the two groups of children (3-4-year-olds; 5-6-year-olds) deployed word-order-related and case-marking-related knowledge. The children's employment of the Agent-First heuristic was enhanced by case marking in the two-argument canonical patterns. All the children had a good command of case marking (the NOM-as-Agent and the ACC-as-Theme heuristics), as seen in the one-argument patterns.

In the comprehension of the two-argument patterns, the degree to which the children relied on each heuristic seemed to be affected by age and the position of the case-marked arguments in a sentence. By and large, both case marking heuristics contributed to comprehension more when the corresponding arguments appear in typical positions (i.e., initial NOM; non-initial ACC) than in atypical positions (i.e., non-initial NOM; initial ACC). In addition, the NOM-as-Agent heuristic exhibited this typicality effect later than the ACC-as-Theme heuristic: both child groups performed in a significantly different way in the patterns involving only the ACC present ($N_{\not{CASE}}N_{ACC}V_{act}$ vs. $^{\dagger}N_{ACC}N_{\not{CASE}}V_{act}$) whereas the 5-6-year-olds additionally showed a significant difference in the patterns involving only the NOM present ($N_{NOM}N_{\not{CASE}}V_{act}$ vs. $^{\dagger}N_{\not{CASE}}N_{NOM}V_{act}$).

CHAPTER VIII

KOREAN-SPEAKING CHILDREN'S COMPREHENSION OF SUFFIXAL PASSIVES

This chapter provides the results of the experiment conducted to investigate children's comprehension of suffixal passives with varying degrees of omission of argument and case marking. These patterns involve all three grammatical factors under investigation in this dissertation (i.e., word order, case marking, and voice (by way of passive morphology)), which makes it possible to investigate the interplay between word-order-related knowledge (the Agent-First heuristic), case-marking-related knowledge (the NOM-as-Agent and the ACC-as-Theme heuristics), and voice-related knowledge (the Theme-First and the DAT-as-Agent heuristics) by age. At least one case marker is present in these patterns to indicate the thematic role of an argument, so all scores in this chapter indicate mean rates of accuracy.

8.1. Canonical patterns

Table 8-1 presents the participants' performance on the voice add-on and case marking retention conditions (see Section 5.2.1.1 for the condition types) by age group.

Table 8-1. Correct response by group: Voice add-on & case marking retention conditions

Condition	Case marking	Pattern (example)	Mean % (SD)		
			3-4-year-old	5-6-year-old	Adult
Voice add-on & case marking retention	Yes (1st only)	$N_{NOM}N_{\cancel{CASE}}V_{psv}$ (dog-NOM cat*yumyum* kick-psv)	53.03 (0.50)	53.03 (0.50)	93.33 (0.25)
	Yes (2nd only)	$N_{\cancel{CASE}}N_{DAT}V_{psv}$ (dog*cough* cat-DAT kick-psv)	50.67 (0.50)	73.91 (0.44)	96.67 (0.18)
	Yes	$N_{NOM}N_{DAT}V_{psv}$ (dog-NOM cat-DAT kick-psv)	44.44 (0.50)	47.83 (0.50)	100.00 (0.00)

The 3-4-year-olds were uniformly at-chance in every pattern of this condition. In contrast, whereas the 5-6-year-olds were at-chance in the patterns with the NOM present ($N_{NOM}N_{\text{~~CASE~~}}V_{psv}$; $N_{NOM}N_{DAT}V_{psv}$), they achieved an above-chance level of accuracy in the pattern with the NOM obscured ($N_{\text{~~CASE~~}}N_{DAT}V_{psv}$). The statistical comparison of accuracy between $N_{\text{~~CASE~~}}N_{DAT}V_{psv}$ and the rest of the patterns showed significance: $\beta = 1.115$, $SE = 0.522$, $p = .033$ (F1 analysis) in comparison to $N_{NOM}N_{\text{~~CASE~~}}V_{psv}$; $\beta = 1.287$, $SE = 0.537$, $p = .016$ in comparison to $N_{NOM}N_{DAT}V_{psv}$.

To sum up, both age groups were at-chance in the canonical suffixal passive patterns involving (partial) case marking, except that the 5-6-year-olds manifested an improved rate of accuracy in the pattern where the NOM was obscured.

8.2. Scrambled patterns

Table 8-2 shows the participants' accuracy rates in the scrambled voice add-on and case marking retention conditions (see Section 5.2.1.1 for the condition types) by age group.

Table 8-2. Correct response by group: Scrambled voice add-on & case marking retention conditions

Condition	Case marking	Pattern (example)	Mean % (SD)		
			3-4-year-old	5-6-year-old	Adult
Scrambled voice add-on & case marking retention	Yes (1st only)	†$N_{DAT}N_{\text{~~CASE~~}}V_{psv}$ (dog-DAT cat*yumyum* kick-psv)	56.06 (0.50)	78.79 (0.41)	98.33 (0.13)
	Yes (2nd only)	†$N_{\text{~~CASE~~}}N_{NOM}V_{psv}$ (dog*cough* cat-NOM kick-psv)	46.67 (0.50)	71.01 (0.46)	95.00 (0.22)
	Yes	†$N_{DAT}N_{NOM}V_{psv}$ (dog-DAT cat-NOM kick-psv)	51.11 (0.50)	76.81 (0.43)	100.00 (0.00)

Similar to the case of the canonical suffixal passive, the 3-4-year-olds performed at-chance in all the patterns in this condition. In contrast, the 5-6-year-olds were above-chance in all the patterns. They also showed a significant improvement in accuracy in $^{\dagger}N_{DAT}N_{NOM}V_{psv}$ compared to $N_{NOM}N_{DAT}V_{psv}$ (48%), $\beta = -1.288$, $SE = 0.381$, $p < .001$.

8.3. One-argument patterns

Table 8-3 presents the participants' performance in the one-argument voice add-on and case marking retention conditions (see Section 5.2.1.1 for the condition types) by age group:

Table 8-3. Correct response by group: One-argument voice add-on and case marking retention condition

Condition	Case marking	Pattern (example)	Mean % (SD)		
			3-4-year-old	5-6-year-old	Adult
One-argument voice add-on & case marking retention	Yes	$N_{NOM}V_{psv}$ (dog-NOM kick-psv)	52.22 (0.50)	71.01 (0.46)	96.67 (0.18)
		$N_{DAT}V_{psv}$ (dog-DAT kick-psv)	53.33 (0.50)	84.06 (0.37)	95.00 (0.22)

In the one-argument pattern with case marking obscured ($N_{CASE}V_{psv}$; see Section 6.4), the 3-4-year-olds were slightly above-chance (59%), showing a weak preference for the agent-first interpretation. In contrast, 5-6-year-olds were below-chance (33%) in this pattern, showing a strong preference for the theme-first interpretation. When the case marking information became available ($N_{NOM}V_{psv}$ and $N_{DAT}V_{psv}$), as in the patterns in Table 8-3, the 3-4-year-olds demonstrated uniformly at-chance performance, which was similar to their performance in the other passive patterns. However, the 5-6-year-olds were above-chance in these two patterns,

showing a statistical difference from the 3-4-year-olds' rates of accuracy: $\beta = 0.949$, $SE = 0.385$, $p = .014$ in $N_{NOM}V_{psv}$; $\beta = 1.563$, $SE = 0.400$, $p < .001$ in $N_{DAT}V_{psv}$.

In sum, the two age groups performed differently in this condition, with the 5-6-year-olds demonstrating an interpretation closer to the intended passive than the 3-4-year-olds did.

8.4. Summary of results

The performance of the 3-4-year-olds made it difficult to determine whether they employed voice-related knowledge (Theme-First; DAT-as-Agent) when comprehending the suffixal passive patterns. In contrast, results from the 5-6-year-olds' performance confirm the role of voice-related knowledge, clearly supported by success in $N_{NOM}V_{psv}$ and $N_{DAT}V_{psv}$, along with $N_{CASE}V_{psv}$. The findings suggest that voice-related knowledge works reliably in comprehension from around five or six years after birth.

