REFERRING TO ENTITIES AND CONVEYING SOURCE OF INFORMATION:
DEVELOPMENT OF CHILDREN'S COMMUNICATIVE SKILLS

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This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Doctor of Philosophy.

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Berna Arslan Uzundağ

Thesis Abstract

Berna Arslan Uzundağ, "Referring to Entities and Conveying Source of Information: Development of Children's Communicative Skills"

This thesis investigates the development of Turkish-speaking children's communicative skills by examining development of referential communication skills and the acquisition of evidentiality and relative clauses in language via experimental and corpus-based approaches. In Chapter I, we manipulated the degree of informativeness of adults' descriptions of referents in input to children and tested how hearing these descriptions affected the way children formed and repaired their own referential expressions. We further examined the link between children's cognitive skills (short-term and working memory, cognitive flexibility, and theory of mind) and referential communication skills. Children who heard more informative expressions showed a greater increase in uniquely identifying initial descriptions than children who heard less informative expressions. The ability to repair ambiguous messages was found to be related to children's memory skills and cognitive flexibility. In Chapter II, we investigated the acquisition of relative clauses, which are complex language structures that refer to entities with modifiers. We used longitudinal child-caregiver and cross-sectional peer interactions to examine the age of emergence and patterns of use of relative clauses in child speech in relation to child-directed speech and in comparison to other languages. Findings indicated that relative clauses are acquired late in Turkish compared to other languages where corpus studies are available. Although children's use of relative clauses was highly similar to adults' use in terms of the frequency distribution of the syntactic role of the head noun in the relative clause and the matrix clause, children's productions were lower in complexity indicating a gradual developmental process. Finally, in Chapter III, we studied the acquisition of the evidential marker *–mIş* by examining longitudinally collected child-caregiver interactions. By charting individual differences in child and caregiver speech over time with growth curve analyses, we showed that children followed a similar course of acquisition in terms of the frequency of use of the evidential marker despite differences in caregiver input. Children exhibited differences with respect to the order of emergence of different evidential functions (e.g., inference, hearsay), where each child showed a unique pattern irrespective of the frequency in the input. The use of the pragmatic functions of the evidential marker in child-directed speech depended on parental education. Overall, in this thesis we showed that (1) children's cognitive skills play an important role in their communication skills, (2) how children use language is affected by adults' use of language both in short term (as shown in Chapter I) and long term (as shown in Chapters II and III), (3) language input provided by the caregivers shows differences with respect to parental education, and (4) the development of complex language structures is gradual and not an all-or-none accomplishment.

Tez Özeti

Berna Arslan Uzundağ, "Varlıklara Atıfta Bulunma ve Bilgi Kaynağını Aktarma: Çocukların İletişim Becerilerinin Gelişimi"

