UNIFORMITY OF PRONOUN CASE ERRORS IN TYPICAL DEVELOPMENT: THE ASSOCIATION BETWEEN CHILDREN'S FIRST PERSON AND THIRD PERSON CASE ERRORS IN A LONGITUDINAL STUDY

BY

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DISSERTATION

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ABSTRACT

The purpose of this study was to determine if grammatical case is acquired as a unified system or if it is acquired in a piecemeal fashion. Case is a property of sentences that codes subjects and objects for their roles in sentences. In the course of typical English language acquisition, some children make errors in marking case on subject position pronouns (e.g., *Me* do it, *Him* like it; Huxley, 1970; Rispoli, 1994; Schütze & Wexler, 1996; Vainikka, 1993). It is an assumption of generative linguistic accounts that the case system is unified with case assignment uniform across grammatical person. A prominent account of the phenomenon posits a link between case and finiteness (i.e., tense and agreement; Schütze, 1997; Schütze & Wexler, 1996). Cognitive linguistic accounts do not posit uniformity and have claimed there is a causal link between the errors and a pattern found in input, in which subject pronouns in embedded clauses are standardly assigned object case (e.g., Let *me* do it; Kirjavainen et al., 2009; Pine et al., 2005). Previous literature had not established whether the same children who make first person errors (i.e., *me* or *my* used for *I*) also make third person errors (i.e., *him*, *her*, *them*, for *he*, s*he*, *they*), a pattern that would be congruent with generativist linguistic accounts, but not necessarily with cognitive linguistic accounts. Previous literature had not established whether errors in first person pronouns are made at the same point in development as errors with third person pronouns, which would be expected if case were uniform across person. Previous literature had not examined whether first person pronoun case errors or finiteness could predict the presence of third person pronoun case errors.

Spontaneous pronoun case errors were collected from language samples of 43 typically developing toddlers interacting with their primary caregivers and examiners. Language samples were collected at 21, 24, 27, 30, 33 and 36 months of age. Association of errors across person was tested with a chi-square test using data from the entire longitudinal sample by asking whether children were more likely to make both types of errors. The uniformity of the system was further investigated by asking whether errors in first and third person occurred at the same time using a Wilcoxon signed-ranks test. Logistic regression was used to test the predictive value of first person error, vocabulary size, and finiteness development on third person pronoun case error.

Most children treated case uniformly in the first and third persons, producing both first and third person pronoun case errors or producing no case errors at all, resulting in a significant association. Of the 43 children, 23 children produced both first and third person errors, seven children produced only first person errors, five children produced only third person errors and eight produced neither. Additionally, errors were not significantly different in timing. Neither the peak number of first person errors nor their duration between 21 and 30 months predicted the presence of third person errors from 30 to 36 months. Likewise, the number of different words at 30 months of age, a measure of vocabulary size, did not predict the presence of third person error. However, tense/agreement accuracy at 30 months, a measure of finiteness development, was a significant predictor. Children with lower tense/agreement at 30 months were more likely to produce a third person pronoun case error between 30 and 36 months.

The results of this investigation lend support to the assumption of generative linguistic accounts that case is a unified system. Errors are associated across person, and errors in first and third person overlap in development. Pronoun case is not acquired in a piecemeal fashion with case being acquired separately for each grammatical person. Further, a deep connection between finiteness and third person case errors was confirmed. Taken together, these results implicate the existence of abstract grammatical features early in development.

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TABLE OF CONTENTS

CHAPTER 1

Literature Review

The Phenomenon of Pronoun Case Errors

Within the field of developmental psycholinguistics is a longstanding tradition of examining children's developmental errors during the course of language acquisition. Similarities among young children in meeting linguistic milestones and producing grammatical errors have led to hypotheses regarding the process of language development (Bellugi, 1968; Slobin, 1970). With Brown's (1973) detailed observations of three children's developmental patterns of inflectional morphology began a trend of studies examining the emergence and mastery of numerous grammatical structures and the errors that occurred when children attempted these structures (de Villiers & de Villiers, 1973; Pinker, 1981). Such errors have been seen as a window into children's representations of language at a given time. More generally, such studies help us understand the human language making capacity.

Among the developmental errors that have been investigated are sentences lacking grammatical case marking from young children acquiring English. Case errors from typically developing children in which an object or possessive pronoun is produced in a subject pronoun context such as "*Her* watching TV" (Wexler, Schütze, & Rice, 1998) or "*My* can do this" (Rispoli, 1994) have been widely documented. Errors also exist in which subject forms are used in contexts for object pronouns or possessive pronouns, e.g., "I want *they*" (Rispoli, 1998). These latter errors have been reported to occur far less frequently than the errors on subject targets; hence, most researchers have chosen to focus on errors in the subject position (Rispoli, 1998; Tanz, 1974).

Case. Investigating developmental pronoun case errors could uncover clues specifically about how children acquire grammatical case. Case is a grammatical feature related to a noun phrase's (NP) semantic role (Haspelmath, 2002). It has been described as a system that marks nouns based on their dependent relationships with verbs, prepositions, or other nouns in the same clause (Blake, 2001). Kittilä, Västi, and Ylikoski (2011) described high variability in definitions of case in the linguistic literature but noted similarities too. In all definitions, case was described in terms of the relationship between nouns and verbs. Specifically, nouns in clauses have semantic roles such as agent or patient, and case is a systematic way of marking their grammatical relations, such as subject, direct object, or indirect object, to one another and to the verb (Kittilä et al., 2011). However, agents and patients do not always align with subjects and objects. For example, in passive sentences, children must learn that the participant affected by the action needs to be coded as the subject. The relationship between the nouns and verbs in sentences provides this information.

In English, grammatical case (i.e., nominative, accusative/dative, genitive) is apparent on personal pronouns and certain other NPs. Whereas nominative case marks NPs as sentence subjects (i.e., *I, he, she, they*), accusative and dative case mark NPs as direct and indirect objects (i.e., *me, him, her, them*), and genitive case marks possession through pronouns (i.e., *mine, his, hers, theirs*) and determiners in NPs (e.g., *my, his, her, their*). Children acquiring English must learn the function of each case to use pronoun forms correctly.

Person. Subject and object case distinctions vary by grammatical person. Person is a classification of pronouns that distinguishes the speaker (i.e., first person) from the

listener (i.e., second person). Additionally, there exists a third category (i.e., third person), which is "definite" and "objective," meaning that its referent does not change depending on the speaker (Forchheimer, 1953, p. 5). Benveniste (1971) added that third person is actually a "non-person" because its function is to replace a name given in the discourse rather than to refer directly to speakers as *I* and *you* do (p. 221). Adopting Benveniste's view, Harley and Ritter (2002) incorporated the first/second person versus third person distinction into a pronoun hierarchy with a participant node that included only first and second persons, with third person arising only when the participant node is absent.

An investigation of pronoun case errors must first identify which grammatical persons distinguish case. In English, case is contrastive between subjects and objects only for the first and third persons (e.g., *I* vs. *me*; *he* vs. *him*). In the second person, *you* is used for both. Accordingly, errors substituting object case for subject case can only exist in the first and third persons. The complexity of a construction and its difficulty to produce are also considerations (Stromswold, 1996). The switching reference of *I* and *you* or the third person's ability to take on subdivisions such as gender could affect children's performance (Forchheimer, 1953).

The pronoun paradigm. Pinker (1984) portrayed pronouns and other grammatical structures as being organized in a paradigm. The child must sort out the paradigm before correctly using adult grammatical distinctions. Pinker (1984) described the paradigm as a matrix with grammatical feature dimensions that each carry values. For English, the four grammatical features (and associated values) that can be carried by a personal pronoun are number (singular or plural), person (first, second, or third), gender (masculine, feminine, or neuter) and case (subject, object, or genitive).

Figure 1 illustrates the English personal pronoun paradigm displaying all four features in a single diagram. The paradigm organizes overlapping values of two or more of these features. For example, the two values of second person and genitive case overlap onto the form *your*. Pronouns with values for more of these four features are more specific in their use than pronouns with values for fewer features. For example, like *your*, the pronoun *my* also carries values for the features person (i.e., in this instance first person) and case (i.e., genitive), but it is only used for singular number, an additional third feature relative to the two carried by *your*.

The task for the child is to learn what grammatical features can apply to pronouns and which junctures of features have a form specific to them. In Figure 1, pronouns that intersect more features are represented by a smaller box. The smaller the box is, the more specific the pronoun. In the adult paradigm of English personal pronouns, only four of 16 forms carry one value for each of the four features (i.e., *he*, *him, his*, and *she*). Thus, a child most commonly hears uses of less specific pronouns (i.e., *I*, *you*) but must still learn the values of number, person, gender, and case for these four most specific forms (Pelham, 2011). The high frequency of the less specified pronouns such as *you* in input directed to children might put children at a disadvantage for acquiring case. In other words, adult input makes the system appear simpler than it really is because highly specified forms are underrepresented in the input.

A Unified System or Piecemeal Acquisition?

An open question regarding the development of grammatical case is whether the case feature is acquired and applied uniformly across the entire pronoun paradigm or if instead children must learn case distinctions (e.g., subject vs. object) for each pronoun form.

The first alternative posits that case is acquired as a unified system. If acquisition were unified, all subject pronouns would begin to have correct case once a child learns subject case. That is, regardless of person, number or gender, correct case will be uniformly applied. More exposure to some values of features relative to others (e.g., singular > plural; first person > third person) could produce a slight offset in when errors corresponding to these features are resolved, but a unified case system would mean that case is marked similarly across features overall. For example, a child who correctly uses the first person subject *I* should also correctly use the third person subject *he* (i.e., different grammatical person) within a short time frame. Likewise, a child who correctly marks case on the subject *he* should also correctly mark case on the subject *she* (i.e., different grammatical gender) if *she* is attempted. This scenario would also entail that when a child does not fully understand the conditions of case marking, case errors could be made on any pronominal subject regardless of person, number or gender. For example, children who are making errors on first person pronouns would be expected to make errors on third person pronouns at the same time if they attempt them (Wexler et al., 1998).

A second way to conceptualize case acquisition is that case is acquired in a piecemeal fashion. In other words, the child would acquire case distinctions individually for each pronominal form. In such a scenario, a child may acquire case for one person, number or gender while making case errors for other intersections of these features. For example, a child may correctly produce *I* as a subject but make pronoun case errors on *he* and *she* targets because the subject-object case distinction had only been acquired for first person. From this perspective, the reverse is also possible: *he* and *she* subjects could be produced

correctly during a time of *me* for *I* or *my* for *I* errors (Kirjavainen, Theakston, & Lieven, 2009; Pine, Rowland, Lieven, & Theakston, 2005).

Another possibility is that children will not trend in either direction as a group. Thus far, the literature has not explored the possibility that as individuals, children may provide mixed support for a unified system and piecemeal acquisition of case. Some children may display overlapping first and third person errors while other children produce only one type of error or errors that do not overlap in time. Studying the relative timing of developmental pronoun case errors could provide insight into whether an underlying case relationship exists across the pronoun paradigm. An overlap in the timing of errors in which first and third person errors occur followed by a period of correct use for both persons would support the position that case is acquired as a unified system. If children mainly produce both first and third person errors, then the only support for piecemeal case acquisition would come from a pattern of some children continuing to produce third person errors after first person errors end, and other children continuing to produce first person errors after third person errors end.

The potential for a case association to exist across person could be examined by determining if children who make pronoun case errors in one person (i.e., first person) also make them on pronouns representing a different grammatical person (i.e., third person) during the same developmental period. However, the literature is unclear about whether children who make first person errors (e.g., *Me* do it) also make third person errors (e.g., *Him* do it) and if so, whether the two types of error overlap in time. Evidence that children either apply case information uniformly across person, apply it discriminately across different lexical forms, or differ at the level of the individual child could have implications

for how other grammatical features are learned and ultimately what mechanisms underlie language acquisition.

In the next sections, the empirical evidence and theoretical explanations for pronoun case errors are reviewed in detail. First, the available developmental data on pronoun case errors is described with attention to the ages when pronoun case error has been studied. A critique of methodological decisions follows. Then, theoretical explanations for the data are described. Lastly, the gap in the current knowledgebase regarding the timing of pronoun case errors is discussed. The potential for an association between first and third person errors is considered from the perspectives of the theoretical explanations described. Asking whether there is an association between case errors of different persons is not a test of any specific theoretical explanation reviewed. Rather, it is a test of the fundamental assumptions underlying these perspectives, that there is, or is not, a case system stretching across person during this stage of development. Potential support for either piecemeal acquisition of case or a unified, underlying case system is then considered.

When have pronoun case errors been observed?

The numerous existing studies of pronoun case errors suggest that toddlers produce pronoun case errors over a several month span that coincides with the development of sentence structure and other grammatical inflections. With advances in the study of early grammatical development, it is easier now to narrow the window of time for searching for errors than when early studies were conducted. Previous studies include spontaneous language samples collected from typically developing children as young as 12 months (Rispoli, 1994) and older than 4 years old (Chiat, 1980) or even 5 years old (Moore, 2001). It is unlikely that the youngest children at 12 months would produce a context for a

pronominal sentence subject as 12 months is the average age for first spoken words (Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991). Pronoun case errors could only be expected when children have begun their earliest sentences. Between 12 and 36 months, children produce far more first person pronoun subjects than third person pronoun subjects (Rispoli, 1994). More precisely, children's sentence subjects expand to include third person subjects by 30 months (McKenna, 2013). Once this occurs for an individual child, third person errors on pronouns could begin. In addition, Radford (1990) noted the absence of case during the period in which children combine words to form child-like sentences lacking tense and agreement marking, i.e., finiteness marking. Hence, an appropriate time to study pronoun case errors in spontaneous samples is after children begin producing their first sentences and before finiteness mastery.

Figure 2 displays ages for which pronoun case error has been investigated and the language level where typical children of each age would be expected to be. The figure illustrates that children in studies of first person case errors were generally younger than children in studies of third person case errors. Additionally, the ages of children in these studies is displayed relative to the ages of milestones for other aspects of grammatical development from first word combinations to the emergence and mastery of tense and agreement morphemes (Radford, 1990; Rice, Wexler, & Hershberger, 1998).

Studies of first person errors. The youngest children for whom first person subject contexts were examined are from Rispoli (1994). Rispoli observed first person errors, both *me* and *my* for *I* errors, from 12 children. Monthly language samples from 12 to 36 months were collapsed and all pronouns were examined without regard to age, so it is not possible to know that children made first person errors beginning at 12 months or that

they made them all the way up to 36 months. Rispoli (1994) found that *me* for *I* errors are far more common than *my* for *I* errors and that children vary widely in percent error, ranging from errors in 1% to 55% of first person pronominal subject contexts.

Budwig (1989) and Kirjavainen et al. (2009) included participants from a narrower range of ages. Budwig (1989) examined language samples for *me* and *my* errors from six children ranging from 20 to 32 months old. Three of the six, including the two youngest and a child at 30 months, made first person errors. Kirjavainen et al. (2009) searched for first person *me* and *my* for *I* errors that were combined with a verb (e.g., "*Me* do it" but not "*Me* happy") in longitudinal language samples. The samples were from 17 children between the ages of 22 months and 5 years old. These were pared down by a mean length of utterance (MLU; Miller & Chapman, 1981) criterion to include nine consecutive language samples beginning with the first sample having MLU ≥ 2.0. The analyzed samples were collected between ages 22 and 33 months. Fifteen of 17 children produced at least one first person pronoun case error. The child who provided the earliest sample at 22 months and the child who provided the latest sample at 33 months both produced both *me* and *my* errors. Three of the 17 children never produced a *my* error and four never produced a *me* error. Kirjavainen et al.'s (2009) findings were consistent with Rispoli's (1994) finding that *me* for *I* errors have a higher error rate that *my* for *I* errors do. Specifically, the study revealed that the 13 children who made *me* for *I* errors made them in up to 63% of all *I* + verb contexts, but the 14 children who made *my* for *I* errors made them only in about 10% of *I* + verb contexts. Ten of the 13 who made *me* for *I* errors used 5 or fewer *me* subjects compared to over 100 to several hundred correct *I* uses; accordingly, they had error rates

near 1%. Of the children who made *my* errors, nine made 5 or fewer errors, yielding error rates under 3%.

Reports of first person errors also come from case studies. Vainikka (1993) and Schütze and Wexler (1996) reported that Nina (Suppes, 1973) made both *me* and *my* first person case errors between the ages of 23 and 29 months. Nina's language samples comprised an average of 3.3 recordings per month. In her first 6 language samples, during the weeks between ages 23 months and 24 months, Nina used subject *my* 50 times and subject *I* 7 times. Nina produced only 2 *me* for *I* errors in all files, the first in file 7 also at 24 months and the other in the next available language sample at 25 months (Vainikka, 1993). Nina's first *my* subject occurred during her second of three recordings at age 23 months. She continued to use subject *my* until at least 25 months.

Schütze and Wexler (1996) found that Peter (Bloom, 1970) made first person errors between 23 and 29 months less often than Nina did, in 11 of 283 contexts, or just under 4% of the time in contexts for which the authors could determine if finiteness had been marked. Bloom (1970) collected 1 to 2 samples per month from Peter. He produced *my* errors from 23 to 29 months and produced *me* errors in every sample between 24 and 28 months (Schütze & Wexler, 1996). Huxley (1970) recorded first person errors from one child, Douglas, whose weekly samples span age 27 months to at least 41 months. Douglas began making first person errors at 31 months and continued making them until 36 months (see also Tanz, 1974). In comparison to children in the other studies reported here, Douglas' errors seem to occur at an older age than other children's.

From these studies, the most conservative estimate of when first person case errors occur based on most children's data is sometime after 20 months and before 33 months of

age. This estimate is drawn from data in the studies above that reported the ages of the children who contributed errors. Because Douglas was possibly at a lower language level and the children on the extremes of Rispoli's (1994) age range may not have made errors, they are excluded from this estimate. Future studies should investigate first person pronoun case errors during the 20 to 33 months age range beginning just after 20 months. The beginning of this age range overlaps with when children begin producing their earliest first person sentences (Villa, 2010). These subjects are often first person subjects possibly because children master a first person simple sentence schema (Tomasello, 2000) or because children's early communicative attempts between 20 and 32 months often pertain to themselves (Budwig, 1985, 1989). Additionally, Valian (1991) reported that for 10 children between 22 and 32 months, the vast majority of the children's sentence subjects were pronoun NPs, with this rate growing as age and MLU increased within this range.

Studies of third person errors. Like with first person errors, group studies of multiple children are the most helpful in determining the timing of third person errors (see Figure 2). Loeb and Leonard (1991) examined spontaneous and elicited utterances from eight children between 35 and 40 months, and found wide variation in rate of third person pronoun case error. Of the eight children, seven produced pronoun case errors. Three children produced 7 or fewer errors out of over 200 contexts, and they had error rates under 3%. The other four children ranged from 38% to 69% error. The children with error rates over 60% had 31 or fewer contexts for third person subject pronouns, underscoring the fact that variation in the denominator of an error rate calculation can lead to difficulty in comparing children by when using percent error.

In Rispoli's (1994) cross-sectional study described previously, third person errors were also reported on from the same 12 children between 12 and 36 months. Because the monthly language samples were collapsed, the age of the children at the time the errors occurred is not reported. However, all 11 children who attempted *she*, made *her* for *she* errors with 10% to 88% error rates and 11 of the 12 children who attempted *he*, used *him* or *his* instead with 1% to 14% error rates. Rispoli (1994) reported third person plural errors for 9 of the 12 children with 1% to 22% error rates. This study demonstrated that third person errors began before age 36 months for these children. Rispoli (2005) also reported third person errors for a cross-sectional sample of 44 children ranging in age from 12 to 48 months with a mean age of 36 months. Their mean error rate was 17% and ranged from 0% to 70%. Moore (1995; 2001) examined errors from children older than those in the studies reviewed above. Moore (1995) found that eight children, including both the youngest and oldest, in a group (N = 10) aged 2;11 to 3;5 months made third person errors with error rate ranging from 18.75% to 100%. However, children in an older group (N = 10) aged 4;10 to 5;6 did not. Moore (2001) examined third person case errors in a group of children (N = 12) between 3;1 and 3;8 and another group (N = 12) between 4;2 and 5;4. Errors arose for both groups although the older group, as a whole, made only 2 errors out of 1579 contexts. The younger group's average error rate was 81.4%. The ages of the children who contributed errors to either group are not reported. Pine et al. (2005) examined samples for children much younger than the children in Moore (2001). They discovered errors for seven of 12 children between 22 and 36 months old. All seven had error rates under 17% with the number of contexts ranging from 12 to 511. Similar to the three toddlers in Loeb and Leonard (1991) who made few errors, four of the seven children

in Pine et al. (2005) made only 1 or 2 errors. Finally, in a longitudinal study, Wexler et al. (1998) collected spontaneous samples from 20 children when they were an average age of 36 months and again when their average age was 43 months. At 36 months, the children made *her* for *she* and *him* for *he* errors at a group average rate of 15% and at 43 months made such errors in 17% of contexts on average. Wexler et al. (1998) reported that these children were not making *them* for *they* errors at 36 or 43 months old.

A number of case studies also document when third person errors occur. Vainikka (1993) reported that Nina made third person case errors between 23 and 29 months of age. With these samples combined, Nina used *him* or *her* as a subject in a *he* or *she* context 134 times out of 528 opportunities, or 25% of the time. It is not reported whether Nina made third person errors at every sample during this entire period and whether she made errors after. Schütze and Wexler (1996) searched for third person feminine contexts in Sarah's (Brown, 1973) language samples and found she did not begin making errors until 32 months and made them until at least 37 months when her samples ended. Sarah produced *her* for *she* in 17 of 62 contexts, or 27% of the time. Lastly, Douglas (Huxley, 1970; Tanz, 1974) first made *her* for *she* errors at 32 months and *him* for *he* errors at age 34 months, and ceased all third person errors at 41 months.

It is undetermined when third person errors begin, but the available data suggest that they start after or at least last longer than first person errors do. The data reported in the available literature indicate that third person errors occur when first person errors have ceased, but may also occur earlier with the two types of errors overlapping. Taken together, the studies above indicate that with little exception, for children who make third person pronoun case errors, the errors begin before age 36 months.

Only some studies of first person case error also examined third person case errors. In some instances, children were not old enough to have begun making third person case errors, and other times, the third person errors were simply not a question of interest to the researchers. Similarly, a number of studies examined only third person errors because of a theoretical motivation or because the children were older and not making first person errors. Unlike the period for first person errors in which children's unmarked finiteness contexts are growing, third person errors appear to occur during a time in which the child-like absence of inflection is decreasing and finiteness is becoming marked more often and more accurately (Fitzgerald, Rispoli, Hadley, & McKenna, 2012; Rice et al., 1998). A consequence of previous studies' focus on only first or only third person errors is that the presence of an association has not yet been determined.

Methodological approaches to collecting errors

The current lack of evidence for either association or independence of pronoun case errors can be attributed to the methodology used in previous studies. Previous studies have varied in how child participants were selected and in what pronouns were examined. In the earliest reports of pronoun case errors, children's language samples were often collected for the analysis of some other language structure with pronoun case errors being examined as an afterthought (e.g., Budwig, 1989; Huxley, 1970). In other cases, pronoun errors were examined by researchers not connected to the original data collection (e.g., Schütze & Wexler, 1996; Vainikka, 1993). This meant that the predicted timing of pronoun case errors was not a motivation in the timing of language samples, leading to wide variation in the ages of children studied.

An additional source of variation that makes comparisons across studies difficult is that researchers developed idiosyncratic criteria for including children in their studies. For example, Kirjavainen et al. (2009) used nine language samples beginning from when the child's MLU was over 2.0. Using these files was sufficient for the purposes of their study, but they may have missed the onset and full duration of errors for some children that other studies captured. On the other hand, Rispoli (1994) examined data from children as young as 12 months before most children have begun producing sentences. Investigations of pronoun case error would benefit from sampling focused on the development of sentences, as the errors will only be encountered when children are producing sentences.

Some studies have investigated subject pronoun contexts for only a subset of children in the available database. Rispoli (1994) excluded one of 12 children for not producing a minimum of 5 contexts for *she*. In Pine et al.'s (2005) investigation of subject position errors, nine of 12 children were excluded for not producing enough spontaneous pronoun case errors, although a total of seven of the 12 produced at least one third person subject pronoun case error. Ambridge and Pine (2006) likewise used data from only five children out of the original 24 in their sample. Future studies should pay careful attention to why some children seem not to make pronoun case errors if the goal is to understand how typically developing children acquire case. A gap in the current knowledgebase is how variable a sample would be on measures of pronoun case error if the children had not been selected for producing errors but instead were more representative of the general population of typically developing toddlers.