However, the two voice-related heuristics are rather weak, thus less influential, in competition with the heuristics based on word order and case marking in the 5-6-year-olds' comprehension. The children performed an above-chance rate of success in patterns with agent-before-theme ordering (i.e., the scrambled suffixal passive), regardless of whether an additional clue (the DAT attached to the initial noun) was present. This suggests a larger contribution of the Agent-First heuristic to comprehension than the DAT-as-Agent heuristic. The 5-6-year-olds were at-chance in the canonical suffixal passive, but their accuracy improved significantly in the canonical pattern where the NOM was obscured. This contrast points to the powerful role of the NOM-as-Agent heuristic in comprehension, suppressing voice-related knowledge, particularly when the nominative-marked argument occurs initially in a sentence.

CHAPTER IX

CONNECTING CAREGIVER INPUT TO SENTENCE COMPREHENSION FOR PRESCHOOL CHILDREN: DEVELOPMENT OF FIRST LANGUAGE IN KOREAN

This chapter provides interpretations of the findings of the picture selection experiment (see Chapters 6 to 8), in accordance with the four research questions regarding the three grammatical factors and their corresponding heuristics (see Chapter 5). It also discusses how the development of children's comprehension ability is explained by properties of caregiver input (see Chapter 4) within the framework and background that I laid out in Chapters 2 and 3.

9.1. Interpretations of the findings of picture selection

The research questions in Chapter 5 are re-stated as follows:

1. What is the role of the Agent-First heuristic in guiding comprehension? (→ Section 9.1.1)
2. What is the role of the NOM-as-Agent and the ACC-as-Theme heuristics in guiding comprehension? (→ Section 9.1.2)
3. What is the role of the Theme-First and the DAT-as-Agent heuristics in guiding comprehension? (→ Section 9.1.3)
4. Is one of these heuristics stronger than the others in guiding comprehension? (→ Section 9.1.4)

9.1.1. Word order: The Agent-First heuristic

I predicted that children's comprehension should be guided strongly by the Agent-First heuristic. Three specific predictions were made with respect to this word-order-related knowledge.

1. Children should demonstrate a higher rate of agent-first response in the active transitive pattern with case marking obscured altogether ($N_{\not CASE}N_{\not CASE}V_{act}$).
2. If children rely on this heuristic as a strong base for comprehension, they should retain a high rate of agent-first response in the corresponding passive pattern with case marking obscured altogether ($N_{\not CASE}N_{\not CASE}V_{psv}$) despite the existence of passive morphology.
3. If this heuristic operates independently of the other factors, children should exhibit the agent-first interpretation reliably for the one argument patterns with case marking obscured ($N_{\not CASE}V_{act}$; $N_{\not CASE}V_{psv}$).

These predictions were tested in Chapter 6 by way of children's mean rates of agent-first response in the four case-less patterns.

The predictions were partially borne out. Both child groups demonstrated above-chance rates of agent-first response in $N_{\not CASE}N_{\not CASE}V_{act}$ (67% for the 3-4-year-olds; 77% for the 5-6-year-olds). This fits well the prediction that children can employ the Agent-First heuristic for comprehension. However, their agent-first response rates in $N_{\not CASE}V_{act}$ dropped significantly, yielding at-chance performance (43%) for the 3-4-year-olds and a slight preference for the agent-first interpretation for the 5-6-year-olds (60%). This finding is surprising in that the first (and the only) argument was *not* reliably interpreted as the agent. This is inconsistent with the predicted

outcome, and challenges previous reports of the agent-first heuristic as an intrinsic bias that leads children to favour associating the agent role with the first argument.

Instead, the findings from the two active patterns ($N_{CASE}N_{CASE}V_{act}$; $N_{CASE}V_{act}$) lead to an idea that the Agent-First heuristic requires other grammatical cues for consistent activation in children's (particularly 3-4-year-olds') comprehension, at least in Korean. If the Agent-First heuristic had applied to their comprehension independently across the board, the children should have demonstrated a strong above-chance rate of agent-first response in $N_{CASE}V_{act}$, which was not the case. This lends support to the idea that Korean-speaking children (3-4-year-olds in particular) need additional cues before activating the Agent-First heuristic. The presence of another argument is evidently one good cue in this respect, given the above-chance rate of agent-first response in $N_{CASE}N_{CASE}V_{act}$ for both age groups. Case marking is also a good cue for this task. To preview, the children reached at-ceiling performance in $N_{NOM}V_{act}$, the pattern where the sole argument is indicated by the NOM (associated strongly with the agent). Thus, when Korean-speaking children interpret a transitive event, they do not employ the Agent-First heuristic automatically and immediately based solely on an argument's initial position in the sentence. Rather, in order for this heuristic to be activated, other grammatical cues are required as the processor moves forward, such as the presence of second argument and/or case marking.

The children's performance involving the two passive patterns ($N_{CASE}N_{CASE}V_{psv}$; $N_{CASE}V_{psv}$), which will be addressed in detail in Section 9.1.3, also does not align with the predicted outcome. The children in both age groups showed reduced rates of agent-first response in $N_{CASE}N_{CASE}V_{psv}$ (55% for the 3-4-year-olds; 42% for the 5-6-year-olds) compared to its active version ($N_{CASE}N_{CASE}V_{act}$). This state of affairs is not consistent with the prediction that children should retain a high rate of agent-first response in this pattern. Rather, their performance

suggests some influences of passive morphology on the use of the Agent-First heuristic for this pattern. In contrast, the two age groups performed differently in $N_{CASE}V_{psv}$: a weak preference for the agent-first interpretation for the 3-4-year-olds (59%) but a strong preference for the theme-first interpretation amongst the 5-6-year-olds (33%). This discrepancy suggests that the Agent-First heuristic competes with (and loses out to) another heuristic (Theme-First together with passive morphology; see Section 9.1.3) from the age of five or six. I will revisit this point in Sections 9.1.3 and 9.1.4.

9.1.2. Case marking: The NOM-as-Agent and ACC-as-Theme heuristics

I made three predictions with respect to case marking:

1. Case-marking-related knowledge should be employed reliably for comprehension, such that it leads children to consistently interpret the argument marked by the NOM as the agent and the one marked by the ACC as the theme.
2. Since I am not aware of any study on how case-marking-related knowledge is manifested contingent upon the relative position of arguments on which individual case markers occur, I formulated the null hypothesis that children's comprehension should not be influenced by this factor (i.e., whether they are attested initially or non-initially). If this hypothesis is correct, children should demonstrate similar rates of success in either the canonical or the scrambled active transitive patterns, as well as the one-argument patterns with case marking.
3. Given the strong association between the NOM and the agent, the NOM-as-Agent heuristic should affect comprehension of the passive in a substantial way, reducing rates

of success in the suffixal passive patterns with the NOM present (since a comprehender has to recalibrate what the thematic status of the nominative-marked argument).

As predicted, the children demonstrated a good command of the two heuristics involving case marking (NOM-as-Agent; ACC-as-Theme), by achieving at-ceiling performance both in $N_{NOM}V_{act}$ and $N_{ACC}V_{act}$. Moreover, they were well above-chance in the canonical active transitive patterns ($N_{NOM}N_{\cancel{CASE}}V_{act}$, $N_{\cancel{CASE}}N_{ACC}V_{act}$, $N_{NOM}N_{ACC}V_{act}$), and their overall performance in these patterns improved in contrast to their agent-first preference in $N_{\cancel{CASE}}N_{\cancel{CASE}}V_{act}$. In particular, there was no statistical difference in accuracy across the three canonical active transitive patterns in either age group. Together, these findings point towards the children's reliable use of the two case marking heuristics for comprehension.