Bu tez, Türkçe konuşan çocukların iletişim becerilerinin gelişimini, çocukların göndergesel iletişim becerilerini ve dildeki kanıtsallığın ve ilgi tümceciklerinin edinimini deneysel ve derlem bazlı yaklaşımlarla inceleyerek araştırmaktadır. Birinci Bölüm'de yetişkinlerin varlıkları tasvirlerinin içerdiği bilgi vericilik düzeyini değiştirerek, bu tasvirleri duymanın çocukların kendi göndergesel anlatımlarını şekillendirme ve düzeltmelerinde nasıl bir etkisi olduğunu test ettik. Ayrıca çocukların bilişsel becerileri ile (kısa süreli bellek, çalışma belleği, bilişsel esneklik ve zihin kuramı) iletişimsel becerileri arasındaki ilişkiyi inceledik. Bilgi vericilik düzeyi daha yüksek olan anlatımları duyan çocuklar ilk anlatımlarında bir varlığı diğerlerinden ayırıcı şekilde anlatma becerilerinde daha büyük bir artış gösterdiler. Muğlak anlatımları düzeltme yetisinin ise çocukların bellek ve bilişsel esneklik becerileri ile ilgisi olduğu bulundu. İkinci Bölüm'de varlıklara atıfta bulunmak için kullanılan ve karmaşık dil yapıları olduğu düşünülen ilgi tümceciklerinin edinimini araştırdık. Boylamsal çocuk-bakıcı ve kesitsel akran etkileşimini kullanarak ilgi tümceciklerinin çocuk konuşmasında ortaya çıkış yaşını ve kullanılma örüntülerini çocuğa yöneltilen konuşma bağlamında ve diğer dillerle karşılaştırmalı olarak inceledik. Bulgular, ilgi tümceciklerinin derlem çalışmaları bulunan diğer dillere göre Türkçe'de daha geç ortaya çıktığını göstermektedir. Çocukların ilgi tümceciklerini kullanımı baş sözcüğün ilgi tümceciği ve ana cümle içindeki rolünün sıklık dağılımı açısından yetişkinlerin kullanımlarına oldukça benzer olsa da, çocukların üretimleri daha az karmaşık olup, bu durum kademeli bir gelişimsel sürece işaret etmektedir. Son olarak, Üçüncü Bölüm'de kanıtsallık eki *–mIş*'ın edinimini boylamsal olarak toplanmış olan çocuk-bakıcı etkileşimini inceleyerek araştırdık. Çocuk ve bakıcı konuşmasındaki bireysel farklılıkları büyüme eğrisi analizleri kullanarak zaman içinde çizdirdik ve bakıcı konuşmasındaki farklara rağmen çocukların kanıtsallık ekini kullanma sıklıkları açısından benzer bir yörünge izlediklerini gösterdik. Çocuklar farklı kanıtsallık işlevlerinin (örn. çıkarım, rivayet) edinimi sıralamasında bakıcı konuşmasındaki sıklıktan bağımsız olarak farklılıklar göstermişlerdir. Kanıtsallık ekinin bakıcı konuşmasındaki edimsel işlevlerinin ebeveynlerin eğitim düzeyine bağlı olduğu görülmüştür. Sonuç olarak, bu tezde (1) çocukların bilişsel becerilerinin iletişim becerilerinde önemli bir rolü olduğunu, (2) çocukların dili kullanımlarının yetişkinlerin kullanımlarından kısa vadede (Birinci Bölüm) ve uzun vadede (İkinci ve Üçüncü Bölümler) etkilendiğini, (3) bakıcı konuşmasının ebeveyn eğitimine göre farklılık gösterdiğini ve (4) karmaşık dil yapılarının birdenbire var olmadığını ve kademeli olarak geliştiğini gösterdik.

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OVERVIEW

"Words have a use—they specify perceived events relative to a set of alternatives; they provide information" (Olson, 1970, p. 263)

For proper communication, the speaker and the listener need to possess various skills. For young children, whose knowledge and experience about the world and the ways to convey these via language are still developing, communicative skills are among the life skills that show continuous development over a long period of time. This thesis focuses on two important communicative skills, namely, referring to entities such as objects, people, and events, and conveying the source of transmitted information.

There are many ways to refer to entities. Preverbal infants refer to things by directing their gaze and pointing. Children who just started speaking tell the object's name and older children whose linguistic abilities are more advanced can name the attributes that set the referent apart from similar competitors. This process is not flawless; preschool-aged children may produce ambiguous messages for the listener (e.g., Deutsch & Pechmann, 1982) and judge ambiguous descriptions they heard as adequate (Robinson & Robinson, 1982). The communication problems children demonstrate in situations that necessitate referential communication were initially attributed to children's egocentrism (Flavell, Botkin, Fry, Wright, & Jarvis, 1968), later to their inability to understand procedural rules (e.g., not mentioning how an object is different from a potential competitor object) (Whitehurst & Sonnenschein, 1985), and to their still-developing cognitive functions (Deutsch & Pechmann, 1982; Nilsen & Fecica, 2011). In Chapter I, we investigated which cognitive skills (e.g., working memory, cognitive flexibility) are able to predict different referential communication skills. Furthermore, we experimentally investigated the effects of hearing adults' informative and uniquely identifying descriptions of referents on how children form their referential expressions and repair ambiguous ones.