Previous studies also have varied in study design, pooling data in different ways and using differing approaches to collecting errors. Commonly, spontaneous pronoun case

error data has come from language samples of individual children in case studies (Budwig, 1989; Huxley, 1970; Schütze & Wexler, 1996; Tanz, 1974; Vainikka, 1993). Spontaneous data also comes from cross sectional studies (Rispoli, 1994, 2005), longitudinal studies (Wexler et al., 1998), and from groups of children within a given age range (Kirjavainen et al., 2009; Loeb & Leonard, 1991; Moore, 1995, 2001; Pine et al., 2005). Pooling data from children of different ages does not provide the same information that a longitudinal study can; namely, these studies often do not report which children contributed errors. Comparing children of different mean ages conceals how children sort out the pronoun paradigm over time. Pronoun case errors have also been examined in elicitation probes (Hatch, 1969; Loeb & Leonard, 1991; Wisman Weil, 2013) and receptive tasks (Grinstead, Donnellan, Barajas, & Johnson, 2013). Probe data is useful for assessing what forms children judge as grammatical and are able to use but also cannot answer how case develops over time and whether an association exists across the person feature.

To summarize, errors made on first person targets (i.e., *me* or *my* used for *I*) have been observed from children in group studies up to 33 months. Errors on third person targets (i.e., *her*, *him*, *them*, for *she*, *he*, *they*) have been reported from groups of children up to 44 months. First person errors may overlap with third person errors or they may occur sequentially given that the maximum age reported for first person errors is nearly a year younger than the maximum age reported for third person errors. This is a gap in the current knowledgebase in developmental psycholinguistics. This gap warrants a study investigating the timing of pronoun case errors of differing grammatical person (i.e., first and third). If either association or independence of errors were established across the person feature in the development of case marking, the study of language acquisition

would gain a better perspective on the process of acquiring grammatical case. Specifically, we would learn whether toddlers possess a representation of case that stretches across pronouns, in effect, a system of the expression of case.

Theoretical Approaches to Pronoun Case Errors

A number of proposals have tackled the basic questions surrounding the phenomenon of pronoun case error in English. These proposals have put forth explanations for how errors occur and for some, why children eventually cease making errors and begin marking case correctly. To date, no study has directly addressed the question of whether case is learned as an underlying connected system that applies to all pronominal subjects synchronously or if instead case marking is learned for each pronoun in its own time. In this section, each proposal will be discussed including its explanation for why pronoun case errors occur. This is followed by the kinds of errors the proposal predicts and empirical evidence that supports and challenges it. Next, this review states if the proposal has made any prediction regarding when to expect errors. Lastly, this literature review addresses whether each proposal assumes a unified representation of case.

Generative linguistic studies. Generative linguists emphasize how the child analyzes parent input to create rules governing grammar. Focus is placed on the child's knowledge of grammar at a given time and pronoun case errors are said to occur as a reflection of the child's current linguistic knowledge. These explanations are situated in linguistic theory, particularly Chomsky's (1981) Case Theory, part of Government Binding Theory. Successors to Case Theory have approached the task of language acquisition as a series of decisions, governed by universal principles, to be made about various parameters in the language, such as case assignment. In this view, children must determine a setting for

each parameter. As an example of how generativists view principles and parameters, children acquiring any language must know the principle that all noun phrases must have case. Children must then learn the correct parameter setting for case marking in their particular language. In English, the correct parameter setting is the nominative-accusative distinction, which means that sentence subjects are treated differently than sentence objects. Children learning English must also discover that accusative is the default case in English and that English marks case overtly on pronouns but not overtly on nouns. Finally, children acquiring English must learn the specific forms that signify each case.

Case theory. Radford (1990) provided an early account of why pronoun case errors occurred. Radford's analysis hinged on Chomsky's (1981) introduction of a functional category called I (for Inflection), which included forms inflected for tense (e.g., *is,* verbal *-s*). In Chomsky's Case Theory, the category I was responsible for assigning nominative case to sentence subjects. Radford's description of pronoun case error relied on updates to Case Theory that left open the possibility that children could acquire tense and agreement as distinct functional categories able to serve different functions in a sentence. In this view, case could be assigned when I was marked for agreement with tense being irrelevant. Also, errors such as "Him go" occur because children do not know the functions of I. When I is not marked for agreement, the verb is bare and subject case is not assigned. In fact, the literature provides support for such errors being far more common than an error such as "Him goes" in which I is marked for agreement but subject case was not assigned (Schütze & Wexler, 1996). However, recent data suggests "Him goes" type errors are more common than previously thought (Grinstead et al., 2013). Radford (1990) did not make predictions regarding when pronoun case errors should be expected. Radford viewed adults as having

a unified representation of a case system but viewed children as lacking case as a formal property during the time when they use objective pronouns in both object and subject position. In other words, young children have no rules governing a subject-object case contrast. Since this contrast occurs across both first and third person, young children's lack of knowledge of nominative case assignment causes both first and third person pronoun errors systematically (Radford, 1990). Therefore, there is no piecemeal acquisition once knowledge of inflection is learned.

Paradigm building hypothesis. Rispoli (1994) also followed the generative linguistic tradition of using the state of the adult grammar as a point of comparison for child productions. Rispoli (1994) was like Radford (1990) in viewing the category I as responsible for uniformly assigning case regardless of person. Additionally, Rispoli (1994) brought Pinker's (1984) hypotheses concerning paradigm acquisition to bear on the acquisition of English personal pronouns. Rispoli (1994) described the task of learning pronouns as the child looking for patterns in the language and extracting out similarities in forms belonging to the same grammatical class and sharing meaning. Some shared meanings are easier for children to detect because they are commonplace in the language. For example, the feature number is marked abundantly on nouns, and children mark number in single words and phrases before they attempt sentences with pronominal subjects. Thus, children may anticipate that pronouns also carry meaning for number. On the other hand, gender and case are not marked anywhere else in the English language, so children might take longer to include these features in their paradigms. Empirical data show an absence of number errors at a time when children are making case and gender errors (Loeb & Leonard, 1991). According to Rispoli (1994), the use of commonly mapped

meanings such as number explains why certain forms tend to replace certain other forms (e.g., *me* for *I,* not *we* for *I*). Rispoli (1994) says that phonetically consistent features across multiple pronouns forms that share the grammatical features of person and number will form a phonetic core. For English personal pronouns, a phonetic core arises for the forms carrying 1st person singular information (i.e., *I, me*, and *my*) because two of the forms start with *m*-. An even stronger core exists for third singular masculine (i.e., *he*, *him*, and *his*) because all three forms begin with the same phoneme, *h*-. These consistent phonemes will be perceived as a stem and their syllable rimes as affixes according to Rispoli (1994). The addition of a phonetic core to a hypothesis explaining pronoun case errors accounted for why *me/my* for *I* errors and *him/his* for *he* errors existed among collected errors. It also captured the trend that third person nominative overextensions occur mostly for the masculine gender (i.e., *he* for *him*) whereas first person nominative (i.e., *I* for *me*) overextensions rarely occur (Rispoli, 1994). In a later publication, Rispoli (1998) presented additional data to support this portion of the pronoun paradigm building hypothesis.

Rispoli (1994) did not predict when errors should occur, but predictions based on an association across person can be made. Since the phonetic core for first person differs from the phonetic core for third person, correct case marking in first person should not affect correct case marking in third person and vice versa based on this data alone. Rispoli (1994) also stated that it is not clear that a phonetic core exists for *we, us*, and *our*, so it is not possible to make predictions for errors on first person plural pronoun targets even when predictions can be made about first person singular targets. Thus, at first glance it may seem that Rispoli supports a piecemeal view of case acquisition. However, Rispoli (1994) intended only to describe patterns of pronoun case error and not to explain how

they occur. Recall that this empirical study was framed in the traditions of both Pinker's paradigm building view in which relationships among grammatical features do matter, and Chomsky's Case Theory. Hence, it would be inexact to say that Rispoli (1994) viewed pronoun case acquisition as a piecemeal process. Rather, later work indicates the opposite, that children make use of the entire suite of grammatical features carried by pronouns in order to sort out the pronoun paradigm in a systematic way (Rispoli, 2009).

Agreement tense omission model. Wexler and colleagues agreed with Radford (1990) that a deterministic relationship exists between agreement and case in which nominative case marking on subject pronouns can only occur when I (Inflection) has been checked (i.e., structurally assigned) for agreement (Schütze & Wexler, 1996; Wexler, 1994; Wexler et al., 1998). However, Wexler et al. differed from Radford (1990) in their explanation of why pronoun case errors occur. The main distinction is that whereas Radford claimed children did not have knowledge of the properties of I, Wexler et al. maintained that children do, but they do not understand the obligatory nature of marking tense and agreement in main clauses in English (Schütze & Wexler, 1996; Wexler, 1994; Wexler et al., 1998). Wexler proposed Very Early Parameter Setting (VEPS), contrary to Radford's claim. VEPS stated that children have set parameters for features of their grammar at young ages and errors do not occur from lack of knowledge (Wexler, 1998; Wexler et al., 1998). Schütze and Wexler (1996), calling the Inflection category INFL, claimed that children know that when INFL contains agreement, nominative case must be used on subjects. Additionally, pronoun case errors are a direct consequence of being in the optional infinitive stage (OI; Wexler, 1994). In the OI stage, agreement is not consistently marked on INFL, which means that case cannot be consistently marked on subjects.

Children use non-nominative forms (e.g., *him, her*) because when a subject is not specified for case, a default form is used instead. In English, the default case is accusative (i.e., *me, him, her, them*). Data from Schütze and Wexler (1996) indicated that usually when a child made a pronoun case error in subject position (e.g. *her* for *she*), the verb in the sentence was an OI form (i.e., not inflected for tense and agreement).

Wexler et al. (1998) incorporated predictions made in Schütze and Wexler (1996) and in Schütze (1997) in a model called the Agreement/Tense Omission Model (ATOM), which unified their previous predictions. ATOM explained how individual utterances could be optionally marked for agreement on verbs and for case on subject pronouns. Specifically, within INFL, agreement and tense are separate functional categories. Children know the properties of INFL, but following with the OI model, ATOM operates on the claim that children do not know that verbs in main clauses must always be finite.

ATOM gives rise to predictions about four types of errors and whether they should occur. They were named according to whether the subject is nominative (i.e., NOM) or non-nominative (i.e., non-NOM) and whether agreement is marked or unmarked (i.e., [+agr] or [–agr]; Wexler et al., 1998). The first error is non-NOM [–agr] (e.g., *Her* run), in which missing agreement causes a pronoun case error. The non-NOM [–agr] error is predicted to occur frequently. A second kind of error is also non-NOM [–agr] with an inflected verb (e.g., *him* cried). These errors were previously known to occur. This error surfaces when the child's syntactic frame includes tense but not agreement. In the third error type, NOM [–agr], a nominative subject is used without correct verbal morphology (e.g., *She* run). This type of error also occurs relatively frequently, but it is not a problem for ATOM. It arises when the tense feature is not specified, but agreement is. The subject pronoun can still

receive case from the agreement feature, but tense is optionally omitted. Tense shares the verbal *-s* affix with agreement, so neither feature is phonetically realized, resulting in the OI verb form. The rare instances of a fourth kind of error appear to be NOM [+agr], (e.g., *him* runs). They occurred on average in 8% of all subject pronoun case errors for 20 typically developing 3-year-olds. Wexler et al. (1998) acknowledged that these occur even though they should not have occurred according to ATOM's predictions. The authors predicted that these errors will occur less frequently than the other error types described on the basis of such a trend existing in their data and lasting over six months.

Evidence supporting ATOM comes from examinations of spontaneous language samples that were reported in Schütze and Wexler (1996) and Schütze (1997). The model was not intended to describe any particular stage in development as OI was (Schütze, 1997). Instead, ATOM explains how knowledge of grammatical features applies at the sentence level. Schütze and Wexler (1996) examined first and third person errors in Nina's files and first person errors only in Peter's files. They found that when the children produced subject pronoun case errors, agreement was not typically marked in the sentence (e.g., *Her* run). This was true for 95% of Nina's first person errors and 95% of her third person errors, and it was also true for 98.8% of Peter's first person errors.

Wexler (1998) proposed a supplemental model of children's errors. It stated that children possess Very Early Knowledge of Inflection (VEKI) and that despite this knowledge of INFL, a computational constraint called the Unique Checking Constraint (UCC) operates on the child's knowledge during the OI stage. The model states that functional categories such as agreement and tense have features that are not interpretable and must be checked (Wexler, 1998). In adult linguistic theory, tense is checked first and

then agreement is checked. The UCC model stated that children in the OI stage can only complete feature checking once, on either tense or agreement, resulting in the production of an OI sentence. When the child does produce a sentence with an inflected verb, the production occurs because UCC did not apply. With biological maturation, the UCC eventually withers away and the child produces adult-like sentences (Wexler, 1998).

Neither Wexler (1998) nor Wexler et al. (1998) stated when pronoun case errors should occur. However, since case errors are caused by a failure of checking, case errors should occur throughout the OI period. Children's progress towards finiteness mastery should be a robust predictor of the presence or absence of error. Once children master case assignment correctly in one part of the paradigm, the entire paradigm should be correctly case marked. Mastery is often defined as the arbitrary value of 90% correct in obligatory contexts (Brown, 1973). Following the predictions of ATOM, children above 90% finiteness marking should not produce pronoun case errors. Rispoli (2005) found support for this from children with a mean age of 36 months. The children in that study with finiteness marking above 80% made very few third person pronoun case errors. The average finiteness composite score for children at 36 months is 56% (Rice et al., 1998), so at that age there should be a wide range of differences between children in pronoun case error. Generally speaking, low values on tense/agreement accuracy at 36 months would increase the likelihood of third person errors being observed (i.e., presence) whereas high values would decrease the likelihood of third person errors being observed (i.e., absence). From this point of view, a unified case system is assumed.

Paradigm expansion. Rispoli (2005) agreed with Wexler et al.'s view that the agreement property of INFL assigns case to subjects, yet differed in explaining how

pronoun case errors arise. A child's linguistic knowledge of the properties of INFL is not the only factor accounting for his or her pronoun productions. Rispoli (2005) explained that some children make many pronoun case errors whereas others are never recorded making errors at all because of differences in expansion of the pronoun paradigm. Expansion refers to adding more word forms as they are identified as carrying particular values for the relevant grammatical features. Consistent with earlier work (Rispoli, 1994, 1998), Rispoli (2005) predicted that errors should occur for nominative targets more often than for object or genitive targets because of phonetic consistencies across forms belonging to the same paradigm. However, Rispoli (2005) also presented evidence that a faster rate of paradigm expansion factored into the likelihood of case errors. Thus, Rispoli's research complemented Schütze and Wexler's (1996) ATOM by explaining additional specific patterns through the inclusion of the elements of the phonetic core in paradigm building and the additional developmental factor of paradigm expansion.

Rispoli (2005) chose to limit the investigation of the effects of paradigm expansion to the third person; therefore, he did not comment on the relative timing of first and third person pronoun case errors. In the view advanced by Rispoli (1994; 2005), pronoun case errors occur in the first or third person based on the phonetic core for that grammatical person and the rate of paradigm expansion. Yet, Rispoli fully adopted the view held by Radford and Wexler et al. that properties of INFL assign subject case. Therefore, Rispoli's (2005) hypotheses seem to align with a unified case hypothesis. However, third person errors might arise after first person errors have arisen if the rate of expansion in third person pronouns is slow.

Recent generativist hypotheses. Grinstead and colleagues also follow in the generative linguistic tradition in using Case Theory as a basis for explaining children's grammatical development and errors (Grinstead, 2011; Grinstead et al., 2013). Grinstead et al. (2013) agreed with the primary tenets of ATOM that the lack of agreement in INFL is the cause of subject pronoun case errors. Grinstead et al. (2013) was novel in adding an explanation for non-NOM [+agr] errors in which the verb was marked with third person singular –s (e.g., *him* runs). They offered that perhaps some of children's uses of -3s are syntactically finite whereas others are not but only appear to be. Some uses of -3s might instead be constructions the child has learned without decomposing the verb stem from the -3s marker.

According to Grinstead et al. (2013), the errors predicted by ATOM should occur in addition to case errors occurring with agreement marked verbs. Evidence for their claim comes from their receptive task with 52 children ages 3;6 to 5;9. Children chose either a nominative or non-nominative pronominal subject as correct for sentences marked with third person singular –*s* or copula BE. In the task, 40 of 52 children chose a non-nominative subject over a nominative subject in at least some of the trials. Additionally 16 of the children showed a preference for a non-nominative subject with an agreeing -3s marked verb in 1 of 8 trials. This is above the 8% level that Wexler et al. (1998) considered noise and above a 10% acceptability criterion set by Pine et al. (2005).

Grinstead et al. (2013) cannot provide insight into the timing of first and third person errors for two main reasons. First, *me* and *my* errors could not be assessed because the task required the presence of verbs with third person agreement. Second, because this task was receptive, it does not contribute information about when children's productions

of pronoun case errors occur. As Grinstead et al. (2013) aligns with UCC, it assumes a unified representation of case. Even though the study tested children's acceptance of third person pronouns only, the authors agree that properties of INFL are responsible for case assignment. According to Case Theory, this is true regardless of grammatical person.

Input ambiguity hypothesis. Pelham's (2011) Input Ambiguity Hypothesis uses parent input and language typology to explain why pronoun case errors occur. Pelham compared case marking in German and English because the two languages have interestingly different pronoun paradigms. Further, German children rarely make case errors on pronouns but do make case errors on articles. Pelham said that input for German pronoun case is more "distinct" than comparable input for English pronoun case. She characterized pronoun input as distinct if phonologically different forms are present within the subject/object pronoun paradigm. For example, in English, subject *you* and object *you* are not distinct. This contrasts with German, in which *du* (*you* nominative), *dich* (*you* accusative) and *dir* (*you* dative) are distinct. The Input Ambiguity Hypothesis states that the frequency of shared forms in English, (i.e., *you* and *it* within the subject-object paradigm, and *her* outside the subject-object paradigm) cause English learning children to be blind to case distinction and subsequently use object pronouns in place of subject pronouns in other areas of the paradigm (e.g., *him* for *he*; Pelham, 2011).

For Pelham, any object for subject pronoun case error could occur in English. It is less clear if genitive for subject errors (e.g., *my* for *I*; *their* for *they*) were predicted to occur since those forms are distinct but are outside of the subject-object contrast investigated. Pelham did not posit what proportion of ambiguous evidence is needed for errors to occur.

Support for the Input Ambiguity Hypothesis comes from Pelham's (2011) investigation of parent input to 24 children acquiring German and 24 age-matched children acquiring English. Pronouns for each language were summed across parents from data collected when children were between 16 and 34 months of age. Pelham found that 62.3% of pronouns spoken to English acquiring children were ambiguous compared to only 9.7% for German acquiring children. German articles were 75.3% ambiguous making them appear more like English pronouns. Pelham (2011) concluded that these data supported the Input Ambiguity Hypothesis and that they explained why children acquiring English produce case errors on pronouns whereas children acquiring German produce case errors on articles but not on pronouns. Wisman Weil (2013) also found support for the Input Ambiguity Hypothesis in a paired priming study. When children aged 30 months to 43 months were primed with ambiguous pronouns (i.e., *it*, *you*), they were more likely to subsequently produce a pronoun case error than when they were primed with contrasting pronouns (e.g., *she*/*her*).

From Pelham's (2011) input data, it is not easy to say when errors can be expected to occur. The corpora that were examined included parent input that varied in sampling frequency and in beginning and ending child ages, with the youngest children being 15 months old at their earliest samples and the oldest children being 36 months old at their last samples. However, Pelham (2011) did make the observation that children have been recorded making first person errors months before making third person errors. Pelham (2011) referred to Rispoli's (1991) concept of *mosaic* acquisition to explain this observation. Pelham suggested that children can acquire case for a compartment of the grammar. This is reflected by the phenomenon in German, whereby case errors are

virtually absent for pronouns, but characteristic for articles. Pelham's view of case is that it can be acquired in a piecemeal fashion with children seeming to have mastered case with some grammatical features or lexical categories while appearing incompetent in case marking with others. The reason errors appear is that signaling of case in the input is found across pronouns, i.e. the lack of distinction between *you* (subject) and *you* (object) affects the acquisition of *I* and *me*. Thus, while generativist in nature because it is feature-based, Pelham's hypothesis also leaves room for a kind of piecemeal, or partitioned, acquisition influenced by properties of the input.

Cognitive linguistic studies. Cognitive linguistic approaches to language acquisition differ from generative approaches in placing emphasis on how the child makes use of context in learning. In the cognitive linguistic view, form and function pairs are prominent. Children map representations of their experiences onto grammatical constructions. They inductively learn the rules of their language rather than deducing them with the help of innate guidance (Croft & Cruse, 2004).

Patterns of agentivity. Budwig (1989) offered an account of pronominal subject form and use based on the context of the child's utterance. Budwig claimed that whether a child used *I* or *my* as a sentence subject was determined by semantic patterns of agentivity. Budwig did not explain how third person errors or *me* for *I* errors occur but *my* for *I* errors are accounted for. Budwig (1989) found that children tended to use *I* as a subject more for assertive utterances about their existing state and *my* as a subject more for utterances seeking to control something in the environment. Errors occur up until the time when children begin referring to others as a greater proportion of all utterances. Budwig (1989)

assumes a piecemeal acquisition of case because correct forms are learned on the basis of pragmatics and semantics and not underlying grammatical features.

Usage-based grammar. To explain children's pronoun case errors, some cognitive linguists have examined variation in parents' use of personal pronouns. Within the field of cognitive linguistics, a model called usage-based grammar has emerged which makes use of parent input to describe how children construct a grammar. Usage-based approaches claim that children pay particular attention to how words are used in frames and construct their grammars by hearing and subsequently using grammatical forms in more widely varying contexts (Lieven, 2010; Tomasello, 2003). Children are most likely to use constructions, or smaller chunks of language that they have heard in frequently used larger pieces of language such as complex sentences (Rowland & Pine, 2000). Children will first use these constructions (e.g., I want it) as memorized chunks before then beginning to use smaller parts of the chunk in new ways (e.g., I want ___) in a process called "abstraction" (Tomasello, 2003). When children hear constructions repeatedly over time they eventually generalize them to learn more abstract constructions like subject-verb-object word order (Ambridge, Theakston, Lieven, & Tomasello, 2006).

Pine et al. (2005) described how pronoun case errors occur from the perspective of usage-based grammar. They stated that pronoun case errors may result from a lack of abstract knowledge of grammatical features such as case and agreement. Any knowledge of case that children do have is limited to specific lexical forms. Hence, pronoun case errors will be found with either agreeing or non-agreeing verb phrases and the deterministic relationship between agreement and case proposed in ATOM does not exist. Pine et al. (2005) also acknowledged the possibility that errors occur because children are in the

process of paradigm building as described by Rispoli (1994). Pine et al. (2005) tested ATOM's prediction that when INFL is marked for agreement, correct subject case will be assigned. The study revealed that children use non-nominative subjects with agreeing verbs (e.g., *him* runs) more often than the 8% level that Wexler et al. (1998) considered noise. Pine et al. interpreted this finding as problematic for ATOM.

Pine et al. (2005) did not make predictions about when case errors should occur, but their explanation for case errors does not seem to predict an overlap of first and third person errors. Instead, they stated that children use lexically specific constructions as early pronoun + verb combinations. Hence, Pine et al.'s usage-based grammar perspective means that case is acquired for individual forms and not as an abstract feature learned in a unified system. This piecemeal acquisition results from abstracting grammar from lexically specific constructions and not from the mosaic pattern described by Pelham (2011).

Parent input in usage-based grammar. Kirjavainen et al. (2009) advanced an explanation for pronoun case errors that came from a usage-based perspective and used linguistic frames in parent input. They explained that children are exposed to pronouns appearing before verbs in complex sentences such as "Let me do it" and simple sentences such as "I do that every day" (Kirjavainen et al., 2009; p. 1094). From these competing frames in which a pronoun appears preverbally, a *me* for *I* error may arise leading to a child production of "me do it." Kirjavainen et al. also explained that *me* + *V*(erb) may be such a common construction in child-directed speech that children may begin using *me* as a sentence subject with new verbs in their own productive language (e.g., "me want").

According to this perspective, the errors that are expected to occur are *me* for *I* errors and third person errors with *him, her* and *them* replacing subject forms. Third

person errors could occur from hearing the accusative pronoun *her* at the beginnings of sentences because it also functions as a possessive determiner and can start sentences such as "Her drink is over there" (Kirjavainen et al., 2009, p. 1095). *Him* and *them* errors can occur from frames such as "Watch him/them go" (Croker, Pine, & Gobet, 2001). Studies of pronoun case error based in usage-based grammar cannot account for *my* for *I* errors although cognitive linguists acknowledge their existence (Lieven, 2010).