Contrary to the second prediction, it appears that the degree to which the two case marking heuristics affect comprehension of active transitives is contingent upon where the relevant arguments occur in the sentence, and this varies by age. For the 3-4-year-olds, their above-chance performance in $N_{NOM}N_{\cancel{CASE}}V_{act}$ (79%), $N_{\cancel{CASE}}N_{ACC}V_{act}$ (79%), and $N_{NOM}N_{ACC}V_{act}$ (84%), together with the lack of significance in comparison to their agent-first preference in $N_{\cancel{CASE}}N_{\cancel{CASE}}V_{act}$ (67%), indicates that the two pairings of case marking contribute equally to comprehension when the case-marked arguments are situated in typical positions (i.e., initial NOM-agent; non-initial ACC-theme). In the scrambled active transitive, whereas the children's performance was not particularly influenced by the presence of the ACC (68% in $^{\dagger}N_{\cancel{CASE}}N_{NOM}V_{act}$; 78% in $^{\dagger}N_{ACC}N_{NOM}V_{act}$), it was significantly affected by the presence of the NOM (55% in $^{\dagger}N_{ACC}N_{\cancel{CASE}}V_{act}$; 78% in $^{\dagger}N_{ACC}N_{NOM}V_{act}$). This divergence in performance suggests an asymmetry involving the two case marking heuristics in the comprehension of the

scrambled active transitive: when two case-marked arguments are situated in atypical positions (i.e., initial ACC-marked argument; non-initial NOM-marked argument), the NOM-as-Agent heuristic is more reliable than the ACC-as-Theme heuristic.

Turning to the 5-6-year-olds, their agent-first interpretation was enhanced more by the initial NOM (significant change from 77% in $N_{\text{CASE}}N_{\text{CASE}}V_{act}$ to 97% in $N_{NOM}N_{\text{CASE}}V_{act}$) than by the non-initial ACC (non-significant change from 77% in $N_{\text{CASE}}N_{\text{CASE}}V_{act}$ to 84% in $N_{\text{CASE}}N_{ACC}V_{act}$). These asymmetrical rates of enhancement for the agent-first interpretation suggest a difference in the strength of the two case marking heuristics with respect to comprehension of the canonical active transitive. That is, the NOM-as-Agent heuristic is more reliable than the ACC-as-Theme heuristic when the relevant arguments appear in typical positions. In the case of the scrambled active transitive, the children demonstrated above-chance accuracy rates only in the patterns with the NOM present (71% in both $^{\dagger}N_{\text{CASE}}N_{NOM}V_{act}$ and $^{\dagger}N_{ACC}N_{NOM}V_{act}$), whereas their performance was at-chance in the pattern with only the NOM obscured (56% in $^{\dagger}N_{ACC}N_{\text{CASE}}V_{act}$). It is thus reasonably clear that the NOM-as-Agent heuristic is more reliable than the ACC-as-Theme heuristic when these markers appear on arguments in atypical positions.

Taken together, the two case marking heuristics affect children's comprehension of active transitives in an asymmetric way. The NOM-as-Agent heuristic emerges early on (which is consistent with previous research; see Section 3.2.2.2), leading to success in the comprehension of both the canonical and the scrambled active transitives for the 3-4-year-olds. In particular, their above-chance performance in the scrambled active transitive patterns with the NOM present (68% in $^{\dagger}N_{\text{CASE}}N_{NOM}V_{act}$; 78% in $^{\dagger}N_{ACC}N_{NOM}V_{act}$) compared to their at-chance performance when the NOM was obscured (55% in $^{\dagger}N_{ACC}N_{\text{CASE}}V_{act}$) suggests that the NOM-as-Agent

heuristic is strong enough in this age group to suppress the Agent-First heuristic to some degree. As age increases, this heuristic is further strengthened so that it leads the 5-6-year-olds to achieve at-ceiling rates of success in $N_{NOM}N_{\text{~~CASE~~}}V_{act}$ (97%) and in $N_{NOM}N_{ACC}V_{act}$ (94%). The NOM itself even suffices to enhance the agent-first interpretation (77% in $N_{\text{~~CASE~~}}N_{\text{~~CASE~~}}V_{act}$ versus 97% in $N_{NOM}N_{\text{~~CASE~~}}V_{act}$). More importantly, for this age group, the strength of the NOM-as-Agent heuristic is contingent upon where it occurs. A comparison of the rates of accuracy in $N_{NOM}N_{\text{~~CASE~~}}V_{act}$ (97%) and in $^{\dagger}N_{\text{~~CASE~~}}N_{NOM}V_{act}$ (71%) showed a statistically significant difference. This difference suggests that, although the NOM works reliably for the indication of the agent at an early point in development in general, it is around the age of five or six when use of the NOM-as-Agent heuristic is affected by where the NOM-marked argument appears (i.e., initially or non-initially) for its optimal operation.

In contrast, the ACC-as-Theme heuristic works better when the ACC-marked argument appears in a typical (non-initial) position than when it appears in an atypical (initial) position from early on. For the 3-4-year-olds, the comparison between the canonical and scrambled active transitive patterns with only the ACC present revealed a significant difference (79% in $N_{\text{~~CASE~~}}N_{ACC}V_{act}$ versus 55% in $^{\dagger}N_{ACC}N_{\text{~~CASE~~}}V_{act}$). A similar significant contrast was also found in the 5-6-year-olds' comprehension (84% in $N_{\text{~~CASE~~}}N_{ACC}V_{act}$; 56% in $^{\dagger}N_{ACC}N_{\text{~~CASE~~}}V_{act}$). This by-position difference suggests that the impact of the ACC-as-Theme heuristic on children's comprehension from the age of three or four is affected by where the relevant arguments occur. This effect kicks in earlier than when the NOM-as-Agent heuristic starts to be sensitive to the typical position factor.

The scrambled active transitive patterns involve an interaction between the Agent-First heuristic and the typicality effect of two case marking heuristics, which I return in Section 9.1.4.

The final prediction concerning the NOM-as-Agent heuristic in the passive requires examining the role of voice-related knowledge for comprehension (Section 9.1.3) and the interplay between the three factors (Section 9.1.4). For that reason, I will revisit this point in these sections.

9.1.3. Voice: The Theme-First and the DAT-as-Agent heuristics

Regarding voice-related knowledge, I predicted that the degree to which voice heuristics are employed in comprehension should be proportionate to age. In other words, the impact of these heuristics on comprehension should be observable only for children aged five to six, as claimed in previous research (see Section 3.2.3.2), with better rates of success in these patterns than in the performance of 3-4-year-olds.

As predicted, age seems to be crucial for employing voice-related knowledge. Our 3-4-year-olds showed a weak preference for the agent-first interpretation in $N_{CASE}V_{psv}$ (59%), but it was not statistically significant in comparison to the response rate in $N_{CASE}V_{act}$ (43%). This points to the children's uniform, chance-level performance across these patterns. A lack of statistical significance was also found in the comparison between $N_{CASE}V_{psv}$ and the other one-argument passive patterns with case marking present (52% in $N_{NOM}V_{psv}$ and 53% in $N_{DAT}V_{psv}$). Moreover, the children demonstrated uniformly at-chance performance on the remaining passive patterns in the experiment.

There are two possible interpretations for the 3-4-year-olds' performance in the passive. One is that the children have some awareness of the passive, but that it is not decisive for the actual comprehension of the passive. Take $N_{CASE}N_{CASE}V_{psv}$ as an example. The children showed a numerical decrease, but not a statistically significant change, in agent-first response for this

pattern (55%) in comparison to $N_{\text{CASE}}N_{\text{CASE}}V_{act}$ (67%). This finding suggests that, although the children in this age group may know something about passive morphology, it is not reliable enough to activate the Theme-First heuristic (the only voice heuristic applicable to this pattern). The uniform at-chance rates of accuracy in $N_{DAT}V_{psv}$ (53%) and in $N_{\text{CASE}}N_{DAT}V_{psv}$ (51%) also indicate the reduced impact of the DAT-as-Agent heuristic on comprehension, which further supports the possibility that voice-related knowledge is not a decisive factor for comprehension in this age group.

The other possible interpretation is that the presence of passive morphology interferes with the 3-4-year-olds' interpretation in an adverse way. As noted in Chapter 3, verbal morphology in Korean requires revision of the initial interpretive commitment, and the suffixes for the passive and morphological causatives overlap. In addition, the passive occurs extremely rarely in caregiver input (see Chapter 4). The intricacies involving passive morphology may thus bring in detrimental effects on their comprehension, undermining their interpretation.