When referring to an entity, sometimes just naming the referent (e.g., *Can you give me the ball?*), or uttering an adjective (e.g., *the blue ball*) is sufficient, but in some situations more complex descriptions are required. Relative clauses (e.g., *the ball that I bought yesterday*) are among these complex descriptions. Although in many languages relative clauses are produced by children in early ages (around the ages of 2–3) (e.g., Diessel & Tomasello, 2000; Ozeki & Shirai, 2007), experimental findings showed that children master these constructions in later ages (e.g., Friedmann & Novogrodsky, 2004; Rahmany, Marefat, & Kidd, 2011). Many experimental and corpus-based studies have been conducted about relative clauses in various languages, but there is a dearth of studies of spontaneous speech in Turkish, where the existing studies do not provide information about children's use of relative clauses in daily interactions. In Chapter II, our goal was to investigate the acquisition and use of relative clauses by Turkish-speaking children by examining their spontaneous speech. In line with this purpose, we studied how children's acquisition processes are affected by child-directed speech and what kind of differences Turkish-speaking children demonstrate compared to children speaking typologically diverse languages.

When communicating and conveying a piece of knowledge to the listener, we frequently transmit the source of this knowledge too. There are various ways to specify whether we obtained a piece of information via seeing, hearing about it, or making an inference. In English, one can convey the source of information via utterances like “I heard that”, or “I assumed that”, whereas in some languages the source is specified via grammaticalized special markers that are called evidentials (Willett, 1988). Turkish is one of the languages that have evidential markers where each event in past tense is expressed either with *–DI*, marking direct experience or *–mIş*, marking indirect experience such as hearsay and inference (Aksu-Koç & Slobin, 1986). In Chapter III, we have taken a corpus linguistic approach to study the acquisition and use of the indirect experience marker *–mIş* in child-caregiver interactions by examining longitudinally sampled data. Analyzing the frequency of the evidential marker and its change over time in child and caregiver speech, examining the relationship between child speech and caregiver input, and classifying different evidential functions were among our goals.

Overall, this thesis examined the development of young children’s abilities of referring to entities and conveying source of information via experimental and corpus-based methods. Chapter I has the accepted manuscript by the *Journal of Experimental Child Psychology*. Chapter II has the manuscript of the journal article to be submitted. Finally, Chapter III has the accepted manuscript by the *Journal of Child Language*. A list of works published and presented during the PhD is given below.

LIST OF PUBLICATIONS

- Uzundag, B. A., Taşçı, S. S., Küntay, A. C., & Aksu-Koç, A. (2018). Functions of Turkish evidentials in early child-caregiver interactions: a growth curve analysis of longitudinal data. *Journal of Child Language*, doi:10.1017/ S0305000911000183.

- Uzundag, B. A., & Küntay, A. C. (2018). Children's referential communication skills: The role of cognitive abilities and adult models of speech. *Journal of Experimental Child Psychology, 172*, 73–95.

- Uzundag, B. A., & Küntay, A. C. (to be submitted). The acquisition and use of relative clauses in Turkish: An analysis of spontaneous interactions.

- Küntay, A. C., Özkan, D., & Uzundag, B. A. (to be submitted). Learning language is learning typology: Acquisition of argument structure and relative clauses in typologically diverse languages. In J. von Koss Torkildsen and J. Horst (Eds.), *International Handbook of Language Development.* London: Routledge.

- Uzundag, B. A., Tasci, S. S., & Küntay, A. C. (2017). Nonfactual meanings in early use of evidentials in Turkish child-caregiver interactions. In F. N. Ketrez, A. Küntay, A. Özyürek, & Ş. Özçalışkan (Eds.), *Social environment and cognition in language development: Studies in honor of Ayhan Aksu-Koç.* Trends in Language Acquisition Research Series. John Benjamins Publications.

- Uzundag, B. A., Tasci, S. S., Küntay, A. C., & Aksu-Koç, A. (2016). Functions of evidentials in Turkish child and child-directed speech in early child-caregiver interactions. *Proceedings of the 40th Annual Boston University Conference on Language Development.* Somerville, MA: Cascadilla Press.

- Uzundag, B. A., & Küntay, A. C. (2016). İkidillilik gelişen zihni farklı şekillendirir mi? In Ç. Aydın, T. Göksun, A. Küntay, & D. Tahiroğlu (Eds.), *Aklın Çocuk Hali - Zihin Gelişimi Araştırmaları* (pp. 41–67). İstanbul: Koç Üniversitesi Yayınları.