Support for the usage-based point of view comes from Croker et al.'s (2001) use of a computational model of natural language called MOSAIC (Model of Syntax Acquisition in Children). MOSAIC processes adult input not only from the left edge of sentences to the right but also vice versa, allowing children to form pronoun + V connections from "There he goes," "Does he go?" and "Watch him go." MOSAIC and children can produce combinations by rote or generate new uses expanding their sentences. Croker et al. (2001) analyzed data from MOSAIC after training the model on actual parent input sentences spoken to one child that began with *he, him, she* or *her*. The resulting data included pronoun case errors with and without agreeing verbs, having a distribution similar to child data. Additionally, Kirjavainen et al. (2009) found that parents' use of *me* in preverbal contexts was correlated with children's production of *me* for *I* errors. However, a primary criticism of the usage-based approach to explaining pronoun case errors is that it does not account for the fact that the vast majority of child directed sentences are simple, not complex, sentences and that when pronouns appear before verbs in child directed speech, they are nearly always nominative pronouns because they are in simple sentences. Because usage-based approaches place such emphasis on frequency, the predominance of nominative pronouns + verbs over accusative pronouns + verbs in the input seems problematic.

Cognitive linguists do not predict a timeline for the occurrence of first or third person errors. Based on their explanations of errors, they should not predict any relationship in the timing of different pronoun case errors. Croker et al. (2001) concluded that it is unnecessary to credit children with innate knowledge of tense and agreement properties as Wexler and colleagues would (Schütze & Wexler, 1996; Wexler 1998). Instead, they posited a simpler explanation: children's earliest uses of tense and agreement come from hearing inflected forms in the input. Kirjavainen et al. (2009) and Croker et al. (2001) assume a piecemeal acquisition of case in which children use pronoun + verb combinations they have heard in the input rather than abstract knowledge of a case system.

In summary, the extant literature does not lend itself to consensus about whether children who make first person errors also make third person errors and if so, whether the two types of error occur during the same developmental period. It is conceivable that a child could cease making first person case errors before third person case errors begin, in effect learning case separately for each person. If children were found to resolve case errors in the first person before producing case errors in the third person, then the notion of a unified system would be less supported. If instead, children produce case errors in the first and third persons simultaneously, the notion of a unified case system would be more supported.

The Present Study

The primary research question of the current study is whether an association exists between case errors made in the first person and in the third person over time. The rationale for the question was to determine if case is a unified grammatical system with case errors linked across the person feature or if instead the acquisition of individual

pronominal forms is unrelated, with case acquired separately for first and third person. If an association is found, the secondary aim of the study is to explore the prediction of third person errors from first person errors and finiteness to further understand the potential unification of the case system. The importance of testing whether a unified case system exists is that the notion of unified grammatical features is an assumption of many generative linguistic accounts but is generally rejected by cognitive linguistic accounts. This rather fundamental question about case has never been directly tested, and the lack of such an investigation is a deep gap in our knowledge of the acquisition of the case system.

Thus, the presence or absence of an association between first and third person pronoun case errors will address how children apply grammatical knowledge. The presence of pronoun case errors would reflect incomplete or immature knowledge of case. Absence of error (i.e., all uses of subject pronouns are correctly case-marked) would reflect an adult-like knowledge of case. Children with incomplete acquisition of case may apply their knowledge to varying degrees, which would be reflected by variation in error rate. However, regardless of error rate, making pronoun case errors to any degree indicates a child-like status. Thus, the relationship between first and third person errors can be examined by documenting whether children make first and third person errors at all, disregarding the number of errors they produce. An association between first and third person errors would take the form of children inflecting case methodically for the entire lexical category of pronoun. Alternatively, children may inflect the case feature unsystematically with no consistent relationship between the existence of errors in one person and the other.

To determine if such an association exists, an innovative design is needed to investigate children's errors in both first and third person without being affected by developmental differences in first and third person sentences. Thus, this study investigated whether children produce either or both types of error. Previous studies have tended to report either first or third person errors but not both and rely on error rate to characterize children's acquisition of case. The current study is unique in challenging this methodology and instead categorizing children as producing first person errors, third person errors, both, or neither. Additionally, a longitudinal study is necessary to examine whether first and third person errors are made by the same children. Previous studies have collapsed data from many children at different ages, but this study will investigate case errors in a longitudinal database of spontaneous language samples from typically developing toddlers. An advantage of a longitudinal study is that it allows for two types of investigation. First, an association can be tested over the entire developmental period eliminating the problem that some children attempt subject pronouns at a younger age than other children and the problem that first person sentences emerge before third person sentences. Second, a longitudinal study provides the opportunity to test if an association exists in the form of earlier pronoun case errors predicting later errors. The occurrence of an association between first and third person pronoun case errors would provide support for the generative assumption that a unified case system exists whereas the lack of an association would support the cognitive linguistic assumption that no such unification of features exists. Hence, the primary analyses of this study are not a direct test of any one hypothesis; rather, they test of a basic assumption that is critical to both perspectives' explanations of pronoun case error.

CHAPTER 2

Methodology

Existing Database

The current study used data from an existing longitudinal database of spontaneous language samples from toddlers interacting with their primary caregivers (Rispoli & Hadley, 2008). The purpose of the original study was to document the growth of tense and agreement between the ages of 21 and 36 months and to investigate the influence of parent input on the growth of tense and agreement. Longitudinal data were collected as close as possible to ages 21, 24, 27, 30, 33, and 36 months for each child. The database includes a total of 58 toddlers.

Participants for the original study were recruited from Champaign, Vermillion and Macon counties in Illinois through newspaper advertisements, a campus e-mail list, and flyers in the community. Parents who expressed interest in the study were interviewed about the general health and development of their children when children were between the ages of 16 and 20 months before enrolling in the study. Parents were asked about milestones for walking and talking, the language environment at home, pre-maturity or trauma during birth, and intelligibility to parents and strangers. Children were not invited to participate in the study if they had not begun walking and using first words by 15 months, had a history of recurrent middle ear infections, had frank sensory or neurological impairments, or had had pressure equalization tubes inserted. All parents reported that children were exposed only to English at home. Parents were compensated $20.00 for each visit and children received small gifts on their 2nd and 3rd birthdays.

Parents completed two parent report tools providing information on children's general and language development. The *Ages and Stages Questionnaire* (*ASQ*, Bricker & Squires, 1999) was completed at the 21 and 24 month measurement points. The *ASQ* includes screening questions in five domains: communication, gross motor, fine motor, personal-social, and problem-solving. Parents were additionally asked to complete the *MacArthur-Bates Communicative Development Inventories* (*CDI*; Fenson et al., 2007) to provide information about children's expressive vocabularies and sentences. Parents completed *CDI* sections inquiring about words produced, word combinations, early sentences, and grammatical complexity at the 21, 24, 27 and 30 month measurement points.

Two 30-min audio and video recordings were made at each of the six measurement points. Children and their parents interacted in a naturalistic playroom with a standard set of toys for 30 min before being joined by an investigator or research assistant (RA) examiner who interacted with them for another 30 min. Children assented to play with their parents and the examiner before each session began. Parents were instructed to play with their children as they would at home. During the second 30-min portion of the language sample, the examiner engaged the child in semi-structured play with toys selected for their potential to create opportunities for the child to produce tense and agreement morphemes (e.g., blocks, baby dolls, Mr. Potato Head, bubbles). At the 36 month measurement point, the 30-min child and parent sample was typically collected on a different day from the 30-min sample with the child, parent, and examiner because additional testing was completed at this measurement point as part of the original study.

Participants

Eligibility for the current study was based on the following exclusionary criteria. These criteria were necessary for including participants whose developmental level was appropriate for studying both first and third person pronoun case errors. Children from the archival database were excluded if they did not pass the communication domain of the *ASQ* at 21 or 24 months. Additionally, children were excluded if they had been referred for early intervention (EI) speech-language pathology services before the conclusion of the study at 36 months. Children were also excluded if they had low language status at 30 months based on both the vocabulary checklist and the grammatical complexity portions of the *CDI* as reported by parents (Fenson et al., 2007). These domains were selected for exclusionary criteria because of their established history as diagnostic indicators of specific language impairment (SLI; Tomblin, Records, & Zhang, 1996). Children's expressive vocabulary size and grammatical complexity scores must both have been at or above the 10th percentile on the *CDI* at 30 months. This was the latest measurement point at which parents completed the *CDI* and the oldest age for which *CDI* normative data exists. This cutoff at the 10th percentile excluded children at the lowest language level (Heilmann, Ellis Weismer, Evans, & Hollar, 2005). Additionally at 30 months, children with low intelligibility were excluded because children's speech needed to be sufficiently intelligible that transcribers could be certain which subject forms children were attempting. Children's percent intelligibility in their spontaneous speech with their parents needed to be above 52%. This value was 1.25 standard deviations below the sample mean of 71% at this age.

Using these criteria, the participants for the current study were 43 typically developing toddlers (i.e., 22 boys, 21 girls). Of the 58 total children in the archival database,

15 were excluded. Five were excluded because they were referred for EI services before 36 months. Nine children who were not referred for EI services were excluded based on *ASQ* or *CDI* report or intelligibility. Lastly, one child was excluded due to attrition (i.e., participation at 21 months only). One-hour language samples were available from 21 to 36 months for 38 children. Two children's language samples at 36 months were only 30 min long. Three children participated in the study from 21 to 30 months. Children primarily came from college-educated families. Mothers' highest educational levels attained were less than high school (n = 1), high school (n = 2), associate's degree or some college (n = 6), bachelor's degree (n = 21), and advanced degree (n = 13). Children were reported by their parents to be White (n = 38), Black (n = 3), or biracial, i.e., White/Black, (n = 2). One of the children was also reported to be Hispanic. All families spoke only Standard American English.

Procedures

Language samples. The current study used the existing language samples from the archival database. Each 1-hr language sample was transcribed by a trained RA using *Systematic Analysis of Language Transcripts* (*SALT*, Miller & Iglesias, 2010). When possible, the examiner who interacted with the child transcribed the sample. Transcribers had access to contextual notes taken by an observer from the research team during data collection. Transcribers used video recordings for context when needed for interpreting child utterances. Adult utterances were then transcribed by the same or another transcriber.

Transcribers completed 20 hours of transcription training. During training, transcribers were required to transcribe all words and morphemes at a level of 80%

agreement for three consecutive transcripts before transcribing actual data. Reliability for transcripts was obtained through consensus. A transcriber who had not completed any of the first pass transcription completed a consensus pass of all child and adult utterances. The consensus transcriber could remove any utterances or words in disagreement, changing that segment to unintelligible. The consensus transcriber could also delete morphemes but could not add any morphemes or words or replace them with other morphemes or words. If the consensus transcriber heard an additional morpheme or word, it was confirmed by a third laboratory member before being added. Thus, all transcribed utterances designated as intelligible were entirely agreed upon by two transcribers. Transcripts were then coded for standard measures such as MLU and number of different words (NDW) according to *SALT* procedures (Miller & Iglesias, 2010).

Coding procedures. All pronoun case errors were coded for analysis. All case errors were coded with an [E] (see Appendix A). Errors coded included object forms (i.e., *me*, *us*, *him*, *her*, *them*) used incorrectly in subject position as in (1) or to mark possession as in (2). Other errors included rare instances of subject forms (i.e., *I*, *we*, *she*, *he*, *they*) used incorrectly in object position as in (3) or as a possessive as in (4). Genitive forms were coded as errors when used incorrectly as subjects as in (5) or objects as in (6) or in place of other genitive forms such as the sentence in (7). Second person case errors were also coded such as the sentence in (8).

(1a) C *Me* gonna get her milk. (GTP45G, 33 months)
(b) C *Him* need play with us. (GTP51G, 33 months)
(c) C *Her* want a bottle. (GTP58G, 24 months)
(d) C Where *them* go? (GTP26B, 27 months)
(2) C This where *him* shoe go. (GTP54B, 33 months)

(3) C I want *she* sit. (GTP45G, 33 months)
(4) C *She* leg go right there. (GTP05G, 30 months)
(5) C *My* cut it. (GTP44B, 30 months)
(6) C It for *my*. (GTP26B, 30 months)
(7) C I find *hers* carseat. (GTP09G, 33 months)
(8) C Where *you* waffles? (GTP57B, 33 months)

Pronouns were not coded as errors if the discourse with the parent or examiner confirmed that the child used an embedded clause in isolation such as the dialogue in (9). Accusative pronouns in compound subjects such as in the sentence in (10) were not coded as errors because their form is accepted as grammatical by adults in informal speech (Grano, 2006).

(9) M You wanna put him in there?
C Him out. (GTP51G 30 months)
M Wanna put him out?
(10) C Me and mommy blowed that. (GTP08G, 21 months)

Developmental measures. Prior to calculating specific measures of pronoun case for planned analyses, developmental measures were computed for descriptive purposes.

MLU and NDW. First, MLU and NDW were determined to provide a description of utterance length and general level of language development for children who were making pronoun case errors (Miller, 1991). MLU and NDW were calculated for each child at each measurement point using *SALT* (Miller & Iglesias, 2010). MLU was determined following the conventions of Brown (1973). Spellings of words were standardized to prepare data for NDW calculation (e.g., mom and mommy were counted as one word; Hadley, Rispoli, Fitzgerald, and Bahnsen, 2011). MLU and NDW were calculated from all complete, fully intelligible, spontaneous child utterances produced during the 30 min of free play with

parents. Immediate imitations of parent utterances and routine phrases (e.g., singing, counting) were excluded. A minimum of 50 utterances per sample is expected beyond age 24 months in samples at least 10-15 min long (Miller & Chapman, 1981). By 24 months, all 43 children produced at least 50 intelligible, non-imitative utterances per sample.

Tense and agreement accuracy. The next measure computed for each child was a tense and agreement accuracy composite (Bedore & Leonard, 1998; Rice & Wexler, 1996). A tense/agreement measure was selected to compare children's case acquisition to their status on a measure of a different set of grammatical features. Additionally, the measure allowed for describing each child's status in the Optional Infinitive stage, which has been linked to case errors by Schütze (1997). Following the procedures used in Fitzgerald et al. (2012), this measure was calculated using the 1 hr language samples at 30 months. The measure was based on children's correct uses, errors, and omissions of all forms of copula and auxiliary BE, auxiliary DO (i.e., do, did, does, don't), third person singular present tense (i.e., regular *-3s* and irregular), and past tense (i.e., regular *–ed* and irregular). Overregularizations (e.g., eat/ed) were counted as correct uses of verb inflections. All children's language samples at this measurement point contained at least 10 obligatory contexts for finiteness morphemes (Fitzgerald et al., 2012).

Sentence contexts. For each participant, at each measurement point, the number of contexts for producing a first person pronoun case error was totaled. This was necessary to ensure that absence of observed error was not a consequence of limited opportunities. This measure needed to be computed to determine the earliest sample that could be examined for the presence of first person errors. For first person errors, any context for *I* was an opportunity to make a first person error. Contexts for *I* included correct subject uses of *I*,

erroneous subject uses of *me, my*, or *mine*, and uses of the child's own name as a subject. These uses appeared in transcripts as "Cname".

Transcripts were also searched for opportunities to produce third person errors. Correct subject uses of *he*, *she*, and *they* were individually totaled. Uses of *him*, *his*, *her*, *hers* and *them* as subjects were also individually totaled. Determining opportunities for subject pronoun use is more complex for third person than for first person because of the infinite number of third person subjects that a child could use. First, for any sample in which third person error was not observed, the sample was searched for third person sentences to determine that the participant had begun using them. Third person sentences included sentences with lexical NP subjects, NP subjects in wh- questions, and the subjects *it*, *that*, and *this*. This tally excluded the subjects *here* and *there* because they do not represent opportunities to use a third person pronoun. Uses of "mommy" as a sentence subject were excluded because it is difficult to reach consensus among transcribers about whether a child's use of "mommy" is a subject or addressee. By 30 months, 80% of children can be expected to use a minimum of five unique third person subject and verb combinations in 30 min of parent-child conversational interaction (McKenna, 2013). Unique combinations are sufficiently different combinations of subjects and lexical verbs; subjects or lexical verbs can be repeated as long as one element is different (e.g., *Baby eat* and *Baby sleep* are unique; Hadley, 1999; McKenna, 2013; Villa, 2010). In the current study, subjects were of primary interest. Thus, transcripts were considered to have a sufficient number of opportunities for third person pronoun case errors if children used five unique third person subject and predicate combinations (e.g., *Baby eat* vs. *Baby hungry*). Additionally, use of at least one correct nominative third person subject pronoun or one third person

pronoun case error was counted as sufficient opportunity to produce third person subject case errors. That is, children who used any third person pronoun in subject position or used a sufficient number of third person sentences were included in analyses of third person pronoun case errors.

Pronoun case error measures.

Presence of error. The primary measure of the study was the presence of pronoun case error during the period observed. This categorical variable was selected for its potential to examine the relatedness of two grammatical errors (i.e., first person case errors and third person case errors) that might not occur at the same stage of development. At different language levels, children vary in the number of sentences produced and the type of sentences produced. These variables affect the likelihood of observing errors. By using a categorical variable, *presence of error*, the potential relationship between errors could be investigated independently of language level. This variable could capture instances of pronoun case error from their earliest occurrences in the study. Stromswold (1996) stated that for rare linguistic phenomena, it can be advantageous to measure the first use instead of requiring multiple uses to avoid overestimating the age of appearance. The categorical variable also avoided the challenges of using accuracy, which is complicated by variability in the number of opportunities to produce error (Balason & Dollaghan, 2002). Although this study did not focus on the accuracy of marking the case feature because that could obscure the relationship of errors represented by different pronoun forms, it was included for purposes of relating the findings of this study to metrics characterizing the intensity of pronoun case errors in the extant literature (see *Error rate*).

Subject pronoun case errors were searched for in *SALT* using Explore Multiple Transcripts. First and third person pronouns were included in the search list, i.e., *I*, *me*, *my*, *mine*, *we*, *us*, *our*, *ours*, *he*, *him*, *his*, *she*, *her*, *hers*, *they*, *them*. After examining each child's subject pronouns, a determination was made about whether any subject pronoun case errors were made. The transcripts selected included the entire hour language sample for each child at every measurement point. Including all measurement points for this search allowed for a determination of which children produced any subject pronoun case errors across the entire study. The rationale for collapsing measurement points for certain variables at this point was to determine how common subject pronoun case error is during this stage of language development. A large degree of individual variation exists in rate of grammatical development during the ages sampled (Hadley, Rispoli, Holt, Fitzgerald, & Bahnsen, 2014). Given this variation, choosing a single measurement point in which to examine contexts for error could have underestimated how frequently case errors occur during the acquisition of English. Searching for errors across multiple measurement points also allowed for a better understanding of when errors occur for most children.

Once presence of error was determined for each child, the child was assigned to one of four categories based on the presence of error. The categories were children who produce no error, first person error only, third person error only, or both first and third person error. These four combinations will account for all participants.

Age of onset of error. The next measure calculated provided empirical data for the age of onset of first and third person pronoun case errors. Age of onset was defined as the first measurement point at which a pronoun case error was observed. All children who made any case errors were included to provide the most information about when pronoun

case errors appear. The mean, standard deviation, and range were determined for the two age of onset measures, the age first person errors appeared and the age third person errors appeared.

Error rate. For every measurement point, the pronominal subjects used by the child were totaled. All correct uses of subject pronouns from the search list were individually tallied along with incorrect subject uses of the non-subject forms *me*, *my*, *mine*, *us*, *our*, *ours, him*, *his*, *her*, *hers*, and *them*. Following Rispoli (1994), children were required to have a minimum of five obligatory contexts for each error rate calculated. Obligatory contexts were any correct or incorrect uses of a personal pronoun as a subject. Using pronoun attempt totals, pronoun case error rate was calculated individually for *I*, *we*, *he*, *she*, and *they*. Correct nominative subject uses were divided by all subject pronoun attempts. First person percent accuracy was calculated by combining *I* and *we* attempts. Third person percent accuracy was calculated by combining *he*, *she*, and *they* attempts. Third person percent accuracy was calculated by combining *he*, *she*, and *they* attempts.

Age of last observed error. The age at which children resolved pronoun case errors was determined based on the earliest measurement points when errors were no longer observed. As a group, the average age of last appearance for each type of error was determined.

Duration of error. Finally, the duration of errors was reported to describe when children made first and third person errors in relation to each other and how long errors persisted. It was predicted that first person errors would no longer be observed by the end of the study for many children. This measure was computed to reveal whether third person errors persisted during a decline in the number of children making first person errors.

Duration also provided a way to assess the degree of case knowledge. Children with weaker case knowledge should produce errors for a longer time. Duration was determined in two ways. The first way was by subtracting the age of onset for each type of error from its age of last observed error. The second way of reporting duration was by the number of measurement points that errors persisted.

Reliability. All transcripts underwent a consensus reliability pass performed by an independent trained transcriber. When disagreements arose, a third RA confirmed the morpheme in question or it was marked unintelligible. In addition to transcription, error codes (i.e., [E]) were added to all subject pronoun case errors during transcription. All errors were confirmed for the current study. Reliability coding for tense/agreement accuracy was completed prior to this study. Five files had been randomly selected at 30 months and their accuracy was independently coded. Mean percent agreement between independent coders for these samples was 91% (*SD* = .09).

Analyses.

Association analysis. The first analysis of this study was conducted to determine whether an association existed between first and third person pronoun case errors. The rationale for this analysis was to determine if case is acquired as a unified system or in a piecemeal fashion. All participants who produced first and third person sentences during the study were included in this analysis. The numbers of children who produce only first person errors, only third person errors, both first and third person errors and neither type of error were entered into the cells of a contingency table (See Figure 3). The presence of an association was then determined with a Chi-square test using these values.

The Chi-square test was conducted because its possible outcomes were each viewed as having different implications for the assumptions of generative linguistic and cognitive linguistic theories. First, the presence of an association between first and third person errors would indicate that a unified system underlies case acquisition. This would be evident because children would be treating pronominal subjects alike regardless of person. An association in which children who make first person errors also make third person errors aligns with a primary assumption of generative linguistic accounts, that abstract grammatical features are shared by multiple related forms.

If the Chi-square result were not significant, other factors would need to be considered before interpreting results. If many children were only producing first person errors and they had attempted third person pronoun subjects (i.e., *me* or *my* errors exists but all attempts for *he*, *she*, and *they* are correct), then the lack of association would warrant a closer look at generative assumptions. The conflict would be that case is being assigned to third person pronouns but not to first person pronouns. This could not be dismissed as being caused by slow development since instances of correct third person pronominal subjects are occurring at the same time. A lack of association for this reason would suggest that the child's initial productions of third person subject pronouns were not influenced by their difficulties with case in the first person.

Another possibility was that no association existed between first and third person pronouns because many children made only third person pronoun errors. If children who made only third person errors have acquired correct use of *I*, it would be difficult to explain from a generative perspective because case is being marked for first person but not third person. This scenario would not support the notion of a unified case system and points to

case being acquired individually for different forms. Here again, the lack of an association between first and third person pronoun case errors would provide support for cognitive linguistic accounts.

In summary, an association between first and third person pronoun case errors would lend support to an assumption of generative linguistic theory, that a unified system underlies case. Alternatively, if first person case marking is independent of third person case marking, no association would exist and what a child does with one pronoun would have no relationship to what that child does with another pronoun. It was possible that children could use individual forms correctly without having knowledge of case extending across the paradigm to other subjects. The alternative to a unified case system, that case is acquired in a piecemeal way, is better aligned with cognitive linguistic accounts, which emphasize connections between linguistic forms and the functions they perform.

Overlap analyses. The next analyses were conducted to determine whether errors overlapped or occurred sequentially. The rationale for this planned analysis was to determine if the end of first person errors was significantly different from the onset of third person errors. If a unified case system existed, errors should overlap, assuming opportunity for error. A unified system would entail that while children are producing both first and third person sentences, they would apply knowledge of case marking to first and third person pronouns in the same way by producing errors in both persons or neither.

Children who made both singular first and third person errors were included in overlap analyses. Plural forms were not included because they were expected to emerge later in the study than singular forms. The overlap analyses only included children producing both first and third person pronoun case error. The overlap analysis asked

whether there was a difference in the age at which first person errors resolved and third person errors began using a Wilcoxon signed ranks test to determine the significance of the number of children whose errors overlapped. Stromswold (1996) recommended the use of a sign test for determining if two aspects of syntax occur at the same time in development. A Wilcoxon signed ranks test is appropriate for comparing the distributions of two non-independent samples (Gibbons & Chakraborti, 2011). The matched pairs of values in the test will be the age of last observed first person error and the age of onset of third person errors (See Figure 4).