In contrast, the below-chance rates of agent-first response in $N_{\text{CASE}}V_{psv}$ (33%) and in $N_{\text{CASE}}N_{\text{CASE}}V_{psv}$ (42%) for our 5-6-year-olds provide evidence that children in this age group are able to employ voice-related knowledge (the Theme-First heuristic). Recall that only the Theme-First heuristic is applicable because there is no case marking in these patterns. Under these circumstances, the 5-6-year-olds employed the heuristic reliably, together with passive morphology, suppressing the Agent-First heuristic. The children also showed above-chance performance in $N_{NOM}V_{psv}$ (71%), the one-argument pattern where the Theme-First heuristic consistently overrides[1] the NOM-as-Agent heuristic in competition, leading to interpretive

[1] I use the term 'override' in a neutral way to indicate a situation in which one heuristic reliably wins out over another due to its stronger influence on comprehension (which is apparently proportionate to its frequency of occurrence in the input)

success. This success also points towards children's ability to reliably deploy voice-related knowledge in the passive. Voice-related knowledge strongly influenced the children's interpretation of $N_{DAT}V_{psv}$ (84%), $N_{\text{~~CASE~~}}N_{DAT}V_{psv}$ (74%), and the two scrambled suffixal passive patterns (79% in $^{\dagger}N_{DAT}N_{\text{~~CASE~~}}V_{psv}$ and 77% in $^{\dagger}N_{DAT}N_{NOM}V_{psv}$[2]) as well, which supports the role of the DAT-as-Agent heuristic (together with passive morphology) for comprehension.

Moreover, the finding that the 5-6-year-olds demonstrated significantly more passive-like interpretations than the 3-4-year-olds did both in $N_{\text{~~CASE~~}}V_{psv}$ (agent-first interpretation: 59% for the 3-4-year-olds vs. 33% for the 5-6-year-olds) and in $N_{DAT}V_{psv}$ (accuracy: 53% for the 3-4-year-olds vs. 84% for the 5-6-year-olds) suggests that children's voice-related knowledge grows as age increases.

9.1.4. The relative priority of these heuristics

I made two predictions as to the relative priority of the heuristics based on the three factors (i.e., word order, case marking, and voice).

1. I predicted that the voice-related heuristics should have a reduced impact on comprehension in general. Particularly for the 5-6-year-olds, the voice heuristics should be less influential than word order and case marking heuristics. This should lead to success in the scrambled suffixal passive pattern with the DAT obscured ($^{\dagger}N_{\text{~~CASE~~}}N_{NOM}V_{psv}$) where the Theme-First heuristic competes with the Agent-First heuristic. It should also lead to improved accuracy rates in the canonical suffixal passive

[2] The NOM-as-Agent heuristic exerted a reduced impact on their comprehension of this pattern because of its non-initiality. See Section 9.1.2 for more explanation on this point.

pattern with the NOM obscured ($N_{\not CASE}N_{DAT}V_{psv}$) in comparison to the same patterns with the NOM present ($N_{NOM}N_{\not CASE}V_{psv}$ and $N_{NOM}N_{DAT}V_{psv}$).

2. Regarding the heuristics relating to word order (Agent-First) and case marking (NOM-as-Agent; ACC-as-Theme), I predicted that children should reliably employ the case marking heuristics prior to the word order heuristic due to their local application to a single argument (thus computationally easier than word order facts; cf. Wittek & Tomasello, 2005). This characteristic should guide the children to perform better in the one-argument active patterns when case marking is attested than when it is obscured. This should also lead children to demonstrate a higher level of agent-first interpretation in $N_{NOM}V_{act}$ than in $N_{\not CASE}N_{\not CASE}V_{act}$ in comparison to $N_{\not CASE}V_{act}$.

Results from the 5-6-year-olds' performance are consistent with the first prediction. They achieved above-chance performance on $^{\dagger}N_{\not CASE}N_{NOM}V_{psv}$ (71%), the pattern where there is no dative marker and competition arises between the Agent-First heuristic and the Theme-First heuristic. If the Theme-First heuristic had affected the interpretation of this pattern strongly, the children's performance would have been below-chance. Rather, the theme-first interpretation was undermined by the Agent-First heuristic, which allowed the children to achieve above-chance performance with an accuracy rate comparable to that of $^{\dagger}N_{DAT}N_{\not CASE}V_{psv}$ and $^{\dagger}N_{DAT}N_{NOM}V_{psv}$. Note that the non-initial NOM-marked argument may have been another possible candidate for the agent-first interpretation in this pattern (since this invites the NOM-as-Agent heuristic), but because it occurred in a non-initial position, its impact was weaker than the influence of the Agent-First heuristic.

In addition, of the three canonical suffixal passive patterns involving case marking, the 5-6-year-olds were above-chance only in $N_{\text{CASE}}N_{DAT}V_{psv}$ (74%), which significantly differed from the accuracy rates in $N_{NOM}N_{\text{CASE}}V_{psv}$ (53%) and in $N_{NOM}N_{DAT}V_{psv}$ (48%). The at-chance performance in $N_{NOM}N_{\text{CASE}}V_{psv}$ and in $N_{NOM}N_{DAT}V_{psv}$ is ascribable to the presence of the initial NOM-marked argument, in combination with the presence of the second argument, affecting children's comprehension of the canonical suffixal passive. The children may have started with the NOM-as-Agent heuristic because of the initial NOM-marked argument, and they may have proceeded to activate the Agent-First heuristic due to the presence of the second argument. Knowledge about word order and case marking may have suppressed voice-related knowledge (Theme-First; DAT-as-Agent) in comprehension to some extent. This in turn supports the last prediction of RQ2, namely, the contribution of the NOM-as-Agent heuristic to comprehension contingent upon where the relevant argument appears.

The less prioritised nature of voice-related knowledge for comprehension is further supported by comparison of the patterns involving all the heuristics from the three factors ($N_{NOM}N_{DAT}V_{psv}$; $^{\dagger}N_{DAT}N_{NOM}V_{psv}$). The Agent-First heuristic applies to both patterns but is enhanced by the NOM-as-Agent heuristic for $N_{NOM}N_{DAT}V_{psv}$ and the DAT-as-Agent heuristic (together with passive morphology) for $^{\dagger}N_{DAT}N_{NOM}V_{psv}$.[3] The 5-6-year-olds showed a significant drop in accuracy in $N_{NOM}N_{DAT}V_{psv}$ (48%) compared to $^{\dagger}N_{DAT}N_{NOM}V_{psv}$ (77%). This reduction indicates that the NOM-as-Agent heuristic in the initial position is stronger than the DAT-as-agent heuristic in that the NOM suppresses activation of the two voice heuristics and enhance the agent-first interpretation in $N_{NOM}N_{DAT}V_{psv}$, leading to the at-chance rate of success in this pattern. If this is correct, the above-chance rate of accuracy in $^{\dagger}N_{DAT}N_{NOM}V_{psv}$ must be attributed

[3] In this pattern, the NOM-marked argument appears non-initially. The NOM-as-Agent is thus weaker in its impact than when it applies to an argument in an initial position.

more to the non-initiality of the NOM-marked argument than to the DAT-as-Agent heuristic. The DAT-as-Agent heuristic may thus play a relatively small role in the comprehension of the scrambled passive patterns.

However, this does not mean that voice heuristics do not have an effect on the comprehension of the passive for this age group. We have seen below-chance rates of agent-first response in $N_{\not CASE}V_{psv}$ (33%) and in $N_{\not CASE}N_{\not CASE}V_{psv}$ (42%), as well as an above-chance rate of success in $N_{NOM}V_{psv}$, for our 5-6-year-olds. This invites the conclusion that voice-related knowledge is not firmly in place for this age group, thus failing to force successful revision of the initial interpretive commitment in constructional patterns that require consideration of multiple cues present at the same time. The relatively poor performance on the two-argument canonical passive patterns (53% in $N_{NOM}N_{\not CASE}V_{psv}$ and 48% in $N_{NOM}N_{DAT}V_{psv}$) may then be ascribed to the cognitive burden created by the need to attend to other informative (and more prioritised) clues for comprehension, possibly distracting the children in this age group from employing voice-related knowledge (which is less influential in comprehension).