LIST OF PRESENTATIONS

- Uzundag, B. A., & Küntay, A. C. (2018, May). *Preschoolers' Referential Communication Skills: Learning from Adults and the Impact of Executive Functions.* To be presented as a poster at the 30th APS Annual Convention, San Francisco, CA, USA.

- Uzundag, B. A., & Küntay, A. C. (2018, February). *The acquisition and use of relative clauses in Turkish: An analysis of spontaneous interactions.* Talk presented at the 1st Boğaziçi University Student Conference on Theoretical and Experimental Linguistics, Istanbul, Turkey.

- Uzundag, B. A., & Küntay, A. C. (2018, January). *Children's referential communication skills: The role of cognitive abilities and adult models of* *speech.* Poster session presented at the 8th Budapest CEU Conference on Cognitive Development, Budapest, Hungary.

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❖ Uzundag, B. A., Taşçı, S. S., Küntay, A. C., & Aksu-Koç, A. (2015, June). *Differentiation of evidential functions in Turkish child and child-directed speech.* Talk presented at LingDay, Boğaziçi University, Istanbul, Turkey.

❖ Uzundag, B. A., Taşçı, S. S., Küntay, A. C., & Aksu-Koç, A. (2015, April). *A developmental view of evidential functions in Turkish child and child-directed speech: A corpus study*. Poster session presented at the 2nd International Symposium on Brain and Cognitive Science, Ankara, Turkey.

❖ Uzundag, B. A., Taşçı, S. S., Küntay, A. C., & Aksu-Koç, A. (2015, March). *Differentiation of evidential functions in Turkish child and child-directed speech.* Poster session presented at the Society for Research in Child Development, Philadelphia, USA.

CHAPTER I

Children's Referential Communication Skills:
The Role of Cognitive Abilities and Adult Models of Speech

One of the basic goals of communication is to give information or make requests about objects and people. In referring to external things, communicators need to avoid ambiguity and choose appropriate linguistic expressions. This is not an easy feat, and only with development children learn to become referentially informative. Referential communication is an important component of the pragmatic aspect of language development in preschool-aged children (Küntay, Nakamura, & Ateş-Şen, 2014). At preschool ages (ages 4-5), glitches often occur in the production of referring expressions. For example, when a child points to a toy basket that contains several balls and says “ball”, the object that the child’s gesture and utterance are directed towards may be deemed ambiguous. The caregiver, using her former experience, could correctly guess whether the child wants the most bouncy ball or the newly bought red ball. If the caregiver’s guess turns out to be incorrect, the child faces the task of repairing the communication breakdown by providing a more specific referring expression, such as “the ball with stripes”.

Even preschool-aged children can utilize their listener’s communicative feedback to tailor their descriptions appropriately (Glucksberg & Krauss, 1967). When their initial expressions are ambiguous, children benefit from the repetition of their messages in question form (Deutsch & Pechmann, 1982), or the listener picking an alternative referent (Coon, Lipscomb, & Copple, 1982). In addition to making use of communicative feedback, children model on how adults describe referents (e.g., Whitehurst, 1976). There are many linguistic constructions adult speakers use to uniquely describe referents, and relative clause is one such complex construction. One of the communicative functions of relative clauses is to discriminate the intended referent from potential competitors (e.g., “the student *who worked here last year* has moved to another city”). Our first objective in the present study was to investigate the effects of exposure to adults’ informative referential descriptions that contain relative clauses on the development of referential qualities of children’s own descriptions.

The lack of sophisticated language skills is only one reason for young children not to produce adequately informative referring expressions. Thus, our second objective was to investigate the relationship between children’s referential communication abilities and their potentially relevant socio-cognitive skills. In the example that involves identification of a specific striped ball, it may be that the child does not yet have adequate working memory skills to grasp or express the relevant non-linguistic comparisons between the target and its competitors (i.e., the striped ball and all the other balls) to determine which distinguishing properties to convey to the listener. Additionally, taking the precise communicative perspective of the listener in relation to the referent may be difficult. Hence, general limitations in socio-cognitive abilities, such as young children’s still-developing executive functions and relative inability to represent the knowledge states of other people (i.e. relative lack of theory of mind) are factors that may influence referential communication skills (de Cat, 2015; Nilsen & Fecica, 2011).