If first person errors overlap with third person errors for a significant number of children, the assumption of a unified system will be supported. Alternatively, sequential, non-overlapping errors with no association would force us to reconsider generativist assumptions because knowledge of case marking did not generalize across pronouns. Cognitive linguistic accounts do not specifically anticipate a sequential result. However, the emphasis on piecemeal acquisition is more congruent with such a result.

Logistic regression. To further examine the relationship between first person case errors and third person case errors, logistic regression using all 43 children was also performed. Logistic regression allows for predicting a binary outcome from multiple predictor variables. The dependent variable was the presence or absence of third person errors observed between 30 and 36 months inclusive. By 30 months of age, all children were expected to produce a sufficient number of sentences with third person subjects, creating the opportunity for third person pronoun case error. Predictor variables included two quantitative measures of first person case knowledge and two developmental variables. The first person measures were drawn from measurement points up to and

including 30 months. All children were expected to produce a sufficient number of first person sentences to observe first person error by 30 months, with some children producing frequent first person sentences well before this age. The general developmental measures were collected at 30 months, the last measurement point before the dependent variable was measured.

The four independent variables were (a) peak frequency of first person error, (b) duration of first person error, (c) tense/agreement accuracy and (d), number of different words (NDW). The two measures of first person error reflected the intensity and persistence, respectively, of first person pronoun case error. Peak frequency is the highest number of first person case errors produced at any single measurement point between 21 and 30 months. Children who were not observed to produce a first person error were given a 0 for this measure. Accordingly, this variable represented a way to capture quantitative variability in children's production of first person errors beyond a categorical predictor (i.e., presence of first person error). Duration of error ran from zero to four measurement points (i.e., 0-4). From a unified case system perspective, a large error peak and persistent errors would be expected to predict the presence of third person errors. Tense/agreement accuracy and NDW were entered because of the predicted relationship between rate of development and tendency to make errors. Tense/agreement accuracy is a measure of grammar that is independent of case, but that has been posited to be related to case (Schütze, 1997). If case errors are related to agreement as hypothesized by Schütze (1997), then tense/agreement accuracy would be a better predictor than NDW. Evaluating the contribution of both alternatives could distinguish whether presence of third person error is related to general language development or grammatical development specifically. NDW

is a different way to capture rate of development than tense/agreement accuracy because it reflects vocabulary growth, a more general aspect of language development. If case errors are related to language development more generally, then tense/agreement accuracy and NDW should predict the binary outcome presence/absence of third person case errors to a similar extent.

CHAPTER 3

Results

Descriptive Findings

One goal of this study was to characterize the developmental period in which pronoun case error occurs. To answer the primary research question, whether there was an association between first and third person pronoun case errors, it was necessary to know when children had opportunities to produce errors during the 15 month study. This prevented incorrectly categorizing children as producing no errors when they had no opportunity to produce errors. The first major descriptive finding of the study was that production of pronoun case errors was closely tied to the development of sentence type and length. Errors did not arise until children were producing sentences with opportunities for pronominal subjects.

Mean length of utterance. Children who do not yet combine words on a regular basis (MLU < 2.0) are unlikely to have sufficient sentence contexts for producing pronoun case errors. Table 1 shows that at 21 and 24 months, children's mean MLU was under 2.0 indicating that many utterances for the average child were one-word utterances. By 27 months, mean MLU was 2.45, and children were using more utterances long enough to support sentences. By age two and a half, children's MLU approached 3.0, and utterance length continued to grow until the final measurement point.

Opportunity for first person pronoun case error. The presence of first person error could only be assessed for children with contexts for a first person subject pronoun. Table 1 reports descriptive statistics for sentence contexts. At the first measurement point, only 25 children, 58% of the sample, had attempted a sentence with an opportunity for *I* or

we. The mean number of opportunities increased sharply between 24 and 27 months, the first age at which all children attempted first person sentences. Figure 5 displays the variability in the number of first person opportunities at each measurement point. Variability in first person pronoun opportunities increased from 21 months until 30 months then declined. Variability declined after 30 months because the number of first person opportunities continued to increase for the slower developing children and the number of first person opportunities remained stable for the faster developing children.

Opportunity for third person pronoun case error. The opportunity to produce third person pronoun case error came later than the opportunity to produce a first person error for most children. At 21 months, only 10 of 43 children had produced enough third person sentences (i.e., 5) to evaluate whether they were producing subject pronouns in error (see Table 1). At 24 months, only 32 of 43 children produced a sufficient number of third person sentences. All children produced at least five third person sentences at 27 months. They continued to have sufficient opportunity to produce third person error (i.e., 5 third person sentences or one third person subject pronoun) at all measurement points past 27 months. Another way to explore children's opportunity to produce third person subject case errors was to examine change in the mean number of third person subject pronouns (see Figure 6). Initially, the average child used very few if any third person subject pronouns, but the mean number increased over time (see Table 1).

Age of onset of error. The age of onset measure was determined for children who produced pronoun case errors (see Appendix B). The mean age of onset of first person singular error was 26.4 months (n = 30, SD = 3.73, R = 21-36). The mean age of onset for third person singular error was 29.5 months (n = 28, SD = 2.95, R = 21-36). Figure 7

displays for each measurement point the number of children producing first person errors for the first time and the number of children who had previously produced first person error and continued doing so. The dark portion of the bars in Figure 7, indicating onset of first person error, are primarily observed at 24 and 27 months. In contrast, Figure 8 shows the age of onset for third person errors is older with the dark portion of the bars primarily at 27 and 30 months. In the earliest two measurement points, more children began producing first person error than began producing third person errors (see Figures 7 and 8). Half of children who produced first person error made their initial error by 27 months. The median value for third person was 30 months.

The difference in onset between first and third person errors is consistent with the differences in opportunity to produce each type of error. Table 2 shows that at 21 months, when opportunities for using first person subject pronouns were limited, only four children produced a pronoun case error. Children with few first person contexts (i.e., four or fewer) at 21 months did not make pronoun case errors. The onset of first person errors occurred for an additional 10 children at 24 months when most children were using first person sentences. At 21 and 24 months, six children used their own names as first person sentence subjects, which may have protected against making a pronoun case error (see Appendices B). Third person sentences were necessary before observing the onset of third person error. Not all children used third person sentences until 27 months. Onset of third person error occurred before this time for only two children. By the median age of onset for third person errors, 30 months, the onset of first person errors had occurred for over 90% of the children who produced them.

Age of last observed error. Age of last observed first person error was determined for first person singular errors for 29 of the 30 children who produced them. One of the children was lost to attrition at 30 months when she was still making first person errors, so it was not possible to determine her age of last first person error. The mean age of last observed first person error for the 29 children who made first person errors and completed all measurement points was 29.07 (*SD* = 4.17). This value is nearly 3 months older than the mean onset of first person errors for these children. Age of last observed third person error was determined for 27 of the 28 children who produced them. The same child who was lost to attrition at 30 months also produced third person errors in that sample and was excluded from this measure. The mean age of last observed third person singular error for the 27 children who produced them and completed all measurement points was 33.33 months (*SD* = 3.66). Third person error was observed in the final measurement points for most of the children who produced third person error, so third person errors may be likely to persist until a later age.

Duration of error. The next measure, duration of error, was determined for 29 children for first person error and 27 children for third person error. The child lost to attrition after 30 months who made errors at 30 months was excluded from both analyses. Duration of error was computed for singular errors (i.e., *I* targets and *he* and *she* targets combined). Duration was calculated in both number of measurement points and in months by subtracting the onset of error from the last observed error. The mean duration of first person error was 1.74 measurement points (*n* = 29, *SD*= .94) or 2.59 months (SD = 3.47). The mean duration of third person error was 2.26 measurement points (*n* = 27, *SD* = .94) or 3.78 months (*SD* = 2.83). The duration for both first and third person errors could be

underestimated insofar as sampling was not sufficiently long to document six months of no observed errors for 29% of the children who made first person errors and for 74% of the children who made third person errors. Even though the duration of third person error was more likely to be underestimated (i.e., longer than reported), the mean duration for third person was still longer than the mean duration of first person.

Figure 9 displays the duration of first and third person error in number of measurement points for 42 children. Different distributions represented the duration of first and third person errors. First person errors were fleeting for most children, observed in a single language sample and lasting up to a year for just a few children. Thus, the distribution for first person is positively skewed. Third person errors were more likely to be observed for two or more measurement points and had a more normal distribution than first person errors.

Patterns of Pronoun Case Error

Presence of error. Children produced both first and third person pronoun case errors and both types of error were observed to some degree at every measurement point. Of the 43 children in the database, 35 children (i.e., 81%) were observed to produce a pronoun case error between the ages of 21 and 36 months.

By examining both first and third person errors in a large longitudinal database, additional trends regarding the relationship between the two types of errors also emerged. The majority of children who produced first person error also produced third person error (i.e., 23 of 30; 76.6%). Of the 28 children who produced a third person error, only five did not also produce a first person error (i.e., 17.9%). Figure 10 displays by measurement point the number of children producing first person, third person or both pronoun case errors.

Children who made third person errors at 21 or 24 months also made first person errors in the same sample. From 21 through 27 months, more children made first person errors than made third person errors. Figure 10 also shows that 30 months is the peak age for both types of error to occur. All nine children whose first person errors persisted past 30 months also made third person errors at 33 or 36 months. At 36 months, the three children with first person error also made third person errors.

Trends also existed within first person error and within third person error. Children who made first person errors tended to make errors using either *my* or *me* for *I* but not both (see Table 3). At every age, a distinction existed between children who made *my* errors and children who made *me* errors. After 21 months, fewer children made both *my* errors and *me* errors than made just one type. With errors collapsed across measurement points, 18 children exclusively produced *me* errors or *my* errors and eight children produced both.

Making multiple types of third person error was more common than making just one type in a given language sample. Children who made a *him*, *her*, or *them* error were also likely to make at least one other of these three errors. Table 4 displays the numbers of children producing only *him* errors, only *her* errors, only *them* errors, and two or more of these errors. Across all measurement points, 19 of the 28 children (i.e., 69%) who made third person errors made two or more kinds of third person error. At 30 months, children were especially likely to make errors across gender or number. All children who produced a *them* for *they* error also made a singular error *her* or *him* error, or both. The general trend was to make third person pronoun case errors in multiple gender and number combinations.

Pronoun case error rate. Differences between first and third person error were observed in mean error rate. A minimum of five obligatory contexts was required for first person and for third person error rate. Table 2 displays error rates for all children who produced enough contexts for the calculation of error rate. The mean first person error rate peaked early at 21 months then declined with age, but the mean third person error rate increased over time to its highest value at 33 months (i.e., 17%). By the final measurement point, mean first person error rate was very low at 1%, but mean third person error rate remained at a similar level (i.e., 14%) to its 30 and 33 month values. Once all children had opportunities for both first and third person sentences, (i.e., 27 months), the error rate remained higher for third person than for first person.

Tables 5 and 6 display error rates for just the subset of children who produced pronoun case error (i.e., 35 of 43), consistent with the literature. Error rates for these children primarily decreased with age for first person but remained steady for third person after all children had third person sentences at 27 months (see Tables 5 and 6). Overall, for children who made third person errors, mean third person error rate increased with age from 7% to 44% (see Table 6). The children with the highest first person error rates generally made first person errors for three of more measurement points. The children with the highest third person error rates also typically made third person errors for three or more measurement points but additionally, their errors generally persisted until 36 months.

In addition to differences in mean error rate, the variation in error rates with all children included also differed for first and third person. The standard deviation of first person error rate declined with age indicating that children were becoming more

uniformly close to 0% error. By contrast, the standard deviation in third person error rate increased with age indicating that although some children were not making third person errors at later ages, those who were had high error rates (see Table 2). The highest maximum first person error rate (i.e., 79%) was observed at 24 months, but the maximum third person error rate was at 100% at 30 and 33 months and 95% at 36 months. At these three measurement points, eight of the 26 children who made third person errors during this time had third person error rates greater than 80% indicating that most of their third person pronoun subjects had non-subject case.

Pronoun case error and other language measures at 30 months of age.

The significance of the difference between values for first and third person error rate and the developmental measures were examined at 30 months. MLU, tense/agreement accuracy, and NDW were also used to characterize the utterance length, morphosyntactic development, and vocabulary of children who were and were not making pronoun case errors at 30 months of age. The 30 month measurement point was used because the most children (n = 35) had sufficient first and third person sentence opportunities at this age, and no children had been lost to attrition. At 30 months, third person error rate (M =15%, SD = 24%) was significantly higher than first person error rate (M = 3%, SD = 6%), $t(34)$ = 3.19, p = .002.

The developmental measures revealed a wide range of development. Some children at this age were just beginning to use longer sentences and a greater variety of sentences while others had been producing sentences frequently for several months. Mean MLU at 30 months was 2.90 (N = 43, SD = .68, R = 1.58 - 4.62). The mean number of obligatory contexts for overt tense and agreement marking was 104.0 (SD = 60.4, R = 19 - 341). Mean

tense/agreement accuracy at 30 months was 58.1% (*SD* = 22%, *R* = 14% - 93%). Mean NDW was 138.0 words (*SD* = 40.4, *R* = 62 – 244).

MLU was not significantly different for the 18 children who produced first person errors at 30 months (*M* = 2.85, *SD* = .64) and the 25 children who did not (*M* = 2.94, *SD* = .72), *t* (41) = 0.42, *p* = 0.677. Mean MLU was also not significantly different for the 20 children who produced third person pronoun case errors at 30 months (*M* = 2.79, *SD* = .44) and the 23 children who did not (*M* = 2.99, *SD* = .84), *t* (41) = 0.95, *p* = .348.

NDW was not significantly different for the 18 children who produced first person errors at 30 months (*M* = 139.4, *SD* = 40.7) and the 25 children who did not (*M* = 137.0, *SD* = 40.9), *t* (41) = 0.19, *p* = 0.850. NDW was also not significantly different for the 20 children who produced third person pronoun case errors at 30 months (*M* = 133.5, *SD* = 31.7) and the 23 children who did not (*M* = 141.9, *SD* = 47.0), *t* (41) = 0.68, *p* = .500.

Tense/agreement accuracy was not significantly different for the 18 children who produced first person errors at 30 months (*M* = 54.3%, *SD* = 0.22) and the 25 children who did not (*M* = 60.9%, *SD* = .21) *t* (41) = -0.98, *p* = 0.333. However, tense/agreement accuracy was significantly lower for the 20 children who produced third person errors at 30 months (*M* = 48.1%, *SD* = 20%) than the 23 children who did not (*M* = 66.9%, *SD* = 19%) *t* (41) = 3.14, *p* = .003. A point-biserial correlation revealed that tense/agreement accuracy shared a strong negative relationship with the presence of third person error at 30 months, (r_{pb} = -.440, *N* = 43, *p* = .003). The negative direction of the relationship indicated that children with higher tense/agreement accuracy at 30 months were less likely to produce third person error at that age.

In sum, a number of patterns of pronoun case error were evident. For the children in this study, first person pronoun case error did not occur until after the onset of first person sentences (i.e., correct uses of *I*). Third person sentences began later than first person sentences; in turn, third person pronoun case errors generally began after opportunities for error first began to appear. Next, the majority of children produced pronoun case errors. Children who made who made first person errors were likely to also make third person errors. Children with the highest rates of pronoun case error made errors for longer than other children did. Error rates were higher for third person errors than for first person errors on average. Lastly, children who produced third person case errors had lower tense/agreement accuracy scores at 30 months than children who did not, but there was no relationship between the presence of first person error and tense/agreement accuracy.

Primary Analyses

Association between first and third person error. The primary research question focused on whether there was an association between the presence of first person and third person pronoun case error. The purpose of the association analysis was to determine if case is acquired as a unified system or in a piecemeal fashion. All 43 participants met the inclusionary criterion for this analysis. Collapsing across all measurement points, children were classified as making only first person pronoun case errors (n = 7), only third person pronoun case errors (n = 5), both first and third person errors (n = 23), and neither (n = 8) (see Table 7). A chi-squared test of independence was performed to examine the relationship between the presence of first person pronoun case error and the presence of third person pronoun case error. The association between these variables was significant,

$\chi^2(1, N = 43) = 4.27$, $p = .04$, indicating the likelihood of co-occurrence for the two errors was significantly greater than would occur by chance.

Overlap between first and third person error. The next analysis tested whether first person errors overlapped with third person errors for children who produced both. The association analysis indicated the presence of a unified case system. If overlap were found between the two types of errors, it would provide additional support for the generative assumption of unification of features. The measures used in this analysis were age of last observed first person singular error and age of onset of third person singular error. Children who made both first and third person singular errors were included in the analysis. One child who was lost to attrition at 30 months was excluded from this analysis because her age of last observed first person error could not be determined. However, it should be noted that her first and third person errors overlapped at 27 and 30 months.

The remaining 22 children who made first and third person errors were entered into a Wilcoxon signed-ranks test. Each child contributed a pair of values derived from their age in months at the end of first person error (i.e., X_a) and their age at the onset of third person error (i.e., X_b). The absolute difference was taken for each pair (e.g., $|30 - 33| = 3$) and ties in which the two ages were the same were omitted from the calculation. The remaining differences were ranked from smallest to largest and assigned as positive when $X_a - X_b > 0$ and negative when $X_a - X_b < 0$ and the ranks were summed to determine the test statistic (Lowry, 2014). A positive rank indicated that first person errors continued past the onset of third person errors (i.e., overlap). Negative ranks represented cases in which first person errors ended before third person errors began (i.e., no overlap). The Wilcoxon signed-ranks test resulted in nine ties and $n_{s/r} = 13$, or 13 signed ranks. Seven ranks were

positive and six were negative. Collectively, 16 of 22 children demonstrated overlap between first and third person errors in the same sample (i.e., 9 ties and 7 positive ranks). The Wilcoxon test indicated that there was no significant difference in the end of first person errors and the onset of third person errors, $z = -0.12$, $p = 0.90$.

Predicting presence of third person error. The relationship between the presence of first and third person error was also examined parametrically using measures of first person case knowledge and developmental indicators to predict the presence of third person error between 30 and 36 months. The predictor variables used were the peak number of first person errors between 21 and 30 months, the duration of first person errors between 21 and 30 months measured in number of measurement points, tense/agreement accuracy at 30 months, and NDW at 30 months.

Correlations. Five Pearson product-moment correlation coefficients were computed to assess the relationships shared by the predictor variables (see Table 8). The two variables of first person case knowledge, peak number of first person errors and duration of first person errors, were not independent of each other, so a correlation between them was not completed. However, their potential relationships with the two developmental measures could be examined to comprise four of the correlations. The fifth correlation was planned to confirm the relationship between tense/agreement accuracy and NDW. Because four exploratory correlations were planned between the two measures of first person and the two developmental measures, the Bonferroni-corrected alpha level was set at .0125 (i.e., .05/4). No significant relationships existed between the measures of first person and tense/agreement accuracy or NDW. However, tense/agreement accuracy and NDW were moderately positively related, $r = 0.379$, $N = 43$, $p = .012$ (see Table 8).

Logistic regression. The relationships of first person case knowledge and language development with the presence of third person pronoun case error were investigated using multivariate logistic regression. Logistic regression allowed for the prediction of a categorical binary outcome, i.e., presence/absence of third person error. In this study, all four predictor variables were continuous variables.

Two exploratory logistic regression models were evaluated. Both models entered the quantitative measures of first person error intensity and duration and their interaction. The interaction between first person error intensity and duration was entered because those variables are not independent. In Model 1, tense/agreement accuracy was entered and in Model 2, NDW was entered. All variables were normalized by converting values to *z*-scores in order to compare predictor effects of different scales. Tense/agreement accuracy and NDW were entered into separate regression models to compare their relative effects because agreement is posited in the literature to assign nominative case but NDW has not been previously connected to agreement (Schütze, 1997).

The dependent variable was the presence or absence of third person error. The deviance, a measure of dispersion in the model, was 0.849 with tense/agreement accuracy and 1.253 with NDW. Both were near 1.0, which indicated that the data were not over-dispersed and logistic regression was appropriate. The models produced odds ratios, which were the probability of the dependent variable's occurrence (i.e., presence of third person error) to the probability of its nonoccurrence (i.e., absence of third person error). These are reported in Table 9 as Wald Chi-Square statistics. The Wald Chi-Square statistic is a test of the null hypothesis that a parameter equals 0. The beta value (β) for each parameter (i.e., variable) implies that a one unit change in the parameter results in a unit change equal to β

in the log of the odds that third person error will be present. For each predictor variable, its beta, standard error, Wald Chi-Square statistic, 95% confidence interval (CI), degrees of freedom, and *p*-value are reported in Table 9.

The relationships between the two variables of first person case knowledge and the presence of third person error were not significant. In other words, for these data, no significant associations were observed between the presence of third person error and the peak number or duration of first person errors. The intensity and persistence of first person error from 21 to 30 months did not predict the presence of third person error from 30 to 36 months even though the overall presence of first and third person errors from 21 to 36 months was related in the previously reported chi-squared test.

For the language development variables, tense/agreement accuracy had a statistically significant effect on the presence of third person error in Model 1 (Wald Chi-Square = 10.107, p = .001. As tense/agreement accuracy increased, the likelihood of observing a third person error decreased. Children who produced third person error between 30 and 36 months had significantly lower tense/agreement accuracy at 30 months relative to children who did not produce third person error during this time period. The relationship between NDW and presence of third person error approached significance in Model 2 (Wald Chi-Square = 3.734, p = .053).

At each step, the correct classification of children relative to their observed presence or absence of error was examined. Using only the intercept and no predictor variables, 60.5% of children were correctly classified by presence or absence of third person error. This was based only on the information that 26 children produced third person errors from 30 to 36 months and 17 did not. The addition of first person peak

number of errors, duration of errors, and the interaction between the two did not improve the classification rate, which was 62.8%. However, the addition of tense/agreement accuracy on step 2, improved the correct classification in Model 1 to 81.4%. The addition of NDW did not improve correct classification in Model 2. The classification rate remained 60.5%. Therefore, even though NDW and the presence of third person error approached statistical significance, tense/agreement accuracy had greater practical significance than NDW because it improved the correct classification of children by presence of error.

Since tense/agreement accuracy was the only significant predictor in Model 1, it was entered as the only predictor in a new model to determine how much the probability of producing a third person error changed with each unit change in accuracy. In Model 1, each variable was normalized to compare the effect sizes of significant variables. In Model 3, the raw data was used because the effect sizes of multiple variables were not being compared. Raw data was used to interpret how changes in accuracy on its actual scale affected the probability of observing a third person case error. Children's tense/agreement accuracy ranged from 14% to 93% (M = 58%; SD = 21.6%) at 30 months.

The beta value and intercept value obtained were used to determine changes in the probability of observing a third person error. The likelihood was calculated using the equation represented in (1). This equation represents a logistic function, which can take any input value to determine an output value between 0 and 1.

$$p(x) = \frac{e^{(\beta_0 + \beta_1 x)}}{1 + e^{(\beta_0 + \beta_1 x)}} \qquad (1)$$

In the equation, the value $p(x)$ is the probability of observing a third person error, given a tense/agreement accuracy of x. Base e denotes the exponential function. β_0 is the intercept from the logistic regression equation. The intercept is the log odds of observing a third person error when accuracy is 0. Log odds can be converted into odds by raising e to the value of β_0. $\beta_1 X$ is the coefficient for tense/agreement accuracy multiplied by a given value of accuracy. For example, the mean accuracy score at 30 months, 58%, can be used in the equation to determine the probability that a child will produce a third person pronoun case error between 30 and 36 months given an accuracy of 58% at 30 months of age. This probability is represented in equation (2). This equation uses the β_0 and β_1 obtained from the logistic regression in Model 3, which included only accuracy as a predictor.

$$p(58) = \frac{e^{(6.907 + -0.103*58)}}{1 + e^{(6.907 + -0.103*58)}} = 0.72 \qquad (2)$$

A hypothetical child with tense/agreement accuracy of 58% at age 30 months has a 72% probability of producing a third person pronoun case error from 30 to 36 months. Table 10 displays hypothetical values for tense/agreement accuracy and the corresponding predicted probability of producing a third person pronoun case error. Figure 11 displays the same values in a logistic function with x on the horizontal axis and $p(x)$ on the vertical axis.

The predicted values closely reflected actual observations of presence and absence of third person case errors from 30 to 36 months. For example, the model predicted that below 45% accuracy, a child's probability of producing a third person case error between 30 and 36 months was about 90% (see Table 10). In the actual data, all 11 children with

accuracy below 45% produced third person case errors. Likewise, the equation predicted that at 80% accuracy, a child's probability of producing a third person error was 21%. In the actual data, only one out of the seven children above this accuracy level produced third person errors.