Regarding the second prediction, the two child groups performed better in $N_{NOM}V_{act}$ than in $N_{\not CASE}V_{act}$, and each group showed different patterns in comprehension of $N_{NOM}V_{act}$ and $N_{\not CASE}N_{\not CASE}V_{act}$ in comparison to $N_{\not CASE}V_{act}$. The 3-4-year-olds were at-chance in $N_{\not CASE}V_{act}$ (43%), manifesting uncertainty about the thematic role of the sole case-less argument. Their agent-first interpretation was enhanced either when a second argument was present (67% in $N_{\not CASE}N_{\not CASE}V_{act}$) or when the NOM was present (94% in $N_{NOM}V_{act}$), with a significantly stronger degree of enhancement in $N_{NOM}V_{act}$ than in $N_{\not CASE}N_{\not CASE}V_{act}$. Extending the earlier implication that children aged three to four need additional cues in order to employ the Agent-First heuristic reliably (see Section 9.1.1), this asymmetric improvement suggests a bigger contribution of the

NOM (indication of the agent) than the presence of the second argument to comprehension of active transitives in Korean.

The 5-6-year-olds demonstrated a weak preference for the agent-first interpretation in $N_{\not CASE}V_{act}$ (60%), which indicates the emergence of the Agent-First heuristic that operates without support of other grammatical cues. Their agent-first interpretation was still above the chance level both in $N_{\not CASE}N_{\not CASE}V_{act}$ (77%) and in $N_{NOM}V_{act}$ (97%), but the difference between $N_{\not CASE}V_{act}$ and $N_{NOM}V_{act}$ was statistically significant, unlike the difference between $N_{\not CASE}V_{act}$ and $N_{\not CASE}N_{\not CASE}V_{act}$. This suggests that, whereas the presence of the NOM is still more influential for comprehension than the presence of the second argument (when it comes to the agent-first interpretation), children start to rely predominantly on word-order-related knowledge from the age of five or six.

Although the children in both age groups had a good command of case-marking-related knowledge (as evidenced by their at-ceiling performance in the one-argument active patterns), it seems that the ACC-as-Theme heuristic cannot completely override the Agent-First heuristic in comprehension of the scrambled active transitive. Both child groups demonstrated an at-chance level performance in $^{\dagger}N_{ACC}N_{\not CASE}V_{act}$—a significant drop in comparison to $N_{\not CASE}N_{ACC}V_{act}$. Considering the children's uniform above-chance performance in $^{\dagger}N_{\not CASE}N_{NOM}V_{act}$, their poor success rates in $^{\dagger}N_{ACC}N_{\not CASE}V_{act}$ suggest that the ACC-as-Theme heuristic is weaker than the Agent-First heuristic for comprehension of this scrambled pattern. This again supports the association between the ACC-as-Theme heuristic and non-initiality for its reliable application.

9.2. Connecting input properties to comprehension behaviour

I have reported findings from the picture selection experiment by focusing on individual heuristics from the three factors for comprehension of constructional patterns in expressing a transitive event. In summation, word-order-related knowledge (the Agent-First heuristic) operates reliably only with the support of other grammatical cues, and it starts to work independently of these cues later in development. Children generally have a good command of case-marking-related knowledge early on, but the impact of the two heuristics (NOM-as-Agent; ACC-as-Theme) is asymmetric, contingent upon the position of relevant case-marked arguments. Voice-related knowledge emerges later in development, and it is less influential than knowledge about word order and case marking in comprehension: the two voice heuristics (Theme-First & DAT-as-Agent) are often overridden when they compete with the heuristics based on word order (Agent-First) and case marking (NOM-as-Agent). The rest of this chapter discusses how these comprehension behaviours can be explained by properties of caregiver input.

9.2.1. Word-order-related knowledge

It has long been believed that the Agent-First heuristic is a general cognitive bias, which applies automatically to comprehension (see Section 3.2.1). The picture selection experiment in this dissertation adopted a novel methodology by obscuring parts of test sentences, which made it possible to measure the precise role of word-order-related knowledge for comprehension. What our children (particularly the 3-4-year-olds) showed in this experiment is inconsistent with the singular importance of the Agent-First heuristic. When it comes to a transitive event (at least in Korean), the Agent-First heuristic can operate reliably only in conjunction with other grammatical cues. This idea contradicts previous claims that children interpret the initial

argument as the agent automatically, regardless of its actual thematic role, until the age of four (see Section 3.2.1.2).

The mere quantity of Korean caregiver input in the CHILDES database does not seem to be promising in revealing children's performance on $N_{CASE}V_{act}$, the core pattern involving the aforementioned inconsistency. Canonical active transitive utterances in the corpus data consist mostly of animate agents and inanimate themes;[4] only around 12.41 per cent of the transitive utterances in the caregiver input (254 out of 2,047[5] utterances) are reversible. If input characteristics relating to animacy had affected the children's picture selection strongly, the sole animate noun in $N_{CASE}V_{act}$ should have been interpreted as the agent, which was not the case. In fact, because the two participants in our test stimuli were both animate, it is hard to attribute the children's performance in $N_{CASE}V_{act}$ to the animacy-related characteristics of transitive sentences in the input (i.e., animate agents followed by inanimate themes). It may be the case that a considerable number of transitive utterances in which the first noun is interpreted as the theme (mostly as one-argument patterns) distracts children from applying the Agent-First heuristic in the comprehension of that pattern. More importantly, however, I have set to the side the possible influence of sentence-initial nouns in non-transitive sentences in the corpus data.[6] For that reason, the question of whether and how this larger body of input (together with a portion of

[4] It is known that the majority of transitive sentences in ordinary speech tend to have animate agents and inanimate themes (e.g., Dowty, 1991; Langacker, 1991; MacWhinney, 1977; Ibbotson & Tomasello, 2009). In this regard, previous studies report that children are sensitive to this animacy information in identifying the agent of an action (e.g., Chan et al., 2009; Corrigan, 1988; Theakston et al., 2012)—but see Cameron-Faulkner et al. (2003) that show that 80 per cent of the transitive utterances in caregiver input consist of pronoun subjects.

[5] This number is the sum of the instances of canonical active transitives with no omission (1,757), canonical active transitives with no ACC (268), canonical active transitives with no NOM (19), and canonical active transitives (agent-theme) with no case marking (3).

[6] Some examples of these non-transitive sentence types include intransitive-unergatives (e.g., dog-NOM run-SE), intransitive-unaccusatives (e.g., dog-NOM die-SE), and sentences whose predicate is adjectival in nature (e.g., dog-NOM happy-SE).

input that I investigated) guides comprehension in the particular patterns considered in the experiment is difficult to answer at the present time and will require additional research.

Given this situation, since this dissertation focuses on morphosyntactic aspects of language development, I propose that grammatical cues relating to the agent-first interpretation in caregiver input facilitate children's application of the Agent-First heuristic by helping to identify the status of the sentence-initial argument. Recall that the children in the experiment were exposed to pictures prior to stimuli, which means that their interpretation was attuned to transitive events with two *animate* participants (one as an agent and the other as a theme). Under these circumstances, it is plausible that children do not employ animacy information (because no inanimate argument is present) and instead rely on other clues that they have accumulated through exposure. Although input that conforms to the agent-first interpretation in expressing a transitive event make up only around 4.39 per cent of all caregiver sentences in the CHILDES database (3,049[7] out of 69,498 utterances), almost all these utterances have either a second argument or a marker—that is, 98.16 per cent of the canonical active transitive input (2,993[8] out of 3,049 utterances).[9]

In order to choose one picture out of the two when presented with the $N_{CASE}V_{act}$ pattern, a comprehender must decide the thematic role of the sole noun without any supplementary clues.

[7] This number is the sum of the instances of canonical active transitives with no omission (1,757), canonical active transitives with no ACC (268), canonical active transitives with no NOM (19), one-argument active transitives with the NOM (935), scrambled suffixal passives with no omission (1), one-argument suffixal passives with the DAT (13), one-argument (agent) active transitives with no case marking (53), and canonical active transitives (agent-theme) with no case marking (3).

[8] This number is the sum of the instances from Footnote 6 subtracted by the sum of one-argument (agent) active transitives with no case marking (53) and canonical active transitives (agent-theme) with no case marking (3).