Modeling with Adult Speech

Hearing adult models of speech affects how children describe referents. In Whitehurst (1976), 6-year-olds were presented with cups that were similar to or different from each other with respect to their size, color, and pattern. In the listening trials, children were either assigned to the "bad modeling condition" where they listened to adults' descriptions that were ambiguous or to the "good modeling condition" where adults' descriptions were informative enough for children to identify the target cup. In the speaking trials that followed, children described the target cup to the adult listener. Children imitated adults' way of presenting information such that children in the good modeling condition produced more adjectives than children in the bad modeling condition (e.g., "small and red" instead of just "red"). However, children who heard informative descriptions showed an increase in redundant messages (i.e. with more than necessary information to identify a referent) but not in contrastive messages (i.e. adequately informative for the listener to distinguish a referent from nonreferents). Hence, children did not quite grasp the comparison processes between the referent and nonreferents that led to adults' contrastive descriptions.

In the studies that followed, Whitehurst and colleagues demonstrated that preschoolers were not able to convey the distinguishing features of a referent as a result of hearing adults' informative messages. In Whitehurst and Merkur (1977), 5-, 7-, and 9-year-olds either heard contrastive or redundant messages. The oldest group's messages were more contrastive after hearing contrastive messages and more redundant after hearing redundant ones. The youngest group of children became more redundant in both conditions. A following study further found that preschool-aged children were only sensitive to message length and not to the informativeness of messages (Whitehurst, Sonnenschein, & Ianfolla, 1981). Hearing longer messages caused children to produce more adjectives. These findings indicate that preschool-aged children can imitate adults' styles of communication without explicitly understanding the need for comparing the referent to nonreferents. An alternative explanation would be that preschoolers understand this need but fail to do the necessary comparisons. When preschoolers were specifically trained about conducting comparisons between the referent and competitors by receiving feedback about their descriptions (e.g., "That's wrong; you did not tell me how the triangle with the star above it was different from the other."), they provided more adequate descriptions of referents in a different task, and the effects of this training were maintained over a one-week delay (Whitehurst & Sonnenschein, 1981).

Recent research in referential communication has regenerated interest in children's sensitivity to contributions of interactive partners and especially to adult models of speech (Ateş-Şen & Küntay, 2015). Matthews, Lieven, and Tomasello (2007) designed a sticker selection task, where 2-, 3-, and 4-year-olds completed picture-books by verbally requesting missing stickers from an ignorant experimenter after determining the sticker they are missing in comparison to another experimenter's version of the picture-book. After the pretest, children received training in four sessions conducted over three days. In one of the training conditions that followed the pretest, children heard an adult produce model descriptions for the missing stickers with reduced subject relative clauses (e.g., "Ah, you need *the girl singing*. Here you are."). In the posttest, it was found that the children who were exposed to such descriptions produced more uniquely identifying descriptions, and used simple uninformative naming of the target character to a lesser extent. Training effects did not seem to transfer to a different task where children described video clips to an adult who could not see them.

A similar study was conducted with Turkish-speaking children by Sarılar, Matthews, and Küntay (2015), who pre- and posttested 3- and 4-year-olds with the same paradigm. After the pretest, children interacted only with one experimenter who knew which picture was missing and presented sticker alternatives to the child. For each item, children described the missing sticker to the experimenter, who then produced a sentence that either contained a subject relative clause (e.g., "you selected *the girl that is eating cake*"), a demonstrative noun phrase (e.g., "you selected *that girl*"), or a general approval (e.g., "you did a nice selection") depending on the modeling condition. In the posttest that immediately followed the modeling, children who heard relative clauses provided more uniquely identifying referential descriptions and relative clauses more than other children.

Both Matthews et al.'s (2007) and Sarılar et al.'s (2015) studies investigated the effects of hearing informative descriptions with relative clauses on children's initial descriptions of a referent among similar distractors. However, children's initial expressions of a referent are usually inadequate and repairing an initially ineffective message is an important aspect of communication (Deutsch & Pechmann, 1982). Hence, in the present study, we did not only inspect children's initial expressions but also the quantity and quality of their attempts at communicative repair following ambiguous communication.