Summary of Primary Analyses

In summary, first and third person pronoun case errors were associated. Children who made first person errors were more likely to make third person errors. The overlap analyses showed that when children made both types of errors, they did not occur at significantly different times. The intensity and persistence of first person pronoun case errors from 21 to 30 months, measured by peak number of errors and duration of errors respectively, did not predict the presence of third person errors from 30 to 36 months. NDW also did not obtain significance in predicting third person error. Tense/agreement accuracy at 30 months was a significant predictor of the presence of third person error between 30 and 36 months.

CHAPTER 4

Discussion

The primary aim of this study was to determine if an association existed between first and third person subject pronoun case errors. The developmental nature of this research question called for methodological decisions that could uncover the potential association. This study identified a point in development appropriate for investigating pronoun case errors in multiple personal pronouns. Spontaneous errors were observed when children's earliest sentences had emerged. By focusing on developmental level rather than age, this study captured the onset of pronoun case errors for the majority of children and encompassed the full duration of errors for many. The current study also explored the potential for overlapping first and third person errors by tracking both types of error over multiple measurement points in a large, longitudinal database. Overlap could not be tested previously because other studies had generally focused on only one error or had studied errors for too short a period of time. Lastly, this study was innovative in classifying children using the categorical variable presence of error. By categorizing children by whether they made an error, children who made few errors were classified together with children who made many. Categorical classification avoided the challenges of using percent error rate to quantify pronoun case error.

The central question of this study was whether case is acquired as a unified system or alternatively, if case is acquired in a piecemeal fashion. If a unified system existed, children should treat case marking for first and third person pronoun subjects alike. If correct subject pronouns were instead learned as individual words, then it would be possible for errors to exist for only one person. This question was investigated for its

implications for the assumptions underlying generative and cognitive linguistic approaches to grammatical development. Generative approaches adopt the view that abstract features exist across a case system. The existence of abstract features is generally rejected by cognitive linguistic views. Uniform marking of case would align with the generative view that case is a system. Piecemeal acquisition with differences in case marking would call into question whether case really is a system with abstract features reaching across person. The potential for an association of case across the person feature was examined by investigating whether children tended to treat case alike in first and third person by making pronoun case errors in both, and if so, whether the errors overlapped or occurred sequentially.

A primary finding of this study was that children who were observed to produce first person case errors were more likely to be observed to produce third person case errors as well. For children who produced both first and third person errors, errors usually overlapped in time. The following section reviews the gap in the literature on pronoun case errors and the descriptive findings from this study. The first descriptive finding was that first person errors occurred before third person errors. Second, they were more transient than third person errors. Lastly, first person error rate was lower than third person error rate.

Descriptive Findings

The descriptive findings of this study help fill a gap in the knowledgebase regarding the acquisition of case. Prior to this study, the relative timing of first and third person case errors was unclear. Studies of first person error tended to search for them in samples collected at younger ages than studies of third person errors did. However, since the two

types of error were generally not explored for the same children, it was unclear what the developmental time course was for the typical child. The current study contributes to filling this gap by not only identifying the onset and duration of first and third person errors for many children, but also by comparing the relative duration of first and third person errors for a single group of individual children. Finally, the current study primarily replicates previous findings regarding differences in first and third person error rate, but it also refines some previous reports as a result of examining error rate separately for each pronoun.

First, the onset of pronoun case errors followed a developmental sequence, reflecting the relative timing of first and third person sentences. Children followed a sequence of producing first person sentences before producing third person sentences and subsequently producing first person pronoun case errors before producing third person pronoun case errors. This difference in timing may be the reason that most previous studies had not noted that many children make both types of errors. Both first and third person errors only occurred after children produced sufficient sentence contexts with opportunity for case errors. When children made their initial first person errors, they often had produced *I* correctly in the prior language sample. Huxley (1970) noticed this sequence with Douglas, and this study replicates her finding in a larger cohort. Furthermore, children's initial *me* and *my* errors were always accompanied by correct uses of *I* in the same language sample. On the other hand, the earliest third person errors were generally not preceded by correct uses. Instead, children's initial *him* and *her* errors were more likely to occur in the same sample as their initial correct uses of *he* and *she*. This was true even though children had often been producing third person sentences with demonstrative

pronoun subjects or lexical subjects. Harley and Ritter (2002) concluded that the first person singular pronoun (i.e., *I* in English) and the third person singular neuter pronoun (i.e., *it* in English) are linguistic defaults because they were the first pronouns acquired by children in 10 acquisition studies spanning six languages. This reflects a key difference between the first person *I* and the third person gendered *he* and *she*. The only correct first person singular subject possible is *I*, yet there are infinite correct third person singular subjects possible (e.g., *it, that one, the car*; Forchheimer, 1953). This means that if children express a communicative function concerning themselves they are necessarily attempting an obligatory context for the pronoun *I*. However, children could potentially avoid attempting third person pronoun subjects for some time.

The next descriptive finding was that first person case errors had a shorter duration than reported in the literature. Generally in previous studies, it was difficult to tell how long first person errors lasted for a group of children because data were collapsed (e.g., Kirjavainen et al., 2009). It was likewise difficult to determine first person error duration for a single child because in many studies, recordings ended too early to know that errors had ended (Suppes, 1973). Duration has not been the focus of prior studies, but some studies provided enough detail that duration can be gathered from the data. Vainikka's (1993) and Schütze and Wexler's (1996) reports of Nina's (Suppes, 1973) errors indicated that she produced first person errors for at least six months until her last available sample. Douglas (Huxley, 1970) also produced errors for six months. However, his first person errors occurred at a later age than the errors that had been reported by most studies of multiple children, so it may have been an unreliable representation of typical duration (Vainikka, 1993; Rispoli, 1994; Schütze & Wexler, 1996). For 29 children in this study, the

mean first person duration was 2.59 months. Given the contrast in this figure to what was previously known, this finding is especially valuable. The size of the sample offered more precision in estimating duration than a case study could provide.

Third person duration was difficult to determine from previous studies for similar reasons as first person duration. Group studies collapsed data (e.g., Moore, 1995; 2001; Pine et al., 2005; Rispoli, 1994). Case studies often did not report if children made errors at every measurement point, and they may have ended too early to know that errors had stopped (Vainikka, 1993). An exception is Huxley (1970), which reported enough data that Douglas' third person duration can be determined to be 5.8 months for *him* errors and 8.6 months for *her* errors. As for first person, Douglas' errors were produced at an older age than other children's. From other studies, minimum durations can be derived even when data may not have been collected for a sufficiently long time to determine full duration. From Schütze and Wexler (1996), Sarah's (Brown, 1973) third person duration can be determined to be at least six months. Additionally, some indication of third person duration was provided by Wexler et al.'s (1998) longitudinal study of 20 children seen twice at an average age of 36 and 43 months. Mean group duration cannot be determined from the data reported, but the group as a whole produced third person errors at both measurement points, so it is probable that some children contributed errors both times. Their third person durations would be at least seven months. The current study determined third person duration for only 26% of children, so confirmation or contradiction of the literature on this issue cannot be concluded. Together, a pattern emerged in this study that first person errors had a shorter duration than third person errors. The duration of first person

errors had not previously been directly compared to the duration of third person errors for the same group of children.

This study expanded upon previous findings regarding first person error rate. Not surprisingly, this study had a higher maximum error rate (i.e., 79%) than Kirjavainen et al.'s (i.e., 63%) or Rispoli's (i.e., 55%) because it had a larger sample size than either of those studies. Similar to Kirjavainen et al.'s (2009) and Rispoli's (1994) findings, some children's first person error rates did not include any *me* errors and some children's did not include any *my* errors. In Rispoli (1994), *me* errors were more common than *my* errors when collapsed across samples from children between 12 and 36 months. In the present study, with errors broken down by measurement point, this was only true at 27 months onward. At 21 and 24 months, *my* errors contributed more to first person error rate than *me* errors. Additionally, *my* errors had virtually disappeared after 30 months, but *me* errors still contributed to first person error rate. Because both of those studies were cross-sectional, this is the first study to report that mean first person error rate peaks at 13% as children produce their earliest first person sentences and then declines to 1% error rate at 36 months.

This study also confirmed previous findings of third person error rate. Rispoli's (1994) finding that third person feminine errors had a higher error rate than third person masculine errors was replicated in this study. Similar to Loeb and Leonard (1991) and Pine et al. (2005), some children made third person errors yet made very few out of many contexts. This was especially true in the current study past 30 months when children's third person sentences were more frequent in general.

Together, the findings of first and third person error rate from this study revealed that first person error rate was generally lower than third person error rate. This finding can also be derived from the data reported in Rispoli (1994). Those children also produced first person error at a lower rate than third person on average. However, the current result slightly diverges from Rispoli (1994). Rispoli found that across all samples from 12 to 36 months, the mean error rate for *I* contexts was lower than the mean error rate for *she* contexts (i.e., 10% vs. 47%), but the mean error rate for *I* contexts was higher than the mean error rate for *he* contexts (i.e., 10% vs. 5%). In the current study with data similarly collapsed from 21 to 36 months, the mean *I* error rate was lower than the mean error rates for both s*he* contexts and *he* contexts (i.e., 2% vs. 29% and 9% respectively). This was also the general trend at each measurement point. As reported earlier, in the current study, the highest mean error rate for first person was 79% but at least some children reached a 100% third person error rate. A 100% error rate was not possible for first person because all children who made first person errors also used *I* correctly in the same language sample. By contrast, some children had very infrequent uses of *he* and *she*. The children with the highest third person error rates were unlike their peers with more moderate or low error rates, who generally produced their initial errors and correct third person pronouns contemporaneously. The five children whose third person error rates exceeded 90% were generally late to use correct third person pronoun subjects. Moreover, two children with third person error rates of 95% and 100% never used *she* in any language sample. Absence or low numbers of correct uses coupled with multiple errors resulted in high error rates for third person.

The differences between first and third person in onset, duration, and error rate may be due to a number of factors distinguishing first and third person pronouns. First, the default nature of first person pronouns may reduce the intensity of their errors (Harley & Ritter, 2002). Charney (1980) suggested that children use first person pronouns before they understand them, although this was questioned later by Chiat (1981). This early use may benefit children's accuracy of subsequent attempts. Second, the differences may reflect that relative to first person, children must associate the additional gender feature with third person pronouns (Loeb & Leonard, 1991; Rispoli, 1994). They could also result from differences in input frequency with *I* being more common in child-directed speech than *he* or *she* (Li & Shirai, 2000; MacWhinney, 2000).

Association between First and Third Person Errors

The purpose of investigating whether an association existed between first and third person pronoun case errors was to test the assumption of unified features. This assumption is held by generative linguists but typically rejected by cognitive linguists. Generative linguists assume the existence of abstract grammatical features (Radford, 1990; Wexler et al., 1998). Experience with words carrying these features helps the child to build up general rules that can be applied to future productions. Cognitive linguistic accounts view grammar as developing out of lexically specific constructions (Pine et al., 2005; Tomasello, 2003). These perspectives lead to different hypotheses about the way adult-like pronoun subjects should be acquired. From a generative linguistic view, children should apply their knowledge of the abstract case feature uniformly across the adult pronoun paradigm. Regardless of whether a subject attempt is in the first or third person, a child with mastery of case knowledge will mark case, and a child with incomplete acquisition of case will be

susceptible to making both first and third person pronoun case errors. On the other hand, cognitive linguists hold that parent input is responsible for children's use of correct pronoun forms. From this point of view, correct forms may be used in one person while errors are produced in the other.

Evidence for a case system was found in the association between first and third person pronoun case errors. The majority of children in this study (i.e., 72%) treated case similarly for first person and third person by producing case errors in both persons (i.e., 53%) or neither (i.e., 19%). Children were more likely to produce first and third person pronoun case errors than to make errors in just one person. They were also more likely to produce masculine and feminine third person errors than to make errors in just one gender and more likely to produce singular and plural errors than to make errors in just one number. This outcome is consistent with a unified case system. The novel methodology of categorizing children by presence of error revealed that children tended to make errors across multiple features in the pronoun paradigm providing evidence that they applied abstract knowledge to their pronoun attempts.

The findings of this study are consistent with generative explanations for grammatical development found in previous literature. The following studies followed in the tradition of Case Theory, which stated that properties of INFL assign case regardless of person. First, Radford (1990) viewed children as lacking a subject-object contrast within a pronoun system. From this point of view, they would make errors on both first and third person attempts until they acquired case. Next, the Agreement/Tense Omission Model was based on a deterministic relationship between case and agreement (Schütze, 1997; Wexler et al., 1998). This relationship was posited to explain both first and third person errors so

either should be affected by omitted agreement in a sentence. ATOM's explanation for errors is much better aligned with the finding that children treated case systematically than if children had mostly made errors in only one person. Once agreement is acquired and both tense and agreement can be checked, case should be assigned to all subject pronouns consistently (Wexler, 1998). The association between first and third person errors is also consistent with Rispoli's (2005, 2009) view that case marked pronouns are part of a paradigm with intersecting abstract grammatical features. In this paradigm, person intersects with case and children face the same task of distinguishing subjects and object for both the first and third persons. This view is consistent with children's producing errors in the first and third person during the period of subject case acquisition. For Pelham's (2011) Input Ambiguity Hypothesis the lack of subject-object distinction in parts of the English pronoun paradigm means that case errors could occur for any subject target. Children's tendency to make both errors supports Pelham's proposal that when children make case errors, they are blind to the subject-object case distinction generally and not just for one grammatical person.

The association between first and third person case errors is more difficult to explain from a cognitive linguistic perspective. Budwig's (1989) proposal that children's case errors pattern with the child's role as the agent of the utterance cannot explain why errors are additionally made for the third person by a majority of children. Usage-based grammar approaches would also have trouble explaining the association between first and third person errors. Usage-based grammar explains that children abstract pronouns from the input (Kirjavainen et al., 2009; Pine et al., 2005). Each pronoun corresponds with a type of parent construction that the child might use such as "Let me do it" or "I do that every day"

(Kirjavainen, 2009; p. 1094). Hence, each form would be learned individually in a piecemeal fashion based on these experiences with the input. It would be challenging to explain why children were more likely to produce both first and third person errors than just one type of error. Usage-based grammar would have been better supported if no pattern had been found of children treating first and third person errors alike and children commonly made errors in just one person.

Overlap analyses were an alternative way to investigate the presence of a case system. If there were an association between first and third person errors, the association would be more easily interpretable if the errors occurred at the same time. The Wilcoxon signed-ranks test indicated that the null hypothesis, that errors overlapped, could not be rejected. For most children, during the time that their acquisition of case was incomplete, they produced errors in both the first and third person. The overlap in errors provides stronger support for generative assumptions of abstract features than just the association alone. Since children treated case systematically, third person errors did not begin after case was acquired for the first person. Instead, third person errors began while children were producing first person errors. Cognitive linguistic views would not have specifically predicted the relationship between first and third person pronoun case errors. The simultaneous errors support the notion of a unified system. If first and third person errors had appeared sequentially, the assumptions of generative frameworks would have required modification to explain the association. The temporal overlap in errors is congruent with the association between errors and systematic treatment of the abstract case feature.

After an association was found between first and third person errors, the next analysis, a logistic regression, asked whether the presence of third person error from 30 to 36 months could be predicted. The predictor variables used were; (a) the peak number of first person errors between 21 and 30 months, (b) the duration of first person errors between 21 and 30 months, (c) tense/agreement accuracy at 30 months, and (d) NDW at 30 months. Of the four predictor variables, only tense and agreement accuracy at 30 months proved to be a significant predictor of the presence of third person error from 30 to 36 months, improving classification accuracy of the logistic regression model.

Children's progress through first person case marking was explored as a predictor of third person error in the logistic regression analysis because the two were associated in the chi-square analysis. However, neither the intensity nor duration of first person error made a significant contribution to predicting the presence of third person errors. One possible reason for this discrepancy is that the longitudinal span of the study was divided into two segments with first person errors measured from 21 to 30 months and third person errors measured from 30 to 36 months. Of the 23 children who produced both first and third person errors, two children produced all instances of both types of error entirely before 30 months, and two children produced all their errors entirely after 30 months. These four children were categorized as producing both errors in the chi-square test, which used all measurement points, and they contributed to the significance of the association. However, for all four, first person and third person errors did not span the two time segments in a way that would be predictive in the logistic regression.

Another possibility for the discrepancy is that in the association test, first person error was treated as a categorical variable and that in the logistic regression first person

error was treated as two continuous variables. Some children who made first person errors had a low peak number of errors (e.g., 1 or 2). The difference between these children and children with 100% correct case marking (i.e., 0 errors) was minimized by the use of a continuous variable, but they were categorically different in the chi-square test. At the same time, the child with the highest peak (i.e., 18) would have been categorized in the same way as the children with peaks of 1 error were for the chi-square test. With a continuous variable, peak number of errors, such children appeared very different from one another because they were at the extremes of the range. Thus, the chi-square test detected a relationship that the logistic regression did not. Using a categorical variable instead of a continuous variable as a predictor results in a loss of statistical information in logistical regression (Royston, Altman, & Sauerbrei, 2006; Streiner, 2002). Therefore, the continuous measures of first person error intensity and duration were preferred. Ultimately, whether first person errors and third person errors are associated is a different question than predicting one error from the other.

Individual differences in vocabulary were not associated with the presence or absence of third person pronoun case errors suggesting that third person pronoun case is not related to lexical development. This finding runs counter to the cognitive, lexicalist viewpoint that grammar is part of the lexicon and that grammatical development is dependent on vocabulary size (Bates & Goodman, 2001). The lexicalist perspective posits a single mechanism for acquiring vocabulary and grammar. Such a mechanism, called the lexical learning device, has been proposed to account for dependent relationships between the acquisition of specific words and the grammatical inflections relevant to those words

(Marchman & Bates, 1994). Acquiring the case distinction among personal pronouns does not appear to fit this lexicalist model.

Tense/agreement accuracy at 30 months was the only significant predictor of the presence or absence of third person pronoun case errors between 30 and 36 months. The finding that agreement and case are related was consistent with much of the literature addressing these features. First, Radford (1990) noted that case was often absent during the same period of development as agreement omissions. The current study builds upon that observation with the new finding that tense/agreement accuracy is predictive of third person case errors. This finding is also consistent with Schütze and Wexler's (1996) reports that agreement omissions and case errors tend to occur in the same sentences. Although the results of the current study are not focused on the sentence level, they indicate that tense/agreement and case acquisition are developmentally related. In the present study, children with accuracy under 40% were highly likely to exhibit third person pronoun case error and children with accuracy above 80% were unlikely to produce a case error. The 80% mark for the disappearance of third person error is reminiscent of Rispoli's (2005) finding that above 80% finiteness almost no variability in pronoun case error rate existed because children made practically no third person case errors. Overall, this result is supportive of the Wexler's (1998; 2011) hypothesis that there is a strong link between agreement and case.

The tense/agreement accuracy measure was heavily dependent on third person singular agreement morphemes; in particular, copula is one of the most frequent morphemes in the language. Auxiliary *does*, auxiliary *is*, regular third person singular *–s* and irregular third person singular also contribute to the estimate of accuracy (Rispoli,

Hadley, & Holt, 2012). Uses of first person agreement (e.g., *am*) were probably less common than uses of third person. Thus, the tense/agreement accuracy score may have especially reflected the third person feature, the feature that corresponds to Harley and Ritter's (2002) posited absence of a participant node.

The Relationship between Case and Agreement in Development

Case and agreement are related grammatical features, but they are fundamentally different in their development in ways that affect how they can be investigated. A primary difference is that all children pass through a developmental period of omitting tense/agreement marking, yet not all children are observed to produce pronoun case errors (Rispoli, 2005; Wexler, 2011). A consequence of this difference is that agreement can be measured in omissions, but case can only be measured in errors of commission.

Another difference is the onset of agreement and case use. Productive tense and agreement morphemes are absent for the majority of children at 21 months (Hadley et al., 2014; Rispoli et al., 2009). Rispoli and Hadley (2011) interpreted this lack of tense/agreement productivity early in development as evidence for an age-defined onset of the tense/agreement system. However, no such age-defined onset has been established for case because of how errors surface. In English, obligatory contexts do not exist for case in the way they exist for agreement. Part of the reason for this is that children have the option of using lexical noun phrase subjects or demonstrative pronoun subjects instead of personal pronouns.

The acquisition of case distinctions for personal pronouns occurs during the Optional Infinitive Stage (Wexler, 2011). Agreement gradually becomes more accurate over time (Rispoli & Hadley, 2011). Agreement acquisition begins with a combination of correct

uses alongside omissions. Many of the early correct forms may be produced by rote (e.g., *it's*, *this is*). Over time, omissions disappear. Case marking for personal pronouns occurs against the backdrop of finiteness acquisition. Initially correct uses dominate; the earliest attempts at the first person pronoun *I* are correct. Only after correct uses of *I* occur do first person errors appear. This pattern makes the most sense if the earliest correct uses of *I* are limited-scope formulae (e.g., *I want X*; Pine & Lieven, 1993). Just as there are early limited-scope formulae in the production of tense and agreement morphemes that may make the grammar appear more sophisticated than it actually is, so too are there early first person subject limited-scope formulae. The developmental profile of case in the third person differs slightly. After a period in which correct third person subjects and errors are produced together, third person errors may come to dominate for some children before a return to correct uses. Apparently, the rote basis of third person pronoun production is not as strong as it is for first person singular.

One alternative account of pronoun case errors is that competition from the input determines the form of children's subject pronouns (Kirjavainen et al., 2009). However, if the co-incidence of correct forms and errors were only due to competition from the input, the pattern of coexisting first and third person errors revealed in this study would be unlikely. Kirjavainen et al.'s (2009) analysis of parent input concentrates on the use of non-finite first person complements such as *let me go* in the input. They do not analyze input for third person pronouns in the same syntactic environment (i.e., *let him go*), but assume that these affect children's productions in the same way. The results of the current study show that first person errors are associated with third person errors and that the errors overlap.

From a usage-based perspective with a heavy emphasis on input frequency, this spread and expansion of error is unanticipated.

Theoretical Limitations and Future Directions

A limitation of this study is the extent to which its results can be brought to bear on usage-based proposals concerning the acquisition of case. The usage-based model's explanation of children's pronoun case errors is that they result from competing forms in parent input (Kirjavainen et al., 2009; Pine et al., 2005). This study did not analyze parent input, so it is not possible to say that children' s case errors occurred independently of the pronouns used in child-directed speech.

To test the usage-based grammar proposal, a future study would first need to identify proposed structures providing competing information in parent input. Kirjavainen et al. (2009) identified preverbal *I* in simple sentences and preverbal *me* in complex sentences as candidates. Lieven et al. (1997) noted that children hear *me* both before and after verbs. That competition should also be identified along with other uses of *me* and *I* in a future study.

After identifying structures of interest in the input, a test of usage-based predictions should test the claim that frequent exposures to specific constructions assists the child in extracting abstract frames that can be used more flexibly (Ambridge et al., 2006). This should be done by quantifying the structures in child-directed speech within parent-child dyads. Kirjavainen et al. (2009) provided "*I* do that every day" as an example of input that competes with *me* (p. 1094). However, the majority of first person singular parent utterances with a bare verb (e.g., *do*) do not appear with *I*; rather, they occur with *I'll* or require some other intervening modal or auxiliary. Without the habitual valence of the rest

of the provided sentence, it becomes ungrammatical. If the theory predicts that children extract constructions based on form and have no abstract knowledge of grammatical categories, then *I'll*, *I'm*, and *I've* should all be coded as competitors to *me* in addition to *I*. Kirjavainen et al. combined all forms of *I*. The proportion of *me* + V in the input may no longer relate to children's outcomes if *me* is a choice among five instead of a choice among two.

A test of the usage-based model should also test the prediction that the results of Kirjavainen et al. (2009) would generalize to the third person if third person input were explored. Kirjavainen et al. (2009) stated that third person pronoun errors could also result from input via sentences such as "See *her* opening it" (p. 1094; see also Tomasello, 2003). These should be identified along with corresponding third person sentence-initial input such as *he* and *she* used at the beginning of sentences. Kirjavainen et al. (2009) gave the example that *he* could combine with the construction "go there" from the sentence "It can go there" (p. 1095). If single words such as *he* are predicted to combine with small chunks from parent phrases to form "*he* go there" then all parent pronouns would need to be quantified, not just pronoun + verb combinations. Subject and object form pronouns could precede many other categories besides lexical verbs. A future study would need to clarify the expected contributions of pronouns in each environment before analyzing parent input.

Lastly, a future study testing usage-based grammar would need to quantify children's pronoun case errors. Kirjavainen et al. only included preverbal pronoun case errors, but a more comprehensive view of case acquisition would also count children's case errors that occur with other predicates (e.g., *Me* ready).