[9] This leads to the idea that the Agent-First heuristic may operate as part of a sentence-sized template, by examining the entire sentence before rendering an interpretation—not unlike the canonical sentence template proposed by Bever (1970). However, there is reason to believe that, unlike the canonical sentence template, the agent-first heuristic starts to work independently of other grammatical cues as age increases (as found in the 5-6-year-olds' performance on this pattern). More research is needed to determine to what extent this idea accounts for children's comprehension by age.

In other words, given the experimental setting (i.e., the absence of animacy differences between the two participants in a transitive event), grammatical cues supporting the agent-first interpretation, frequently attested in transitive sentences in caregiver input, may lead a child processor to use this heuristic only in the company of a second argument and/or case marking. This fits well with the observation that our 3-4-year-olds were uncertain about how to interpret the thematic role of an argument in such an under-informative sentence as $N_{CASE}V_{act}$.[10]

The reliable use of the Agent-First heuristic without the support of other informative clues becomes possible as the processor strengthens the association between the first argument and the agent by way of accumulated exposure. The finding that a weak preference for the agent-first interpretation in $N_{CASE}V_{act}$ was manifested in our 5-6-year-olds supports this reasoning. Note, however, that this heuristic still requires the support of grammatical cues, as shown by the adult controls' performance in the same pattern (67%). This invites the conclusion that, when it comes to a transitive event involving two animate arguments, the Agent-First heuristic becomes stronger with age and language experience but still requires support from grammatical cues for its optimal operation.

Because this dissertation focuses on a transitive event and the specific type of grammatical patterns in the experiment, it is impossible to address the contribution of the Agent-First heuristic to comprehension across all event types, including those involving an inanimate argument. In order to better clarify this issue, further research should pursue a similar style of investigation for intransitive or ditransitive events, taking into account the animacy of arguments. However, this does not change the fact that what I found in relation to word-order-related

[10] See also Cameron-Faulkner et al. (2003) for a related report on a relatively small number of English-speaking parental utterances with a full canonical active transitive scheme and its promising impact on English-speaking children's difficulty in establishing agent-patient relations only through word order until the age of three.

knowledge casts doubt on what we have believed in the Agent-First heuristic, suggesting that this heuristic may not be automatically activated based only on exposure to the first noun in a sentence.

9.2.2. Case-marking-related knowledge

Our children demonstrated a good command of case-marking-related knowledge for comprehension, for which input properties provides a promising account. As reported in Section 4.4.1, there is plenty of input from which children can acquire knowledge of the NOM and the ACC, which occur in 4,974 out of 5,397 utterances expressing transitive events in the CHILDES database. Moreover, ΔP scores (see Sections 4.4.3.1 and 4.4.3.2) substantiated that each case marker (NOM and ACC) was a reliable cue for identifying the agent and the theme. These facts provide a basis for the child processor to employ case markers for comprehension, which is consistent with previous reports on the acquisition of the NOM and the ACC from the age of two or three (e.g., Lee et al., 2013; see also Section 3.2.2.2).

The mastery of case-marking-related knowledge, however, takes more time. Our children demonstrated an asymmetric use of case marking by age, with an early reliance on the ACC-as-Theme heuristic in the non-initial position and a later dependence on the NOM-as-Agent heuristic for the initial position.

Properties of caregiver input provide a reasonable explanation for this asymmetry. Three aspects of input characteristics are worth considering. First, within the active transitive patterns with two overt arguments (see Section 4.4.1), the NOM-marked argument occurs more commonly in the initial position (2,025 instances) than in the non-initial position (57 instances), whereas the ACC-marked argument shows the reverse tendency, appearing non-initially (1,776

instances) more often than initially (51 instances). Next, in the one-argument case-less active pattern ($N_{\not CASE}V_{act}$), omission occurs proportionally more frequently in the ACC (1,155 instances whose noun is interpreted as the theme) than in the NOM (53 instances whose noun is interpreted as the agent). Lastly, although Δ*P* scores (see Sections 4.4.3.1 and 4.4.3.2) are reliable in both directions (i.e., marker → thematic role; thematic role → marker), by and large, the rate at which the NOM introduces the agent (0.853) was much stronger than the rate at which the ACC accompanies the theme (0.350).

Given the characteristics of case-marking-related input, I propose that interactions between these characteristics influence children's development of case marking heuristics in a different way. The NOM occurs mostly on arguments in the initial position (within the two-argument patterns) and is rarely omitted (within the one-argument patterns), so that it serves as a powerful cue for agenthood. The strong association between the NOM and agenthood may thus mitigate the position issue involving the NOM-as-Agent heuristic, which leads a child processor to build a comprehension strategy that focuses on the local pairing of the NOM and the agent *earlier* than on information about the position of the argument in the sentences. This provides a plausible reason why the 3-4-year-olds, but not the 5-6-year-olds, demonstrated uniformly above-chance rates of success both in $N_{NOM}N_{\not CASE}V_{act}$ and in $^{\dagger}N_{\not CASE}N_{NOM}V_{act}$, with no statistical difference. It also provides a good explanation for why the 5-6-year-olds were at-chance in $N_{NOM}N_{\not CASE}V_{psv}$ (where the initial NOM-as-Agent heuristic suppresses the Theme-First heuristic to some degree), but above-chance in $^{\dagger}N_{\not CASE}N_{NOM}V_{psv}$ (where the non-initial NOM-as-Agent heuristic is vulnerable to being overridden by the Agent-First heuristic).

In contrast, the ACC-marked argument occurs mostly in the non-initial position (within the two-argument patterns) and is omitted frequently (within the one-argument patterns).

Moreover, this marker is a moderately reliable cue for themehood (but with weaker association strength than the NOM invites agenthood), as shown in the Δ*P* statistics (0.350). One promising scenario under these circumstances is that a child processor may associate the ACC with the non-initial argument when it comes to comprehension of two-argument active transitive patterns, with the result that the ACC-as-Theme heuristic is linked to the non-initial position before the NOM-as-Agent heuristic comes to be tied to the initial position. This is because, whereas the strong bi-directionality involving the NOM and the agent allows a child processor to focus just on the case cue, the relatively low association strength of the ACC as an indicator of the theme calls for an additional word order clue for the optimal operation of the ACC-as-Theme heuristic. This scenario nicely captures the fact that the 3-4-year-olds were above-chance in $N_{\text{CASE}}N_{\text{ACC}}V_{\text{act}}$ (where the ACC-as-Theme heuristic applies non-initially, thus operating reliably in conjunction with the Agent-First heuristic) but at-chance in $^{\dagger}N_{\text{ACC}}N_{\text{CASE}}V_{\text{act}}$ (where the ACC-as-Theme heuristic must compete with the more powerful Agent-First heuristic).[11]

If these ideas are on the right track, input properties regarding case marking provides motivation for why the ACC-as-Theme heuristic kicks in earlier than the NOM-as-Agent heuristic in active transitives with two overt arguments.

9.2.3. Voice-related knowledge

The children's performance with regard to voice revealed that this type of knowledge emerges later in development and is less influential than knowledge about word order and case marking in comprehension. This aligns well with properties of caregiver input. Overall, the total amount of

[11] Here, I am not claiming that children do not have sufficient knowledge about individual markers: children in both age groups achieved at-ceiling rates of success in one-argument active patterns with case marking ($N_{\text{NOM}}V_{\text{act}}$; $N_{\text{ACC}}V_{\text{act}}$). See Section 7.3 for more information about their performance in these patterns.

input that includes a suffixal passive makes up less than 8 per cent of the utterances that describe a transitive event (and less than 1 per cent of the entire input) in the CHILDES database (see Section 4.4.1). This paucity of input, together with irregularity of the passive morphology and its overlap with causative morphology, limits the opportunity for Korean-speaking children to learn the intricacies of the passive voice. In other words, the extremely rare occurrence of the passive in the input impedes acquisition of voice-related knowledge and hinders the revision of initial interpretive commitments.