Executive Functions and Theory of Mind

Although the relations between language development and cognitive skills such as working memory and theory of mind were extensively studied (e.g., Gathercole & Baddeley, 2014; Milligan, Astington, & Dack, 2007), there is only a handful of studies examining the role of children's cognitive skills in referential communication. To provide an informative description of a referent for a listener, children need to determine the properties of the target referent that distinguish it from the alternatives, consider the listener's characteristics and perspective, be able to monitor their own message, and use the listener's feedback to repair ambiguous messages (Asher, 1979; Krauss & Glucksberg, 1969; Sonnenschein, 1986). Some studies observed a role for executive functions such as inhibitory control and cognitive flexibility in preschoolers' listener skills. Inhibitory control skills measured at 4 years predicted detection of message ambiguity when measured 6 months later and 1 year later (Nilsen & Graham, 2012). Preschoolers with more proficient cognitive flexibility, as was measured by the ability to sort toys in different ways (i.e. with respect to size, color, and function) were more successful in detecting ambiguity in speaker's messages (Gillis & Nilsen, 2014). When it comes to speaker skills, Nilsen and Graham (2009) did not observe a relation between executive functions like working memory and cognitive flexibility, and children's referential expressions. However, in this study, the experimenter picked the correct referent even if the child provided an ambiguous description. When the experimenter picked an incorrect referent upon the child's ambiguous description, the working memory capacity was found to be related to children's use of necessary modifiers (Wardlow & Heyman, 2016). Hence, working memory seems to play a role in children's ability to use the listener's feedback into account. There is only one study that looked into the relationship between children's executive functions and communicative repair skills: Bacso and Nilsen (2017) tested 4- to 6-year-olds on a referential communication task where they either received vague feedback ("I picked the wrong one. I don't know which one you mean.") or detailed feedback based on their responses (e.g., If a child said, "the boy in the red shirt", then she heard the addressee saying "I picked the wrong one. There are two boys in red shirts and I don't know which one you mean.".). Working memory and cognitive flexibility did not interact with the type of feedback, but both were related to initial description ability with cognitive flexibility also playing a role in communicative repair.

The relation of theory of mind to referential communication has also been investigated by several studies. Preschool-aged children in the study of Resches and Perez-Pereira (2007) were paired according to their theory of mind levels where one child directed another child to find a hidden treasure. Children with the lowest theory of mind levels tended to just repeat their utterances but children with the highest theory of mind levels mostly replied to listeners' questions about the treasure with reformulations of previous information. In another study, Maridaki-Kassotaki and Antonopoulou (2011) found a positive association between 5-year-old's theory of mind skills and their ability to detect message ambiguity, however, detecting ambiguity explained a relatively small portion of variance in theory of mind. Sidera, Perpiñà, Serrano, and Rostan (2016) tested 1st and 5th graders on a cooperative task where one child gave instructions to another child to construct a model with blocks. Theory of mind skills such as second-order false belief and faux pas understanding were related to giving information and requesting clarification. Hence, there are no previous studies that measured the relation between preschool-aged children's theory of mind ability and their speaker skills in a referential communication task where they need to describe a referent to an addressee in the presence of similar alternatives.

In sum, there are only very few studies investigating the role of children's individual differences in their referential communication skills. Except one study (Bacso & Nilsen, 2017), previous studies investigated the role of executive functions in children's initial descriptions only. Furthermore, there is no previous modeling/training study that examined the role of children's executive functions in referential communication. The present study is the first to investigate the relation between children's cognitive skills and their communicative repair skills with respect to different modeling conditions in a highly motivating context. We measured children's short-term memory (for storing information), working memory (for comparing stimuli and monitoring the ambiguity of the messages), cognitive flexibility (for thinking flexibly about the properties of the referent or the ways to describe a referent), and theory of mind (for taking the listener's perspective into account).

Present Study

The two main objectives of this study were to investigate the role of (1) hearing more informative referring expressions in the form of relative clauses, and (2) children's socio-cognitive skills in their ability to form and repair descriptions of referents. The study took place in two sessions that were 2 or 3 days apart. All sessions were conducted in preschools in a quiet room specially allocated for the study. In the first session that lasted between 25 to 45 minutes, children completed the referential communication task. In the second session that lasted between 20 to 30 minutes, we tested the children for theory of mind, memory, and cognitive flexibility.