Another limitation of the study is that it used data from a single language. Any theoretical account of case acquisition should be tested crosslinguistically. However, languages vary in which lexical categories require case marking, in which cases are distinguished, and in how subjects and complements are morphosyntactically aligned. To replicate the association in another language, that language should have these attributes in common with English. Finding such a match may not be feasible for some time. First, the language would need to mark case on personal pronouns as German, Polish and Russian do (Corbett, 2008). However, these languages additionally mark case on nouns, determiners, and adjectives (Draye, 2002). The additional experiences with case that these lexical categories would provide may render such a language less than ideal for comparison to English. To be similar to English, a language would also distinguish nominative vs. accusative/dative vs. genitive cases. Many languages (e.g., Finnish, Hungarian, Russian) that have these distinctions do not have *only* these distinctions but also mark additional cases such as instrumental or ablative (Corbett, 2008; Onikki-Rantajääskö, 2006). Thus, the task of case acquisition could be not directly compared to English. Lastly, a study seeking to replicate the finding of an association should use a language with nominative-accusative alignment paired with accusative as the default case. It is critical to identify which case is the default to predict which forms might substitute for others. Default case in other languages is not always as straightforward as it is for English. This is because for other languages either nominative or accusative may pattern as the default in most but not all circumstances. Nonetheless, there are languages for which accusative is usually the default such as Norwegian, Danish and Irish (McCloskey, 1986; Schütze, 2001). All three of these

languages diverge from English in exactly which conditions give rise to default accusative case, so they also would not be well suited for a crosslinguistic comparison (Schütze, 2001).

Methodological Limitations and Future Directions

The primary methodological limitation of this study was the sampling interval. First, the sampling frequency may have been insufficient to estimate the onset and duration of errors precisely. In this study, onset of error was defined as the first measurement point with errors observed from samples collected every three months. However, if the onset of errors occurred between two samples, denser sampling could have more precisely estimated the onset to the nearest month or week. Similarly for duration, children's last observed error was used to determine how long errors lasted. Errors may have persisted one to two months after they were last recorded.

Even with a sampling interval of 3 months, first person duration was revealed to be shorter than third person duration by over one month. This difference may be even greater than these data revealed. Third person errors started later than first person errors did, so they may have lasted longer than the duration that was calculated for these data. A conservative approach might exclude children whose errors persisted until 33 or 36 months as their errors could continue past the conclusion of the study. However, this could bias the measure to be shorter. For the optimal estimate of how long third person errors persist, data should be collected for children older than 36 months. The peak number of errors measure might have also benefited from sampling more frequently. If children's peak error production occurred outside of a language sample, then their recorded peak would be underestimated. This may have limited the potential for the peak number of first person errors to predict third person error presence or absence.

Although measures of onset, duration, and peak number of first person errors might benefit from denser sampling, the sampling interval in this study was sufficient to answer the primary questions of association and overlap. Generally in studies using spontaneous language samples, there is a trade-off between sampling density and the number of participants. As an example, Pine et al. (2005) used data collected weekly for a year from 12 children. This sampling might have been sufficient for capturing the onset of errors for those 12 children, but it could not have detected an association with patterns of overlap because not enough children were included. In spite of the 3-month interval between samples in the current study, an association and overlap were both revealed because the sample size was large. Intervening language samples could only have strengthened those findings by identifying additional errors.

A future study with denser sampling could generate a more precise estimate of onset and duration and in the process uncover why some children did not contribute to the chi-square association between first and third person errors. In this study, seven of 43 children were observed to make only first person errors and five were observed to make only third person errors. It is not certain that they really did produce only first or only third person errors. The sampling interval may have "missed" errors for faster developing children who were only observed to produce one type of error. Children may have produced the other type of error between language samples. Errors were more likely to be caught for children with slower rates of development who made errors over at least a few months. If children make errors in only one person in a study with denser sampling, then there may be two explanations for this pattern. Perhaps there are some children who make first person errors and move through optional agreement marking very quickly. Then,

when they first attempt third person pronoun subjects, they might mark nominative case correctly from the beginning. Other children may be protected from producing first person errors by relying on *I* + verb rotes or uses of their own names as subjects and only produce third person errors.

Therefore, another possible future study is a test of the potential for the earliest uses of correct subject pronouns to be rotes. Such an investigation could shed light on how children transition from correct uses to the onset of errors. To test if particular forms are rotes, the diversity of the contexts in which they appear should be examined. If children typically use a given pronoun form with the same predicates (e.g., *I don't know*), that would suggest they are relying on rotes formed from frequent co-occurrences in the input. To express intentions that are more difficult to express through rotes, children need to use a greater variety of predicates. To reach a high number of different pronoun + verb combinations, children would need to use verbs that are less frequent in the language.

From a cognitive linguistic perspective, many of children's multiword utterances can be linked to their earliest rote constructions (Lieven, Pine, & Baldwin, 1997). That is, many of children's earliest sentences contain words that they have also used in a frozen phrase. For example, if a child produces "*me* do it," then it is likely the child also has said, "I'll do it," taken directly from input. The pronoun case error results from the fact that object pronouns can occur preverbally in input (e.g., Let *me* try it) and the rest of the utterance, "do it," is a rote. From a generative perspective, pronoun error + verb combinations with new, less frequent verbs would be more likely to reflect real grammatical representations and be less likely to have relied on rotes (Rispoli & Hadley, 2011). If there were a pattern of correct pronouns in limited contexts being followed by

errors in a variety of contexts, it would support the proposal that correct forms produced before the onset of errors are rotes. Some children may not make pronoun case errors. If they use correct pronoun forms flexibly in combination with a number of different verbs, then it is more likely that they have early knowledge of the correct sentence position for case marked pronouns.

First person pronoun case errors may be particularly affected by rotes. Correct uses of *I* may be more supported by rotes than correct uses of *he*, *she*, and *they* because *I* is more common in parent input (Li & Shirai, 2000; MacWhinney, 2000). The subject *I* commonly appears in fixed phrases in child utterances (e.g., *I want X*). Subjects that frequently appear in the input with the same verb, especially when contracted (e.g., *I'm*) are less likely to be analyzed as distinct constituents (Wilson, 2003). Children could be protected from substituting *me* or *my* subjects for *I* by relying on rote utterances.. The earliest uses of *I* may not represent a case distinction in the way that later uses do. See Figure 12 for an example of a pattern of error in which *I* precedes exclusive first person errors which are then followed by a combination of correct uses of *I* and errors. This pattern may reflect a change in grammatical knowledge in which the initial uses were entirely rote and the later correct uses and errors represented emerging knowledge of the abstract case feature. This process would end with all *I* targets being correct, reflecting adult-like knowledge of case.

A future study focusing on the influence of rotes on pronoun case errors could investigate whether children's substitution of their own names delays the onset of first person error or reduces its duration and error rate (see GTP49G in Appendix C for an illustrative example). Such a study should also code parent uses of a child's name in place of *you* and uses of *mommy*, *dad*, etc. in place of *I*. In the present study, 19 of the 43 children

used their own names in a context for *I*. From previous studies, it is difficult to quantify how commonly this phenomenon occurs. These substitutions have been commented on before although they have never been the focus of an analysis in any study. Tanz (1974) acknowledged that Douglas' (Huxley, 1970) frequent use of his own name instead of a pronoun complicated the attempt to determine how long he used *I* correctly before the onset of *me* errors. Budwig (1989) quantified children's uses of their own name but then combined those uses with *me* and *my* errors when reporting them. She reported that at least two of six children in that study used their names as subjects. They were also the children who produced *me* or *my* errors. Lieven et al. (1997) reported that many of the 12 children in that study used their own names as subjects, and that this provided evidence that children have no grammatical knowledge of *I*, just knowledge of where it appears in input relative to verbs.

Clinical Applications

Treatment. The primary findings of this study suggest potential clinical applications. First, an association existed between first and third person errors. Second, agreement was related to third person pronoun case errors. These two findings taken together lead to new recommendations for the treatment of pronoun case errors. They demonstrate that not only is case linked through an abstract feature, but also that case and finiteness are related grammatical systems. Future clinical interventions should take advantage of what is known about the underlying features of pronouns and their systematic nature. Specifically, the association between the case errors across person suggests that treatment for case errors should take into account the entire interconnected set of personal pronouns. There is difficulty inherent in using clinician modeling and

recasting to remediate first person case errors. When a clinician recasts *I*, the referent of the pronoun switches from the child to the clinician, potentially reducing effectiveness as a model. Therefore, alternative methods of remediating first person case errors need to be explored. The use of third person personal pronoun models of nominative case might provide an indirect treatment route for acquisition of first person nominative case. Next, based on the relationship between agreement and third person case, it is suggested that clinicians not only target the forms *he, she*, and *they* directly, but also target the third person feature on lexical verbs and auxiliaries. For example, models and elicitations of *he* can be alternated with a classmate or toy's name. Structuring play-based therapy around third person sentence subjects may facilitate the acquisition of agreement, which appeared to precede productive uses of third person subject pronouns in the current study.

Diagnosis. The diagnosis of language impairments has benefited from recognition that affected structures are related in a system. Specifically, prolonged inconsistency in using interconnected tense and agreement morphemes is a well-established characteristic of SLI (Leonard, 2014). Speech-language pathologists (SLP) detect proficiency in these grammatical morphemes through a variety of clinical tools to diagnose SLI. However, other communication partners may not readily detect these deficits and the prevalence of SLI may be higher than actual diagnostic rates (Redmond, 2002). The relationship between third person case and agreement in this study could be exploited to improve detection of impairment. In this study, children whose tense/agreement accuracy was below 40% at 30 months were extremely likely to produce a pronoun case error. If this were also true for children in preschool or early elementary school, then children with weak agreement systems who are at risk for SLI will likely produce case errors. Teachers and other

professionals could be educated to refer children for speech-language services upon observing pronoun case errors. Pronoun case errors are especially salient because, as noted above, they surface as a commission error. Adults may "fill in" omitted agreement morphemes when listening to a child with SLI by using top-down processing. However, the substitution of an oblique pronoun for a subject pronoun is more readily noticeable. This simple recommendation could lead to additional referrals for children whose tense/agreement systems should then be formally assessed by an SLP.

Conclusion

This study investigated whether children apply abstract knowledge of case to all subject pronouns or learn the subject-object distinction separately for each pronoun. In this database of 43 children, making pronoun case errors was rather commonplace. Children not observed to make case errors were the exception rather than the rule. The children in this study were more likely to treat case in the same way regardless of grammatical person. This uniformity in case marking is interpreted as support for a unified case system. Children's overlapping errors in first and third person are taken as evidence that when children do not fully understand the conditions of case marking, case errors will arise across a paradigm of forms.

This study used children's attempts at English subject pronouns as a view into the development of case. The regularity of pronoun case errors makes them a relevant aspect of grammatical development that should continue to be explored. In English, subject pronouns are distinct from other NPs in the variety of grammatical features they can carry. Taking advantage of this exceptionality could open other avenues for understanding the strategies children use on the way to becoming competent language users. Ultimately, new

insights into children's mental language representations will be gained. These will increase appreciation of our unique capability as humans to use language.

CHAPTER 5

Tables

Table 1. Means and (*SD* or percentage of children) for general developmental measures

	21 months	24 months	27 months	30 months	33 months	36 months
N	43	43	43	43 [a]	40[b]	38[b]
MLU	1.37 (.46)	1.84 (.59)	2.45 (.65)	2.90 (.68)	3.18 (.56)	3.38 (.61)
First Person Error Contexts						
n *of children with contexts*	25 (58%)	38 (88%)	43 (100%)	43 (100%)	40 (100%)	38 (100%)
Mean number of contexts	5.4 (14.7)	15.9 (15.4)	39.3 (22.9)	59.2 (32.6)	63.3 (24.7)	70.7 (23.5)
Min	0	0	7	13	21	25
Max	84	66	115	146	118	124
Third Person Error Contexts						
n *of children with 5+ contexts*	10 (23%)	32 (74%)	43 (100%)	43 (100%)	40 (100%)	38 (100%)
Mean number third person subject pronouns	2.2 (9.2)	3.3 (7.0)	15.9 (19.4)	22.9 (27.6)	28.0 (22.8)	37.6 (20.2)
Min	0	0	0	1	1	0
Max	54	31	88	170	135	89

[a] Longitudinal data for the same 43 children were available from 21 to 30 months

[b]Data for some children were not available at 33 and 36 months

Table 2. Means (and *SD* or percent of children) for Pronoun Case Measures

	21 months	24 months	27 months	30 months	33 months	36 months	All Measurement Points
n of children producing any case error	4 (9%)	10 (23%)	17 (40%)	28 (65%)	16 (40%)	13 (36%)	35 (81%)
First Person Error							
n *of children producing error*	4 (9%)	10 (23%)	12 (28%)	18 (42%)	8 (20%)	3 (8%)	30 (70%)
I *error rate*	.13 (.23)	.08 (.19)	.05 (.14)	.03 (.06)	.02 (.07)	.01 (.05)	.02 (.04)
we *error rate*		.00 (.00)	.00 (.00)	.01 (.03)	.00 (.00)	.002 (.01)	.003 (.01)
Total error rate	.13 (.23)	.07 (.19)	.05 (.13)	.03 (.06)	.02 (.06)	.01 (.05)	.02 (.04)
Max total error rate	.60	.79	.75	.33	.40	.28	.22
Third Person Error							
n *of children producing error*	1 (2%)	1 (2%)	9 (21%)	20 (47%)	15 (38%)	14 (37%)	28 (65%)
he *error rate*	.03 (.04)	.00 (.00)	.14 (.32)	.12 (.25)	.13 (.30)	.11 (.29)	.09 (.19)
she *error rate*	.00	.30 (.42)	.13 (.33)	.32 (.45)	.16 (.37)	.26 (.42)	.29 (.40)
they *error rate*		.00	.08 (.20)	.15 (.26)	.02 (.10)	.05 (.17)	.05 (.12)
Total error rate	.03 (.05)	.04 (.11)	.07 (.20)	.15 (.24)	.17 (.32)	.14 (.27)	.14 (.23)
Max total error rate	.07	.30	.78	1.00	1.00	.95	.92

Note. Error rates include all children who produced at least five obligatory contexts for an error.

Table 3. Number of children producing first person errors by measurement point and pronoun form, *n* = 30

	21 months	24 months	27 months	30 months	33 months	36 months	All Measurement Points
My for *I* errors	2	4	2	3	1	1	8
Me for *I* errors	0	5	6	10	6	2	10
Both	2	1	2	4	0	0	8

Table 4. Number of children producing third person errors by measurement point and pronoun form, *n* = 29

	21 months	24 months	27 months	30 months	33 months	36 months	All Measurement Points
Only "*him* for *he*"	0	0	3	4	2	0	3
Only "*her* for *she*"	0	1	0	5	7	5	6
Only "*them* for *they*"	0	0	0	1	0	0	0
2 or more	1	0	5	10	6	8	19

Table 5. Mean error rates for children who produced first person pronoun case error (percentage of children or SD)

	21 months	24 months	27 months	30 months	33 months	36 months	All Measurement Points
First Person Error							
n of children producing error	4 (9%)	10 (23%)	12 (28%)	18 (42%)	8 (20%)	3 (8%)	30 (70%)
I error rate	.33 (.27)	.25 (.28)	.18 (.22)	.08 (.09)	.10 (.15)	.12 (.17)	.03 (.05)
we error rate				.13 (0)		.08	.03 (.01)
Total error rate	.33 (.27)	.23 (.28)	.17 (.21)	.07 (.08)	.08 (.13)	.10 (.15)	.04 (.05)
Min total error rate	.01	.03	.02	.01	.01	.01	.01
Max total error rate	.60	.79	.75	.33	.40	.28	.22

Table 6. Mean error rates for children who produced third person pronoun case error (percentage of children or SD)

	21 months	24 months	27 months	30 months	33 months	36 months	All Measurement Points
Third Person Error							
n of children producing error	1 (2%)	1 (2%)	10 (23%)	20 (47%)	15 (38%)	14 (37%)	29 (67%)
he error rate	.05 (.00)		.51 (.43)	.33 (.31)	.61 (.37)	.59 (.41)	.19 (.25)
she error rate		.60 (.00)	.29 (.48)	.55 (.48)	.81 (.42)	.70 (.40)	.50 (.42)
they error rate			.5 (.00)	.44 (.29)	.41 (.18)	.28 (.32)	.20 (.17)
Total error rate	.07	.30	.30 (.33)	.28 (.28)	.44 (.39)	.35 (.33)	.19 (.25)
Min total error rate	.07	.30	.06	.02	.03	.02	.01
Max total error rate	.07	.30	.78	1.00	1.00	.95	.92

Table 7. Contingency table with frequencies of children by type of pronoun case error produced across 15 months, *N* = 43

		Presence of third person error	
		Yes	No
Presence of first person error	Yes	23	7
	No	5	8

Table 8. Correlation coefficients for logistic regression covariates, *n* = 30

	Tense/Agreement Accuracy	*p*	NDW	*p*
Peak Number of First Person Errors	-.308	.045	.079	.617
Duration of First Person Errors	-.094	.550	.210	.176
Tense/Agreement Accuracy			.379	.012

Note. The Bonferroni-corrected alpha level was set at .0125

Table 9. Logistic regression predicting presence of third person error from first person case error variables and tense/agreement accuracy (Model 1) and from first person case error variables and NDW (Model 2)

Model 1 Parameter	Estimate (β)	Standard Error	Wald Chi-Square	95% CI minimum	95% CI maximum	*df*	*p*
Peak number of first person errors	0.735	1.3249	0.308	-1.861	3.332	1	0.579
Duration of first person errors	0.330	0.7186	0.210	-1.079	1.738	1	0.647
Peak number of errors * Duration of errors	-0.188	0.8447	0.050	-1.844	1.467	1	0.824
Tense/agreement accuracy	-9.978	3.1386	10.107	-16.129	-3.826	1	0.001

Model 2 Parameter	Estimate (β)	Standard Error	Wald Chi-Square	95% CI minimum	95% CI maximum	*df*	*p*
Peak number of first person errors	1.366	1.0887	1.573	-0.768	3.500	1	0.210
Duration of first person errors	0.207	0.6030	0.118	-0.975	1.389	1	0.732
Peak number of errors * Duration of errors	-0.483	0.7378	0.429	-1.929	0.963	1	0.513
NDW	-0.732	0.3790	3.734	-1.475	0.010	1	0.053

Table 10. Hypothetical values of tense/agreement accuracy at 30 months, *x*, and corresponding probabilities of observing third person pronoun case error from 30-36 months, $p(x)$, from equation (1)

Tense/Agreement Accuracy x	Probability of Third Person Pronoun Case Error $p(x)$
0%	1.00
5%	1.00
10%	1.00
15%	1.00
20%	0.99
25%	0.99
30%	0.98
35%	0.96
40%	0.94
45%	0.91
50%	0.85
55%	0.78
60%	0.67
65%	0.55
70%	0.42
75%	0.31
80%	0.21
85%	0.14
90%	0.09
95%	0.05
100%	0.03

CHAPTER 6

Figures

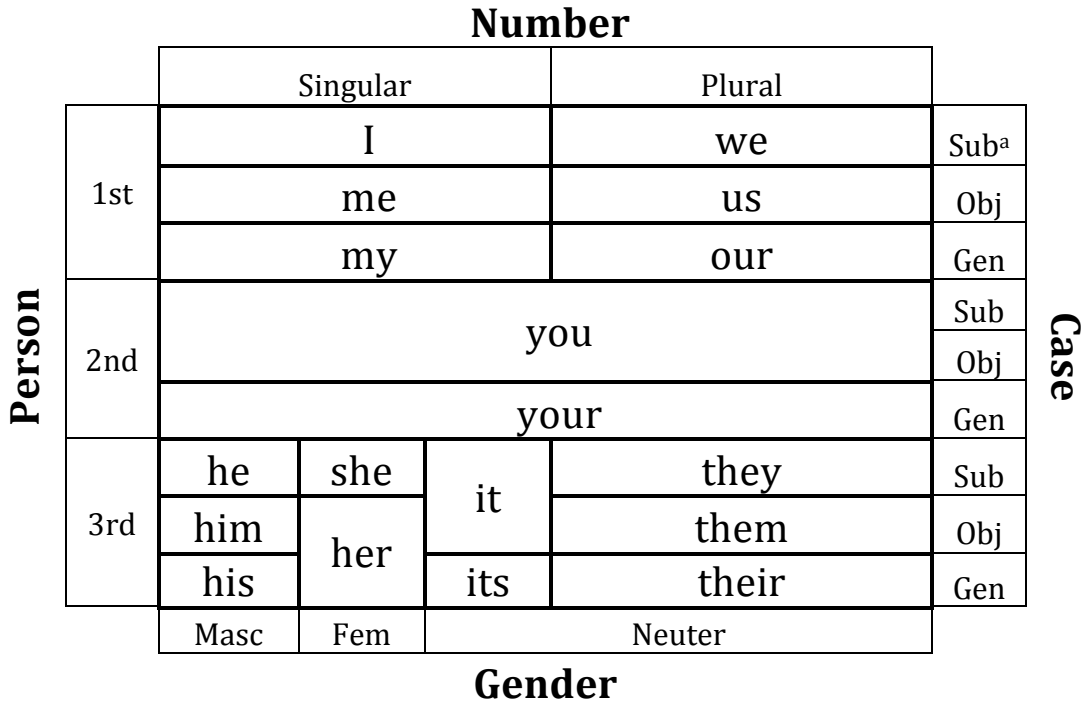

Figure 1. English personal pronoun paradigm.

[a] Sub = subject (nominative), Obj = object (accusative), Gen = genitive (possessive), Masc = masculine, Fem = feminine

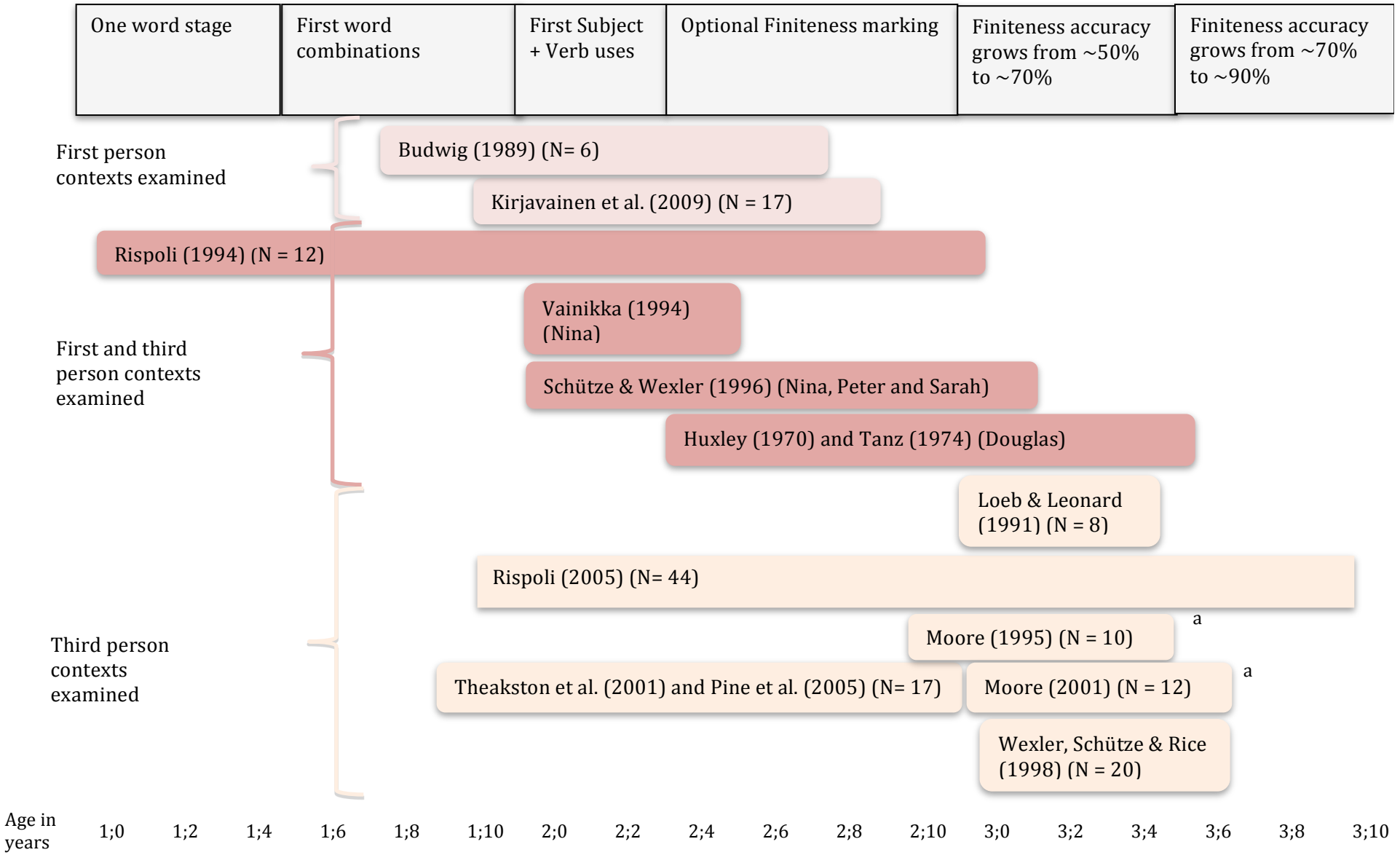

Figure 2. Ages collapsed in studies of typically developing children's spontaneous subject pronoun case errors displayed with timing of finiteness acquisition

[a] Study also examined data from children older than chart displays

	+ 3rd person error	**- 3rd person error**	**Total**
+ 1st person error	Number of children producing both first and third person errors	Number of children producing first person errors only	
- 1st person error	Number of children producing third person errors only	Number of children producing no errors	
Total			

Figure 3. Chi-square contingency table with description of cells.