In light of these facts, children's comprehension of the suffixal passive provides a testbed for the two accounts of how learners' linguistic knowledge evolves from concrete frames towards abstract representations (gradual abstraction vs. early abstraction; see Section 2.2). Recall that the two accounts differ with regard to the emergence and growth of language knowledge, as re-stated below:

- Gradual abstraction: Learners' initial representations are lexically specific, and abstract constructions evolve from previously constructed lexical frames (e.g., Tomasello, 2003).
- Early abstraction: Both abstract representations and lexically specific frames are acquired early and simultaneously; linking the two types of knowledge is contingent upon experience (e.g., Rowland et al., 2012).

For the 3-4-year-olds, I laid out two possible explanations for their uniformly at-chance performance across the passive patterns. Despite their seeming incompatibility, these possibilities both assume that children in this age group are able to discern verbal morphology. In other words, the available input allows 3-4-year-olds to acquire both an abstract property (voice

heuristics) and a concrete schema (the morphological form of passive suffixes) early and at the same time. Crucially, however, the children are not immediately able to amalgamate the two pieces of knowledge (perhaps due to the rarity of the passive voice in the input, together with intricacies involving passive morphology itself). As a consequence, the 3-4-year-olds in our experiment may not have figured out how to exploit the clue offered by passive morphology to a reliable degree. The fact that there was no tendency to interpret just certain verbs (together with passive morphology) as the intended passive runs counter to what the gradual abstraction account predicts—children should demonstrate verb-specific choices in the passive patterns.

With time, children are able to manifest voice-related knowledge more reliably, and our results suggest that children can employ voice-related knowledge by around the age of five or six. However, voice-related knowledge remains weak in competition with knowledge about word order and case marking, which is already strengthened by virtue of their frequency in the input. In other words, 5-6-year-olds start to establish an association between voice heuristics and the passive suffixes, but the association is still far from complete. This finding aligns with previous research that shows early emergence, but late mastery, of knowledge involving morphological constructions, which is contingent upon the accumulated amount of experience (e.g., Dąbrowska & Tomasello, 2008; cf. Dąbrowska, 2005; Rowland et al., 2012; Saffran et al., 1996).

This picture provides a uniform explanation for the development of voice-related knowledge proportionate to age and language experience, appealing more to the early abstraction account than to the gradual abstraction account.

Voice-related knowledge is less influential, but not uninfluential, in 5-6-year-olds' comprehension, as shown by their above-chance performance on the one-argument passive patterns. The relatively lower rates of accuracy in the two-argument passive patterns with

(partial) case marking can perhaps be ascribed to the cost of simultaneous computations of information about word order, case marking, and voice in order to arrive at an interpretation of passive sentences. Multiple cues compete in the course of these computations, with the result that stronger cues often suppress weaker ones. Cues from voice are weaker than those from word order and case marking due to the rarity of input, along with the inherent difficulty involving passive morphology. Because of this, when the child's processor computes multiples cues involving the two-argument passive patterns, it may not reliably draw upon voice-related knowledge (activated through passive morphology at the end of a sentence) to revise the tentative interpretation that the processor has constructed from stronger cues involving word order and case marking.

CHAPTER X

CONCLUSION

Throughout this dissertation, I have made use of corpus analysis and picture selection experiments to investigate developmental trajectories involving two constructions that express transitive events in Korean (active transitives and suffixal passives) for Korean-speaking preschool children. For this purpose, I first conducted a semi-automatic analysis of caregiver input using the entire Korean child-directed speech data in the CHILDES database. Four major findings from this analysis can be analysed as follows:

(1) Of the core constructional patterns with no omission of argument and case marking, the canonical active transitive occurs far more frequently than its scrambled counterpart, and the passives are extremely rare, regardless of canonicity.
(2) Of the three passive types (suffixal, lexical, and paraphrastic), the suffixal passive was the most frequent of all instances of the passive (with or without argument / case marking omission).
(3) The degree of association between individual markers and thematic roles is asymmetric: the NOM is a very strong cue for agenthood (and vice versa), the ACC is a moderately good cue for themehood (and vice versa), and the DAT is not likely to occur with the agent (and vice versa).
(4) When two overt arguments are attested in active transitives, the NOM-marked and ACC-marked arguments tend to appear initially and non-initially, respectively.

Next, I carried out a series of picture selection experiments, by devising a novel methodology in which parts of test sentences were obscured by way of acoustic masking with child-friendly contexts. Given the experimental setting (i.e., reversible stimuli with two animate arguments), it was found that three grammatical factors—word order, case marking, and voice—interact with one another in children's comprehension of the two constructions in the following ways:

(1) The word-order-related heuristic (Agent-First) operates reliably only in conjunction with other grammatical cues such as the presence of a second argument and case marking.
(2) The case-marking-related heuristics (NOM-as-Agent; ACC-as-Theme), which apply locally to a single noun, work more reliably for comprehension than the word-order-related heuristic (Agent-First).
(3) The voice-related heuristics (Theme-First; DAT-as-Agent) are less influential in comprehension than the word order and case marking heuristics, which frequently override them.

Children's performance in this experiment was interpreted in combination with input properties and postulated features of the child processor. By and large, characteristics of each comprehension heuristic mirror properties of caregiver input, which suggests a close connection between what children are exposed to and how knowledge related to these factors emerges and grows. Despite the scope of investigation (i.e., patterns expressing transitive events with animate agents and themes), the nature of input provides a reasonably clear indication that children develop particular heuristics in relation to each factor and apply them to comprehension. This

finding aligns well with usage-based and emergentist approaches to language development, pointing towards a substantial contribution of input to child language development.

Although findings from this dissertation open a door to revealing possible connections between input properties and comprehension, there still remain limitations in light of experimental settings and the scope of investigation, which await future study. First, the current experiment did not include on-line processing measures, thus limiting our access to information about how and at what point children exploit interpretive cues in real-time. There is some reason to believe that children do not apply the Agent-First heuristic automatically and immediately when they encounter the first noun in a sentence (as shown in their performance in the one case-less noun active pattern), and that two case-marking heuristics are sensitive to the position of the associated arguments in active transitives. However, since the current project relies on data from off-line experiments, it is not possible to directly address the question of precisely when and where the proposed heuristics apply in the course of comprehension. Some recent studies on child language development have attempted to incorporate on-line processing data into their interpretation of children's comprehension behaviours (e.g., intermodal preferential looking: Suzuki & Kobayashi, 2017; eye-tracking: Özge et al., 2016). Since the picture selection task in this dissertation involves a pair of two pictures for each test item, it would be promising to combine it with a visual-world eye tracking paradigm and measure real-time processing of information about the three factors.

A second limitation is that all arguments in the experimental stimuli were necessarily animate in order to ensure the reversibility of the test sentences. However, as acknowledged in the previous chapter, the majority of transitive sentences in ordinary conversation involve animate agents and inanimate themes. Transitive utterances found in Korean caregiver input in

CHILDES database also tend to follow this pattern. A follow-up experiment is thus needed, with manipulation of animacy, in order to determine to what degree children's comprehension is affected by animacy cues (cf. Chan et al., 2009).

More broadly, I acknowledge that my dissertation falls short of pinpointing the precise motivation of interactions among these heuristics. I have adopted an operational definition of a heuristic (probabilistic association between form and function acquired through exposure; see Footnote 1 in p. 2), consistent with the major assumption of the particular approach that I adopt in this dissertation. I have also assumed an incremental application of the heuristics, arguing that the voice heuristics (which are activated later in a sentence and weaker in their influences on comprehension) are often overridden by the word order and case marking heuristics (which are activated early in a sentence and stronger in their influences on comprehension). However, there is still a need for a theory with respect to the precise interplay of word order, case marking, and voice. More follow-up work is needed to explicate how the interaction of these factors aligns with various theoretical viewpoints.

Last but not least, I was not able to carry out full-fledged automatic processing in my analysis of caregiver input in Korean. The currently available pipelines for handling corpus data are mostly based on general-purpose corpora, which reduces the applicability of the open-access pipelines to the analysis of child corpora. Characteristics of child corpora such as onomatopoeia and mimetic words also add difficulty in the analysis. In addition, language-specific properties such as scrambling and omission of sentential components remain a big challenge. To bypass these thorny issues, I took a semi-automatic approach to pattern-finding, but I acknowledge that this is not the ultimate solution. I am optimistic that analysis of caregiver input will benefit from techniques that employ probabilistic dependency relations, as several studies (although targeting

written corpora) have suggested (e.g., Park, Hong, & Cha, 2016). Future research should be directed to measuring to what degree cutting-edge methods for general-purpose corpora can overcome the challenges associated with automatic processing of Korean child corpora.

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APPENDIX A. Key Python codes for pattern-finding

Key code #1. Merging information (eojeol, XPOS, UPOS) by sentence

```
sents_for_pf_list = []

for sent in text_conll:
    eojeol_fullinfo_temp = []

    for line in sent:
        if line == "\n":
            continue
        elif line == "":
            continue
        elif "#" in line:
            continue
        else:
            items = line.split("\t")
            eojeol = items[1]
            eojeol_by_morph = items[2]
            upos = items[3]
            xpos = items[4]
            eojeol_fullinfo = eojeol + "/" + eojeol_by_morph + "/" + xpos + "/" + upos
            if "PUNCT" in eojeol_fullinfo:
                continue
            else:
                eojeol_fullinfo_temp.append(eojeol_fullinfo)

    sent_fullinfo = " ".join(eojeol_fullinfo_temp)
    sents_for_pf_list.append(sent_fullinfo)
```

Key code #2. Extracting the active transitive pattern with two overt arguments and markers

```
# sent with JKS & JKO

sent_by_ppt_list = []

for sent in sents_for_pf_list_sanity_chk:
    if "VERB" in sent:
            if "JKS" in sent and "JKO"in sent:
                sent_by_ppt_list.append(sent)

print(len(sent_by_ppt_list))


# sent by canonicity

canonical_active_transitive = []
scrambled_active_transitive = []

for sent in sent_by_ppt_list:
    jks = sent.find("JKS")
    jko = sent.find("JKO")
#    print(jks, jko)
    if jks < jko:
        canonical_active_transitive.append(sent)
    else:
        scrambled_active_transitive.append(sent)

print(len(canonical_active_transitive))
print(len(scrambled_active_transitive))


## output as txt file

output_sent_txt(canonical_active_transitive)
output_sent_txt(scrambled_active_transitive)
```

Key code #3. Extracting the suffixal passive pattern with two overt arguments and markers

```
# sent with JKS & -eykey/hanthey as JKB

sent_by_ppt_list = []

for sent in sents_for_pf_list_sanity_chk:
    if "VERB" in sent:
        item_in_sent = sent.split(" ")
        for indiv_item in item_in_sent:
            if "XSV" in indiv_item:
                verb_morpheme = indiv_item.split("/")[1]
                if "어" in verb_morpheme or "하" in verb_morpheme or "려" in verb_morpheme or "기" in verb_morpheme:
                    sent_by_ppt_list.append(sent)

print(len(sent_by_ppt_list))


# sent by canonicity

canonical_suffixal_passive = []
scrambled_suffixal_passive = []

for sent in sent_by_ppt_list:
    jks = sent.find("JKS")
    jkb = sent.find("JKB")
#    print(jks, jko)
    if jks < jkb:
        canonical_suffixal_passive.append(sent)
    else:
        scrambled_suffixal_passive.append(sent)

print(len(canonical_suffixal_passive))
print(len(scrambled_suffixal_passive))


## output as txt file

output_sent_txt(canonical_suffixal_passive)
output_sent_txt(scrambled_suffixal_passive)
```

APPENDIX B. Information about the experiment

Table B-1. Number of participants in each experimental session

Session	3-4-year-olds (#)	5-6-year-olds (#)
No-masking	30	23
Yawning	18	16
Coughing	25	23
Chewing	22	22

Table B-2. Sentences used in the experiment ($N_{NOM}N_{ACC}V_{act}$)

holangi-ka khokkili-lul kuli-eyo.
tiger-NOM elephant-ACC draw-SE
'The tiger draws the elephant.'

wenswungi-ka talamcwi-lul tenci-eyo.
monkey-NOM squirrel-ACC throw-SE
'The monkey throws the squirrel.'

kkwulpel-i talamcwi-lul chilha-ayo.
honeybee-NOM squirrel-ACC paint-SE
'The honeybee paints the squirrel.'

talamcwi-ka holangi-lul mil-eyo.
squirrel-NOM tiger-ACC push-SE
'The squirrel pushes the tiger.'

kaykwuli-ka wenswungi-lul tul-eyo.
frog-NOM monkey-ACC lift-SE
'The frog lifts the monkey.'

kkwulpel-i napi-lul an-ayo.
honeybee-NOM butterfly-ACC hug-SE
'The honeybee hugs the butterfly.'

Table B-3. Sentences used in the experiment ($N_{NOM}N_{DAT}V_{psv}$)

koyangi-ka kangaci-hanthey cha-i-eyo.
cat-NOM dog-DAT kick-PSV-SE
'The cat is kicked by the dog.'

talamcwi-ka wenswungi-hanthey ep-hi-eyo.
squirrel-NOM monkey-DAT piggyback-PSV-SE
'The squirrel is piggybacked by the monkey.'

saca-ka holangi-hanthey mwul-li-eyo.
lion-NOM tiger-DAT bite-PSV-SE
'The lion is bitten by the tiger.'

kkwulpel-i napi-hanthey ccil-li-eyo.
honeybee-NOM butterfly-DAT poke-PSV-SE
'The honeybee is poked by the butterfly.'

ellwukmal-i twayci-hanthey palp-hi-eyo.
zebra-NOM pig-DAT trample-PSV-SE
'The zebra is trampled by the pig.'

khokkili-ka holangi-hanthey kkocip-hi-eyo.
elephant-NOM tiger-DAT pinch-PSV-SE
'The elephant is pinched by the tiger.'

Table B-3. 1st norming: sentences only

	Active transitive		Suffixal passive		Two nouns only (active transitive)	
	Mean	SD	Mean	SD	Mean	SD
Canonical	3.72	0.30	3.80	0.09	3.60	0.30
Scrambled	3.38	0.23	3.58	0.10	3.47	0.33

Table B-4. 2nd norming: sentence-picture pair

	Active transitive		Suffixal passive		Two nouns only (active transitive)	
	Mean	SD	Mean	SD	Mean	SD
Canonical	3.72	0.27	3.60	0.09	3.75	0.15
Scrambled	3.60	0.09	3.52	0.12	3.65	0.10

Table B-5. 3rd norming: sentence-picture-recording pair

	Baseline		All conditions except for baseline	
	Mean	SD	Mean	SD
Naturalness of recording	4.00	0.00	3.93	0.26
Inferability	4.00	0.00	3.52	0.50

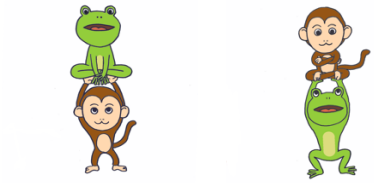
Table B-6. The entire procedure of the picture selection task

Step	Action	Note
Introduction	Say hello to our friend (pointing to the screen) Picture   Today he will study Korean. But he seems to have difficulty studying. How about we help him with his study? (“Yeah~”) If you see pictures, you will listen to a sound. Let’s listen to the sound and press the button that matches the picture.	Two pictures of the main character were presented; one automatically changed to the other

Table B-6. The entire procedure of the picture selection task (Cont'd)

Step	Action	Note
Training	Let's practice first. Picture   Sentence presented: cat-NOM dance What was said just before? Right, good job. Picture   Sentence presented: exercise What was said just before? Right, good job. Picture   Sentence presented: rice-ACC eat What was said just before? Right, good job.	Positive feedback was always provided to participants, irrespective of their responses, with the picture of the main character: 

Table B-6. The entire procedure of the picture selection task (Cont'd)

Step	Action	Note
Transition	We understand what we are going to do, right? Now we are going to help our friend. Are you ready? ("Yeah~")	The main character appeared on the screen again, letting participants know the actual task started: 
Main task	Picture:  Sentence presented: monkey-ACC frog-NOM lift	The composition of the screen for every item in the actual task was equal to that in the practice session No feedback was provided from the main character at this point, but I gave positive feedback to the participants in every response that participants made
Closing	He looks very happy~ Was it fun? Let's help him more later, shall we? Say goodbye to our friend. See you next time!	Stickers were given to children