ID	1;9	2;0	2;3	2;6	2;9	3;0	Overlap or Sequential
GTP01G	--	--	--	--	--	--	Not included in overlap analyses
	--	--	--	--	--	--	
GTP03G	--	--	First	--	--	--	Sequential errors *Age of last 1st = 27* *Age of first 3rd = 30*
	--	--	--	Third	Third	--	
GTP26B	--	First	First	--	--	--	Overlapping errors *Age of last 1st = 27* *Age of first 3rd = 27*
	--	--	Third	Third	Third	--	

Figure 4. Overlapping versus sequential first and third person errors

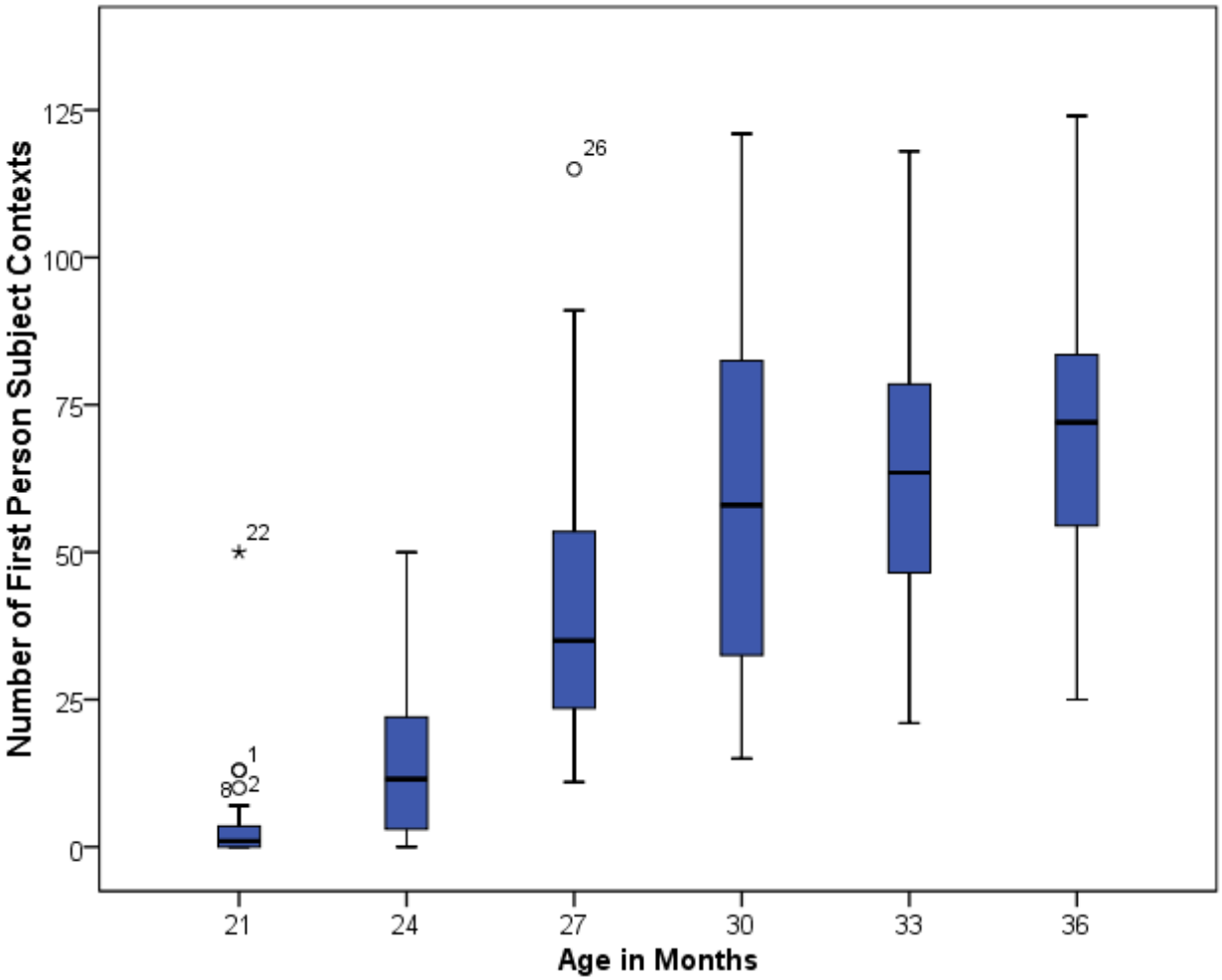

Figure 5. Variability in number of first person subject contexts by age

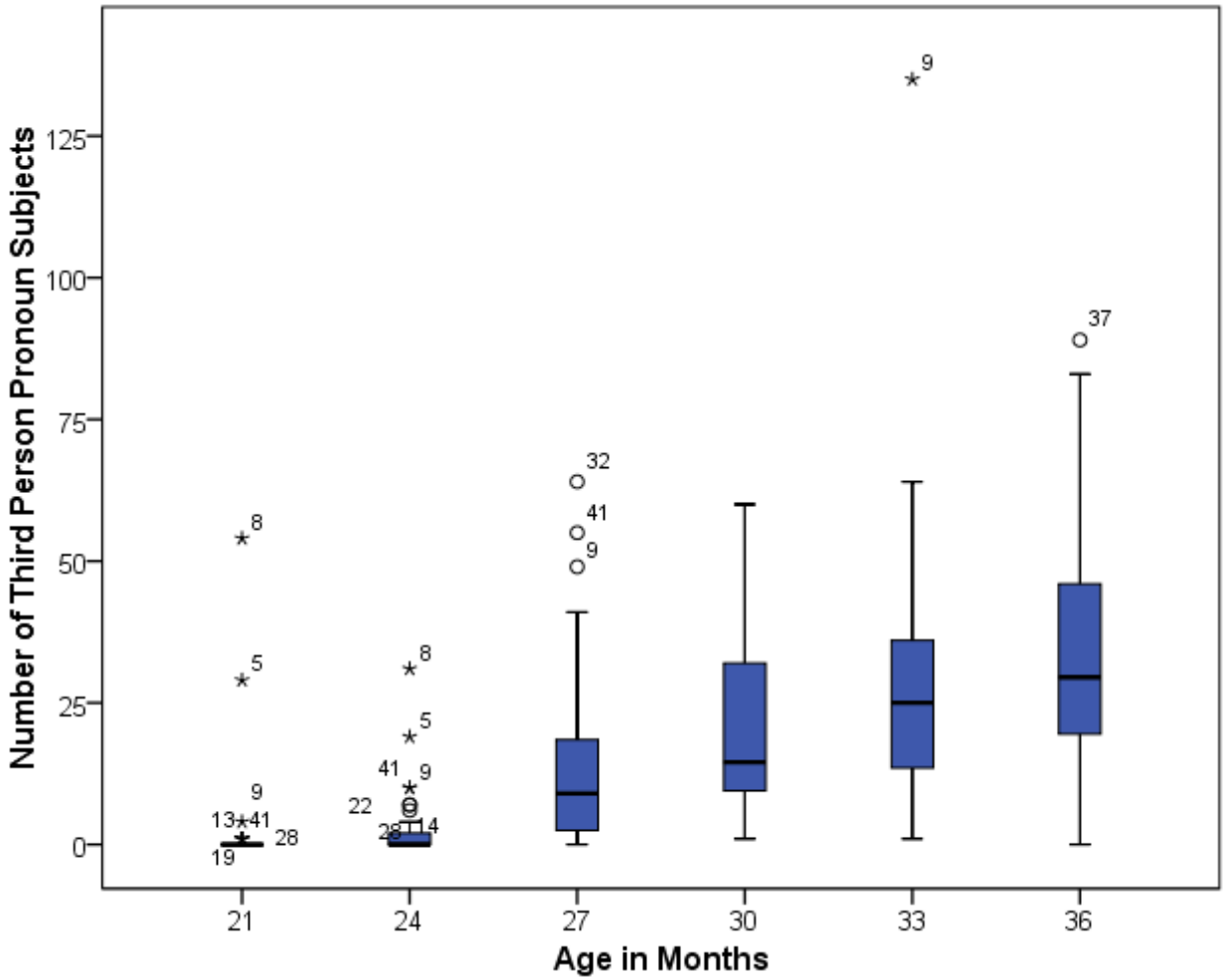

Figure 6. Variability in number of (correct and erroneous) third person pronoun subjects by age

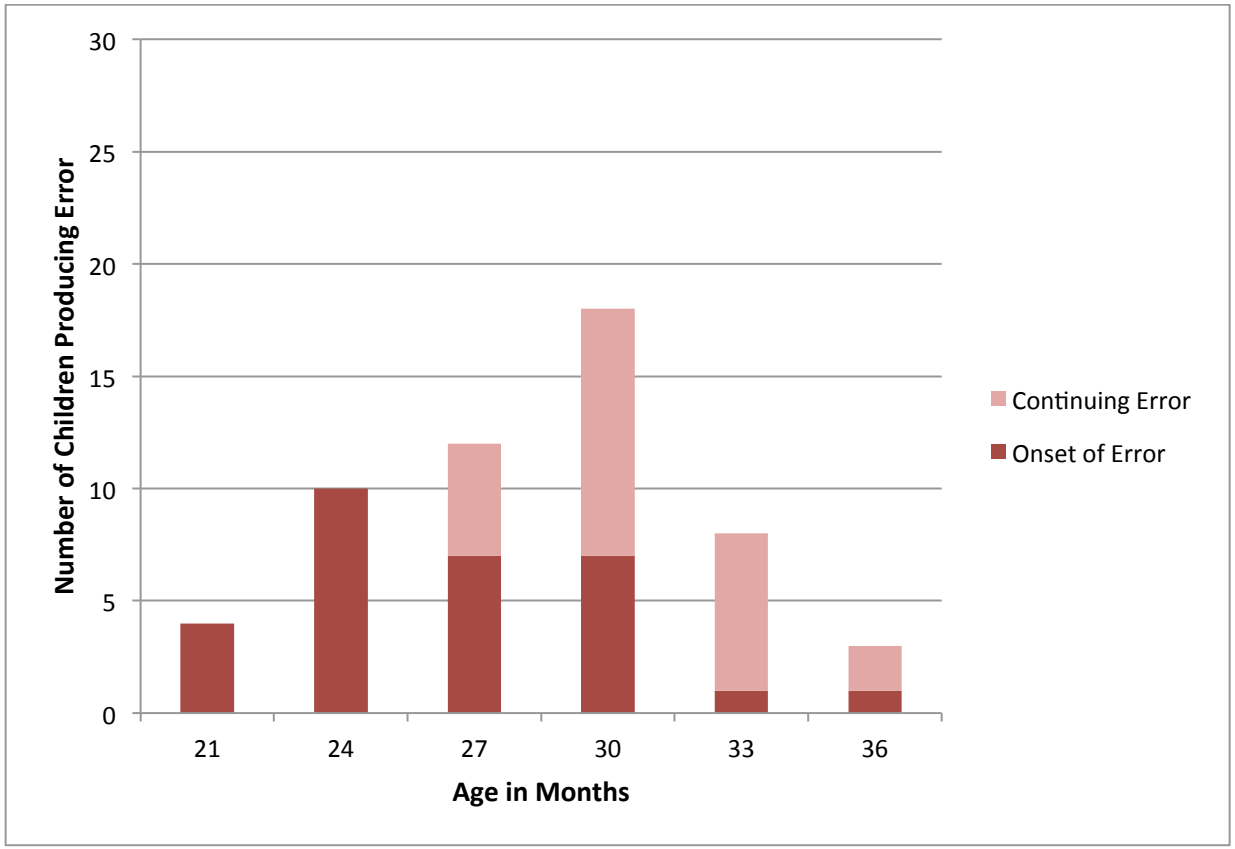

Figure 7. Number of children producing new and continued first person error
Note. N = 43 at 21, 24, 27, and 30 months. n = 40 at 33 months. n = 38 at 36 months.

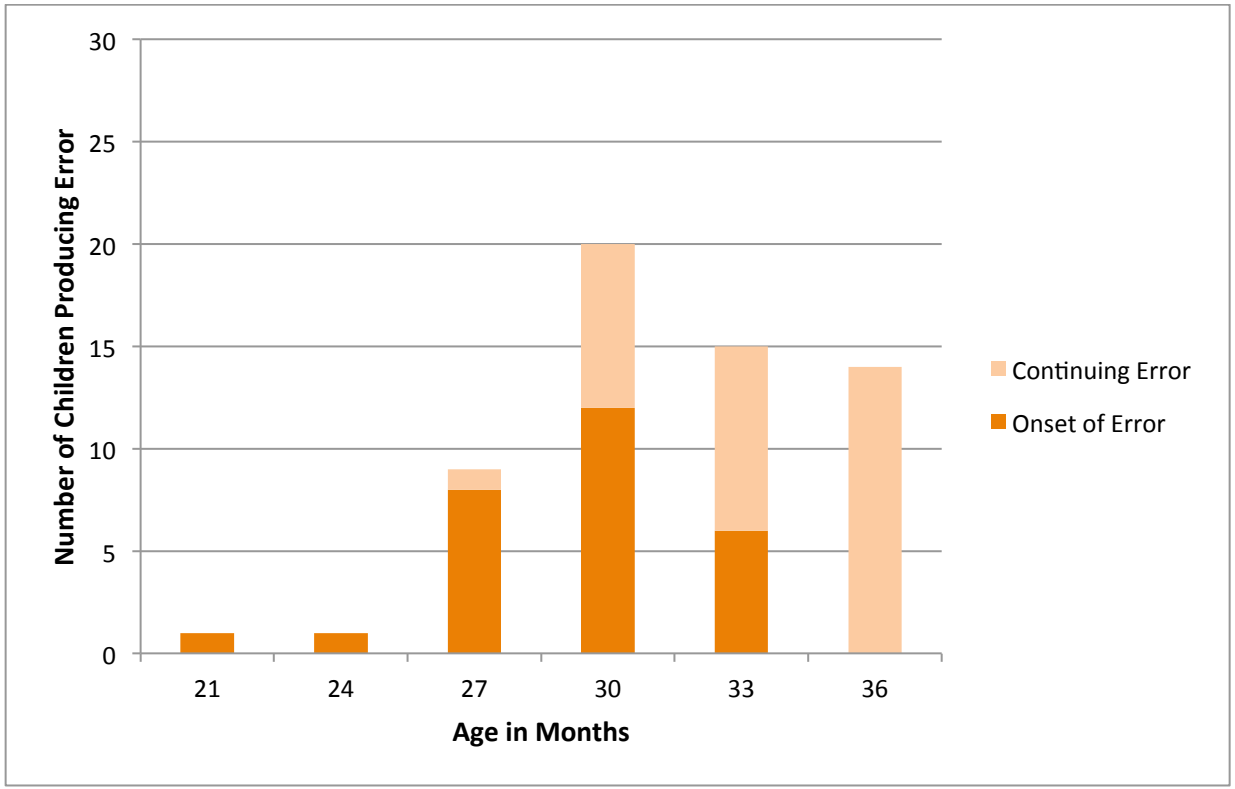

Figure 8. Number of children producing new and continued third person error
Note. N = 43 at 21, 24, 27, and 30 months. n = 40 at 33 months. n = 38 at 36 months.

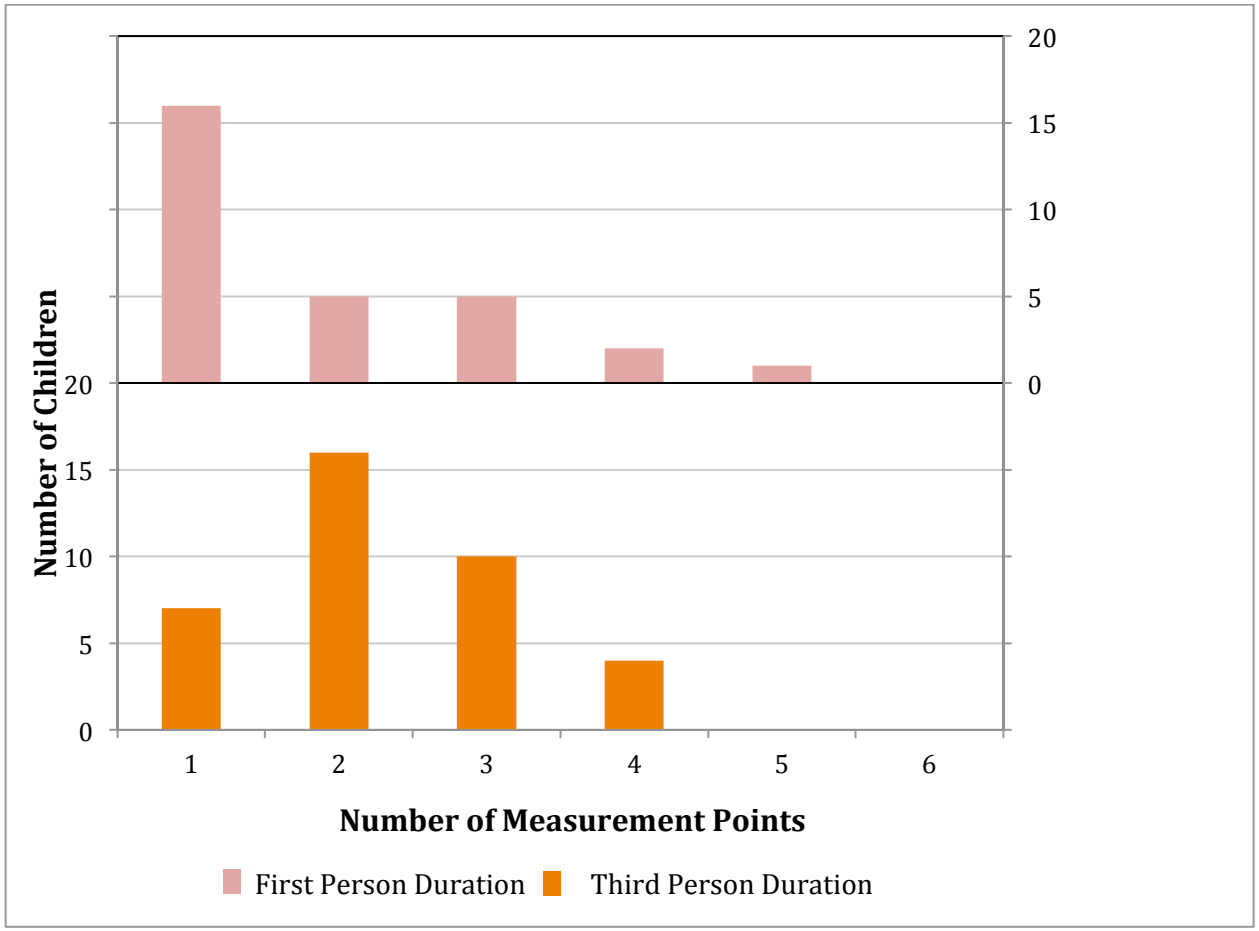

Figure 9. Duration in number of measurement points for first and third person errors

Note. The 13 children who did not make first person errors and the 14 children who did not make third person errors, (i.e., duration = 0) are not represented in this figure.

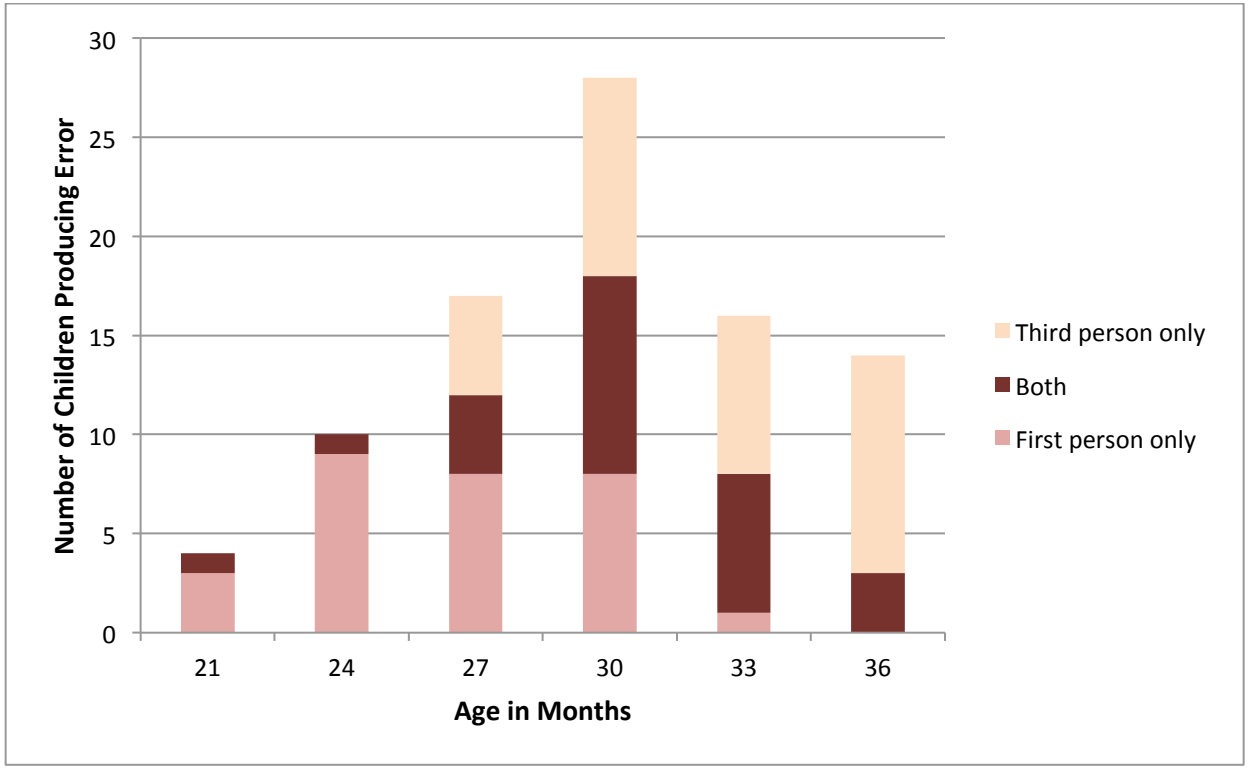

Figure 10. Number of children producing pronoun case errors by measurement point
Note. N = 43 at 21, 24, 27, and 30 months. n = 40 at 33 months. n = 38 at 36 months.

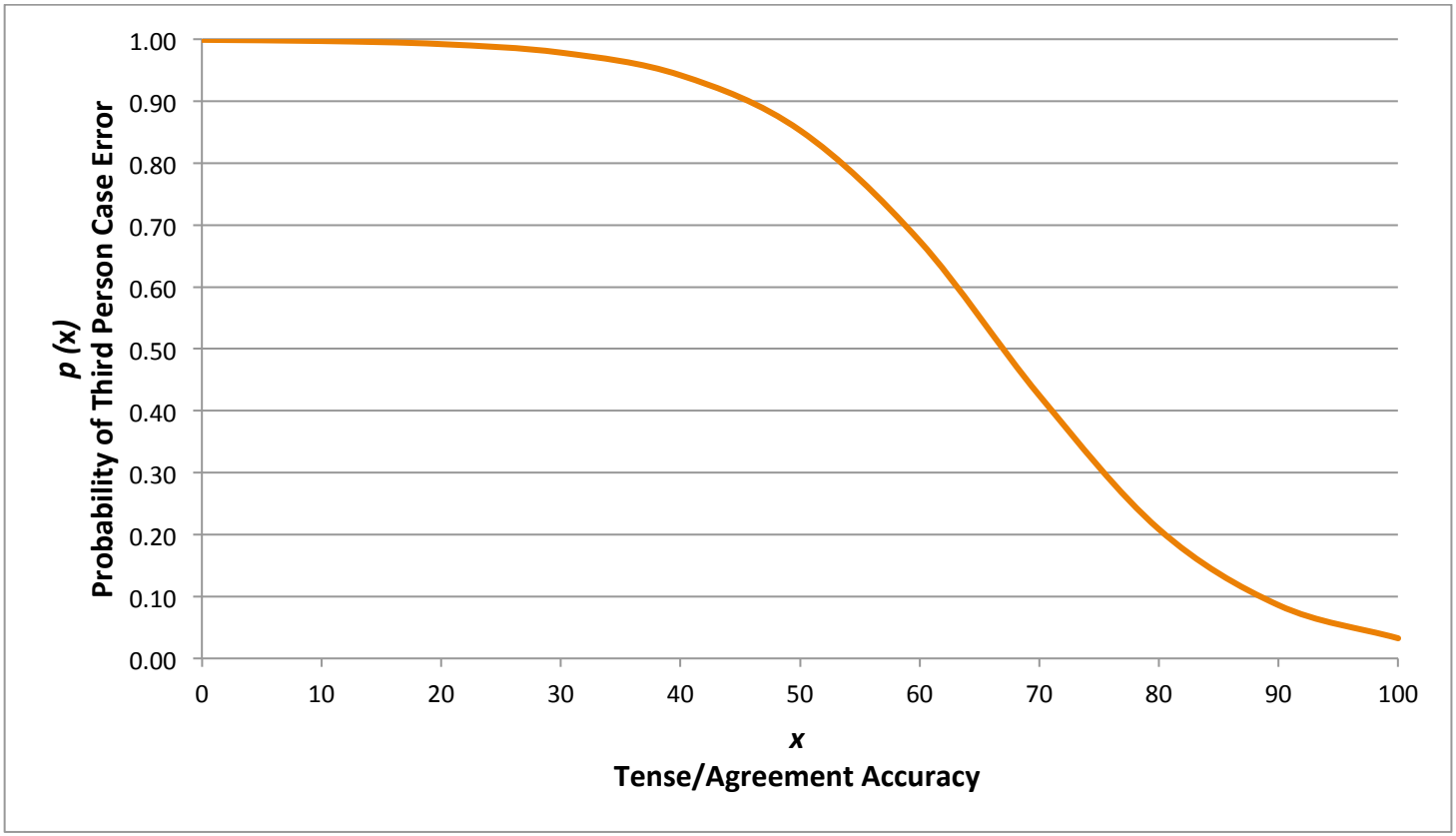

Figure 11. Logistic function displaying the predicted probability of a child producing a third person pronoun case error between 30 and 36 months, $p(x)$, based on a given tense/agreement accuracy at 30 months, x

21 months	24 months	27 months	30 months	33 months	36 months
I	--	I	I	I	I
	My[E]	--	--	--	--
		Me[E]	--	--	--
		We	We	We	We
			Us[E]	Us[E]	--
		He	He	--	He
		Him[E]	Him[E]	Him[E]	--
			She	--	--
		Hers[E]	Her[E]	Her[E]	--
		They	They	--	They
		Them[E]	Them[E]	Them[E]	--

Figure 12. All pronouns in subject position used by one participant, GTP26B, by measurement point

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Appendix A

TRANSCRIPT EXCERPT CODED FOR SUBJECT PRONOUN CASE ERRORS

All spontaneous, complete and fully intelligible child utterances in each 1-hr transcript had been coded through the original coding procedures. Transcripts were searched in this study for *Cname*, *me*, *my, mine*, *us*, *our*, *ours*, *him*, *hims*, *his*, *her*, *hers*, *them* to total all subject pronoun case errors coded with [E] and add codes if needed, and to identify any case errors in non-subject position. Pronouns were considered in subject position if they occurred before a lexical verb, copula, auxiliary, modal or an obligatory context for any of these. Pronoun subjects were identified in declaratives, with inversion or negation, and in elliptical contexts. Discourse was used as needed for elliptical uses to confirm that pronouns were used in subject position. The example below shows a coded transcript excerpt.

GTP26B at 27 months

```
F cheers.
C cheers [im].
C (him) him>
= C drops own cup
F here.
C {hey}!
= cups rolls under table
F where'd it go?
C me[E] spill/ed.
F {oh} you spilled it?
C yeah.
F do we need to clean it up?
C yeah.
F ok,let's clean it up.
C xx xx a napkin.
F xx the napkin?
F we'll have to pretend there's napkin.
C winnie, xx you xx.
C xxx winnie's.
```

C {hey}.
C <{voc}>.
F <{hey} (i)> i picked it up.
F i cleaned it up, ok?
C that *is winnie/z.
F that's winnie's.
C him[E] (go*) *is gonna drink it.
C him[E] *is gonna drink it.
C *does him[E] want more?
F yeah.
F yeah, i want more.
= pooh voice
C there you go.
C winnie.
C {hey}!
C no, winnie.
C not eat it.
C {hey} you, don't eat it.
F you gonna drink it?
F cheers.
F cheers.
C {hey} him[E] want/*3s more of that.

Appendix B

ERROR TOTALS BY PRONOUN FORM AND PARTICIPANT AT EACH MEASUREMENT POINT

21 months

ID	Cname[E]	Me[E]	My[E]	Us[E]	1P Subjects	Him[E]	Her[E]	Them[E]	Other	3P Subjects
GTP01G					13					0
GTP03G					10					0
GTP05G					2					0
GTP06B					0					0
GTP08G	1		1		83	1		1		29
GTP09G					3					0
GTP10G					0					0
GTP11B					13					54
GTP12G					4					4
GTP13B					0					0
GTP14B					0					0
GTP18B					0					0
GTP19G					2					1
GTP20G					3					0
GTP21B					0					0
GTP22B					0					0
GTP25G					0					0
GTP26B					1					0
GTP28G					5					1
GTP30B					0					0
GTP33B					7					0
GTP35G					50					0
GTP36B					1					0
GTP38G					0					0
GTP39B					0					0

ID	Cname[E]	Me[E]	My[E]	Us[E]	1P Subjects	Him[E]	Her[E]	Them[E]	Other	3P Subjects
GTP40B					0					0
GTP41G					0					0
GTP42B	1				2					1
GTP43B			1		5					0
GTP44B					0					0
GTP45G		1	2		5					0
GTP46G					1					0
GTP47B					0					0
GTP48B					0					0
GTP49G		3	2		10					2
GTP50B					2					0
GTP51G					1					0
GTP53G					0					0
GTP54B					1					0
GTP57B					0					0
GTP58G					1					1
GTP59B					2					0
GTP60G					3					0

Note. 1P Subjects = First Person Pronoun Subject Attempts; 3P Subjects = Third Person Pronoun Subject Attempts

24 months

ID	Cname[E]	Me[E]	My[E]	Us[E]	1P Subjects	Him[E]	Her[E]	Them[E]	Other	3P Subjects
GTP01G					3					0
GTP03G					18					0
GTP05G	2	2			29					0
GTP06B					5					0
GTP08G					66					19
GTP09G					18					4
GTP10G					0					0
GTP11B					28					31
GTP12G					35					10
GTP13B					5					1
GTP14B					2					4
GTP18B					0					0
GTP19G					31					2
GTP20G		1	4		16					7
GTP21B					0					0
GTP22B					0					0
GTP25G					21					2
GTP26B			1		32					0
GTP28G					8					0
GTP30B		1			32					0
GTP33B					23					1
GTP35G					46					7
GTP36B					8					1
GTP38G					0					0
GTP39B			15		19					1
GTP40B					34					0
GTP41G		1			20					2
GTP42B	6				44					6
GTP43B	3				2					0
GTP44B					3					0

ID	Cname[E]	Me[E]	My[E]	Us[E]	1P Subjects	Him[E]	Her[E]	Them[E]	Other	3P Subjects
GTP45G					16					0
GTP46G			1		17					0
GTP47B					11					0
GTP48B	6		2		3					0
GTP49G	14				12					28
GTP50B					2					2
GTP51G	1				1					0
GTP53G					8					0
GTP54B					3					0
GTP57B					12					0
GTP58G		1			8		3			10
GTP59B		1			6					0
GTP60G					3					2

Note. 1P Subjects = First Person Pronoun Subject Attempts; 3P Subjects = Third Person Pronoun Subject Attempts

27 months

ID	Cname[E]	Me[E]	My[E]	Us[E]	1P Subjects	Him[E]	Her[E]	Them[E]	Other[a]	3P Subjects
GTP01G					53					0
GTP03G		1			23					1
GTP05G	3	3			51	1	3			6
GTP06B	5				6					8
GTP08G					78					20
GTP09G					41					15
GTP10G		1			35					1
GTP11B			1		58					28
GTP12G	5				39					49
GTP13B					7					4
GTP14B					23					3
GTP18B		1			25	1				17
GTP19G					59					41
GTP20G					35			1		2
GTP21B					42	1	1			32
GTP22B	6				8					2
GTP25G					43					31
GTP26B		18			48	28		3	1	41
GTP28G	2				16					4
GTP30B			1		54	1				9
GTP33B					32					8
GTP35G					57					25
GTP36B					30					15
GTP38G					19					9
GTP39B					91					3
GTP40B					115					1
GTP41G	7				57					1
GTP42B					49					14
GTP43B					79					10
GTP44B	23				9					12

ID	Cname[E]	Me[E]	My[E]	Us[E]	1P Subjects	Him[E]	Her[E]	Them[E]	Other[a]	3P Subjects
GTP45G		4			21					1
GTP46G					61					64
GTP47B	1	5	1		45					17
GTP48B	1				19					3
GTP49G	19		1		10					88
GTP50B					29					8
GTP51G		9	3		16					3
GTP53G		6			24					12
GTP54B	6				10					1
GTP57B					24					13
GTP58G					30	5	2			57
GTP59B					27	1				2
GTP60G					15	1	2			4

Note. 1P Subjects = First Person Pronoun Subject Attempts; 3P Subjects = Third Person Pronoun Subject Attempts
[a] Includes *hers* used as a subject

30 months

ID	Cname[E]	Me[E]	My[E]	Us[E]	1P Subjects	Him[E]	Her[E]	Them[E]	Other	3P Subjects
GTP01G					15					3
GTP03G					57	4	5			11
GTP05G		4			45	1				28
GTP06B					121					1
GTP08G	3				114					60
GTP09G					48					15
GTP10G		3			32					2
GTP11B					34					23
GTP12G					46					25
GTP13B					18					8
GTP14B					40		8			17
GTP18B					60					33
GTP19G					85					34
GTP20G				1	59	1		3		14
GTP21B					27	1	1	1		35
GTP22B	8				100					1
GTP25G		1			84		2			36
GTP26B				1	107	8	1	2		19
GTP28G		2			18					2
GTP30B	1				103	1	2	6		31
GTP33B					63					12
GTP35G					52		1			47
GTP36B					28	7	5			14
GTP38G					44		1			42
GTP39B	2				73					15
GTP40B		1	2		95					1
GTP41G		1			60	1				10
GTP42B			1		41					15
GTP43B					76					25
GTP44B	18		3		51	1				12

ID	Cname[E]	Me[E]	My[E]	Us[E]	1P Subjects	Him[E]	Her[E]	Them[E]	Other	3P Subjects
GTP45G	1	6	2		24			1		1
GTP46G			1		82					59
GTP47B		2	1		91					11
GTP48B					30		2			14
GTP49G					146					170
GTP50B					25					33
GTP51G		4			50	1				7
GTP53G		2			83					9
GTP54B					56	5	2			11
GTP57B		1			63					43
GTP58G					14		1			19
GTP59B		1			18	1		1		11
GTP60G		3	3		33	1		1		2

Note. 1P Subjects = First Person Pronoun Subject Attempts; 3P Subjects = Third Person Pronoun Subject Attempts

33 months

ID	Cname[E]	Me[E]	My[E]	Us[E]	1P Subjects	Him[E]	Her[E]	Them[E]	Other	3P Subjects
GTP01G					30					1
GTP03G					50	18	5			25
GTP05G										
GTP06B					77		1			3
GTP08G					107					29
GTP09G					117					22
GTP10G					55	3	1	8		20
GTP11B					37					30
GTP12G	1				47					135
GTP13B										
GTP14B					107		6			38
GTP18B					90					16
GTP19G					74					48
GTP20G					40					12
GTP21B					24					64
GTP22B	3				88					4
GTP25G					61					25
GTP26B				1	67	12	2	2		16
GTP28G					93		4			34
GTP30B					66					37
GTP33B					77					39
GTP35G					45					17
GTP36B		3			43		4			13
GTP38G					39		1			36
GTP39B					88		1			36
GTP40B		17			43		1			1
GTP41G			1		118					28
GTP42B					64					31
GTP43B					53					17
GTP44B					65			1		13

ID	Cname[E]	Me[E]	My[E]	Us[E]	1P Subjects	Him[E]	Her[E]	Them[E]	Other	3P Subjects
GTP45G		1			66	6				32
GTP46G					99					50
GTP47B		2			51	2				13
GTP48B					21					8
GTP49G										
GTP50B					38					12
GTP51G		6			59	16	17			34
GTP53G					85					25
GTP54B					63	1		8		53
GTP57B					80					43
GTP58G					33					19
GTP59B					64					25
GTP60G		1			49	8	11			22

Note. Data are not available for GTP05G, GTP13B, and GTP49G at 33 months.1P Subjects = First Person Pronoun Subject Attempts; 3P Subjects = Third Person Pronoun Subject Attempts.

36 months

ID	Cname[E]	Me[E]	My[E]	Us[E]	1P Subjects	Him[E]	Her[E]	Them[E]	Other[a]	3P Subjects
GTP01G					65					12
GTP03G					38					43
GTP05G										0
GTP06B		1			100	2	37	3		44
GTP08G										0
GTP09G					115					42
GTP10G					75					21
GTP11B					90					24
GTP12G					29					27
GTP13B										
GTP14B					59	3	9			12
GTP18B					47					17
GTP19G					73					64
GTP20G					42	1		3		37
GTP21B					25					27
GTP22B					89					
GTP25G					61					53
GTP26B					124					16
GTP28G					79					31
GTP30B					116		1			35
GTP33B					88					16
GTP35G					71					27
GTP36B					46		26			50
GTP38G					90		1			1
GTP39B					77		1	1		83
GTP40B			1		53		7	1	1	25
GTP41G					78		25			49
GTP42B					83					28
GTP43B					73					36
GTP44B					91	1	1			73

ID	Cname[E]	Me[E]	My[E]	Us[E]	1P Subjects	Him[E]	Her[E]	Them[E]	Other[a]	3P Subjects
GTP45G					53	9			2	72
GTP46G					67					40
GTP47B					84					24
GTP48B					79		4			18
GTP49G										
GTP50B					70					43
GTP51G		22		1	82	8	39	1		90
GTP53G	1				32					28
GTP54B	2				54					55
GTP57B					71					33
GTP58G										
GTP59B					62					24
GTP60G					60	21	20		1	48

Note. Data are not available for GTP05G, GTP08G, GTP13B, GTP49G, and GTP58G at 36 months. Language samples at 36 months are 30 minutes long for GTP14B and GTP38G. 1P Subjects = First Person Pronoun Subject Attempts; 3P Subjects = Third Person Pronoun Subject Attempts.

[a] Includes *hims* and *hers* used as subjects

Appendix C

CODED PRONOUN CASE ERRORS

All pronoun case errors and uses of children's own names for *I* were coded with [E]. Then, non-subject position errors were subtracted from totals for each pronoun form for each participant at each measurement point. Pronouns were considered in subject position if they occurred before a lexical verb, copula, auxiliary, modal or an obligatory context for any of these. Pronouns were considered in non-subject position if they followed a preposition or preceded a noun phrase. The resulting totals were used to calculate measures. The tables below illustrate this process for four participants and display their number of subject pronoun case errors by pronoun type for each measurement point at which they produced errors. These four participants represent the four patterns of children who made subject pronoun case errors: first person errors only, third person errors only, both first and third person with overlap, and both first and third person with no overlap.

GTP49G (First person errors only)

	Subject Position Errors	Cname Uses in Subject Position	Subject Error Totals
21 months	C me[E] made him. C (uh) me[E] put them on. C (me make) me[E] made them. C my[E] get him. C my[E] make him.		3 *me* errors 2 *my* errors
24 months		C Cname[E] have to open it. C Cname[E] take her cover out of her crib. C Cname[E] put the hat on hair. C Cname[E] bring them all. C Cname[E] want some dinner Pooh. C Cname[E] want/*3s placemat. C Cname[E] want/*3s dinner on this. C Cname[E] want/*3s red on here. C Cname[E] get some for mommy. C Cname[E] *is break/ing him and break/ing him and break/ing him and break/ing. C Cname[E] take her out. C Cname[E] *is do/ing it. C Cname[E] found a box. C Cname[E] blow and where *did mommy/z go?	
27 months	C my[E] like/3s pizza.	C Cname[E]/'s get/ing all the red one for the brick. C Cname[E]/'s get/ing all the red one. C Cname[E] *is gonna get the straw chimney. C Cname[E]/'s gonna finish getting the red one. C and Cname[E]/'s do/ing a brick house. C Cname[E]/'s gonna give him some juice. C (Cname's) Cname[E]/'s close/ing it up. C Cname[E]/'s cook/ing it. C Cname[E] *is wash/ing him. C (Cname's) Cname[E]/'s comb/ing his hair. C Cname[E]/'s gonna dry him off. C Cname[E]/'s gonna wash them off.	1 *my* error

		C Cname[E] *is slide/ing off. C Cname[E] is gonna get one. C Cname[E]/'s gonna scoot over there. C Cname[E]/'s gonna get her. C Cname[E] sit right here. C Cname[E]/'s gonna clean it out. C Cname[E]/'s gonna wash it.	

GTP14B (Third person errors only)

	Subject Position Errors	Non-subject Position Errors	Subject Error Totals
30 months	C her[E] drive/*3s. C her[E] drive/*3s. C her[E] drive/*3s. C her[E] drive/*3s. C her[E] drive/*3s. C her[E] drive/*3s. C (her) her[E] move/*3s. C her[E] go/*3s house.		8 *her* errors
33 months	C her[E] turn the bow around. C her[E] turn the bow around. C her[E] turn the bow around. C her[E] (come) came out. C (her) her[E] can't wake up now. C her[E] ride too.		6 *her* errors
36 months	C him[E] *is too big. C him[E] *is walk/ing. C yeah, him[E] walk. C her[E] *is chunky. C her[E] *is in the closet. C (h*) her[E] *is right there. C her[E] knock a mommy off. C (her) her[E] have go (t*) to a doctor. C (no) no, her[E] can't fit in. C her[E] *is at home. C {oh} (there) there her[E] *is. C her[E] *is nina.	C *is that hers[E] highchair?	3 *him* errors 9 *her* errors

GTP51G (First and third person errors with overlap)

	Subject Position Errors	Non-subject Position Errors	Cname Uses in Subject Position	Subject Error Totals
24 months			C Cname[E] sit.	
27 months	C <no, me[E] do it>. C me[E] put. C me[E] share. C *do me[E] have lion? C me[E] blow too. C me[E] sit. C me[E] fit. C me[E] fit. C <me[E] (help)> help Poohbear. C my[E] want that. C my[E] (want) want that. C my[E] sit.			9 *me* errors 3 *my* errors
30 months	C {hey} me[E] drop you, silly. C me[E] get (me) me a red plate. C me[E] get you knife/s. C me[E] get knife right here now. C (this) him[E] *is not a bubble.	C this *is you[E] purple fork. C this *is you[E] drink. C this *is him[E] plate. C miss him[E] bubble.		4 *me* errors 1 *him* error
33 months	C me[E] *am sit/ing there. C me[E] have sausage <too>. C me[E] share with my piggy. C no, me[E] have it. C me[E] wanna move Poohbear too. C <me[E] have it>. C (wh* him) him[E] got moo. C (him) him[E] play. C him[E] *is out. C him[E] already have vegetable. C <him[E]> need/*3s. C him[E] go in here. C him[E] need/*3s play with us. C him[E] play/*3s with my piggy/s.	C my[E]/z blue. C they/'re mine[E]/z. C this *is mine[E]/z. C where/'s mine[E]/z? C (here's hims) here/'s him[E] tummy. C here/'s[c] him[E] tummy. C let me bring him[E] stroller. C where/'s him[E] lip/s? C for him[E] mommy|mom.		6 *me* errors 16 *him* errors 17 *her* errors

	C him[E] play/*3s with my piggy/s. C him[E] want/*3s play with chicken. C him[E] *is sleep/ing. C him[E] *is sleep/ing. C him[E] need somebody hold him. C him[E] need/*3s get out. C him[E] sit in stroller. C no, him[E] just stay/*3s in stroller. C her[E] *is drink/ing. C (we need) her[E] need/*3s take a bath. C her[E] *is too little. C her[E] eat off here. C her[E] eat off here. C her[E] need/*3s a bed. C her[E] need/*3s rubber ducky in <there>. C her[E] sleep/ing. C her[E] use one of these. C her[E] use one of these. C (her needs her) her[E] need/*3s to eat. C (her needs) her[E]/'s hungry. C (you you) her[E] have (p*) two pink one/s. C <her[E] *is sleep/ing>. C her[E] *is sleep/ing. C her[E] *is hungry. C her[E] need/*3s sunglasses.			
36 months	C and me[E] want chicken. C me[E] feed danny and nina some food. C me[E] gonna make food. C me[E] need feed her some juice <right> now. C me[E] need get her all clean. C me[E] need sit in my chair. C me[E] need these thing/s help us not spill anything.	C <yellow fork him[E] plate>. C yellow fork him[E] plate. C (hi* this her) this *is him[E] mom. C (this) this *is him[E] mom. C him[E] mom need/*3s be with that daddy. C him[E] mommy/'s help		22 *me* errors 1 *us* error 8 *him* errors 39 *her* errors 1 *them* error

	C mom, me[E] need it. C (me for) me[E] need it. C now me[E] need food in. C and me[E] needs it. C me[E] get you some pizza. C me[E] got of these (um) outside. C me[E] got one like : them. C me[E] got one of these rides. C me[E] help him open door. C me[E] need get him. C me[E] need take all our baby/s. C me[E] need take all the baby/s. C me[E] think you need drink out these. C you have some and me[E] have some and you have some. C (what's) me[E] give them some of these right now. C (uh) us[E] need these big cup/s. C him[E] like/*3s pretzel ring/s. C yes, (feed) him[E] *is hungry too. C him[E] fit/3s. C him[E] just need/*3s a little baby girl and (baby bo*) baby boy. C him[E] need/*3s a (s*) sit. C him[E] need/*3s take turn/s. C him[E] too little. C (who wants) *does him[E] want red or her[E] want/3s red? C <(her)> her[E] just need/*3s me. C (h*) her[E] (p*) have a pink on her. C (h* him n*) her[E] need/*3s pink cup. C (her need a) her[E] (need) need/3s a bowl. C <her[E] need/*3s to be all dry>. C <i think her[E] *is poopy>. C <then her[E] *is gonna> lay down.	hims[E] do it. C this daddy need/*3s go with him[E] little boy. C now that little boy need/*3s him[E] mom.		

	C i think (t* t*) <her[E] need/*3s a bowl>. C i think her[E] want/*3s milk and juice. C think her[E] want/*3s to go play. C (her) her[E] *is too little for big mommy. C her[E] *is one. C her[E] *is done now. C her[E] *is done. C her[E] don't need it. C her[E] have one spoon. C her[E] need/*3s to play with someone else. C her[E] really want/*3s something to eat. C her[E] *is garbage. C her[E] can't ride it. C her[E] fit/*3s or any these fit. C her[E] *is gone. C her[E] *is have/ing banana/s. C her[E] need/*3s a mommy or daddy. C her[E] need/*3s be with (her) these girl/s. C her[E] need/*3s be with her daddy. C her[E] need/*3s some daddy. C her[E] need/*3s someone. C her[E] need/3s the dress. C her[E] *is not gonna drive. C her[E] *is too little. C her[E] *is very tiny. C her[E] want/*3s to take/3s it off. C her[E] want/3s that one. C now her[E] need/*3s take turn/s. C think her[E] just want/*3s some pizza. C think her[E] want/*3s baby food. C think her[E] want/*3s some pizza. C them[E] *are silly.			

GTP10G (First and third person errors with no overlap)

	Subject Position Errors	Non-subject Position Errors	Subject Error Totals
27 months	C me[E] blow bubble/s.		1 *me* error
30 months	C me[E] shut it. C me[E] shut it. C me[E] pick it up.		3 *me* errors
33 months	C him[E] have a big tail. C him[E] have a bag for chicken. C him[E] go/3s in there. C her[E]/'s eat/ing. C them[E] *are in there. C them[E] *are this one. C them[E] *are go/ing home. C them[E] *are broken. C them[E] *are gone. C them[E] *are in there. C them[E] have a house. C them[E] *are in (the*) them/z home.	C them *are in (the*) them[E]/z home.	3 *him* errors 1 *her* error 8 *them* errors