In the referential communication task, we assessed the effects of hearing different models of adult speech on children's communicative behavior by examining the change in the quality and quantity of children's referring expressions in a pretest-modeling-posttest design. In the pretest and the posttest, children's task was to complete picture-books by requesting missing stickers from an ignorant experimenter who presented an array of distractor stickers along with the target one. In the previous training/modeling studies with relative clauses, providing a label for the target character (e.g., "dad") was sufficient to receive the correct sticker even if there were other alternative pictures that matched the child's description (Matthews et al., 2007; Sarılar et al., 2015). We changed this procedure to make the communication between the child and the adult more similar to daily interactions. Thus, if the children provided an ambiguous description of the target sticker, they were offered an alternative sticker that matched the description. There were 6 trials of sticker requests in the pretest, and 10 in the posttest.

In the modeling phase that took place between the pretest and the posttest, children completed 10 items where they only interacted with one of the experimenters. Unlike previous studies that used subject relative clauses in the modeling phase (Matthews et al., 2007; Sarılar et al., 2015), children heard slightly more complex referring expressions in the form of object relative clauses. Object relative clauses modify a referent that functions as the object of the event described within the relative clause (e.g., *the ball* that the cat chased), whereas subject relative clauses modify a subject (e.g., *the cat* that chased the ball). When a relation between animate entities is described, object relatives are more difficult to process than subject relatives for child and adult speakers of many languages, including Turkish (e.g., Friedmann & Novogrodsky, 2004; Kim & O'Grady, 2015; Özge, Marinis, & Zeyrek, 2010; Slobin, 1986; Yumrutaş, 2009). Here, we examined whether Turkish-speaking children could benefit from hearing morphosyntactically more complex structures when forming referring expressions. After observing the target and distractor pictures with the experimenter, children described the missing picture and received a type of feedback from the experimenter depending on the experimental condition. In the *object relative clause feedback condition*, children heard a more informative expression that contained an object relative clause (e.g., "you selected *the horse that the boy is riding*"). In the *demonstrative noun phrase feedback condition*, children heard a less informative description containing a demonstrative noun phrase (e.g., “you selected *that horse*”). The pretest, modeling, and posttest were videotaped.

In regard to our first research objective, we expected a greater increase in uniquely identifying initial descriptions from pretest to posttest in the object relative clause feedback condition than in the demonstrative noun phrase feedback condition. If hearing contrastive and more complex referring expressions would lead children to compare the referent to nonreferents more successfully, then we would also expect better communicative repair skills in the relative clause feedback condition. Further, we expected working memory, cognitive flexibility, and theory of mind to be related to children’s initial description and repair skills.

Method

Participants

The participants were 59 typically developing, native Turkish-speaking children (age range=4;0-5;9). All children were of middle to high-SES families with 52 children (26 in relative clause feedback condition) having parents with at least college degrees, 6 (3 in relative clause feedback condition) with high school, and 1 with a two-year college degree. The participants were all exposed to some English as a second language in their preschool, the amount ranging from 5 hours to 2 full days a week. A further 11 children were excluded because either (a) their parent or other primary caregiver provided input in another language (7), (b) they did not want to continue to participate after the pretest (1), or (c) a problem occurred with the video-recording (3). Thirty children (15 girls, *M*=60 months, *SD*=172.4 days) were tested in the relative clause feedback condition, and 29 children (12 girls, *M*=59 months, *SD*=172.9 days) in the demonstrative noun phrase feedback condition. Five children from the relative clause feedback and three children from the demonstrative noun phrase feedback conditions were not available for the second session.

To check whether our referential communication task was able to elicit relative clauses, we also tested 11 undergraduate and graduate students (10 women, *M*=24.3 years, *SD*=4.0) on this task.

Materials and Procedure

Picture books and stickers. Three picture-books were created by using image editing software on pictures from a previous study (Matthews et al., 2007), animation websites (www.toondoo.com and www.powtoon.com), and search engines.

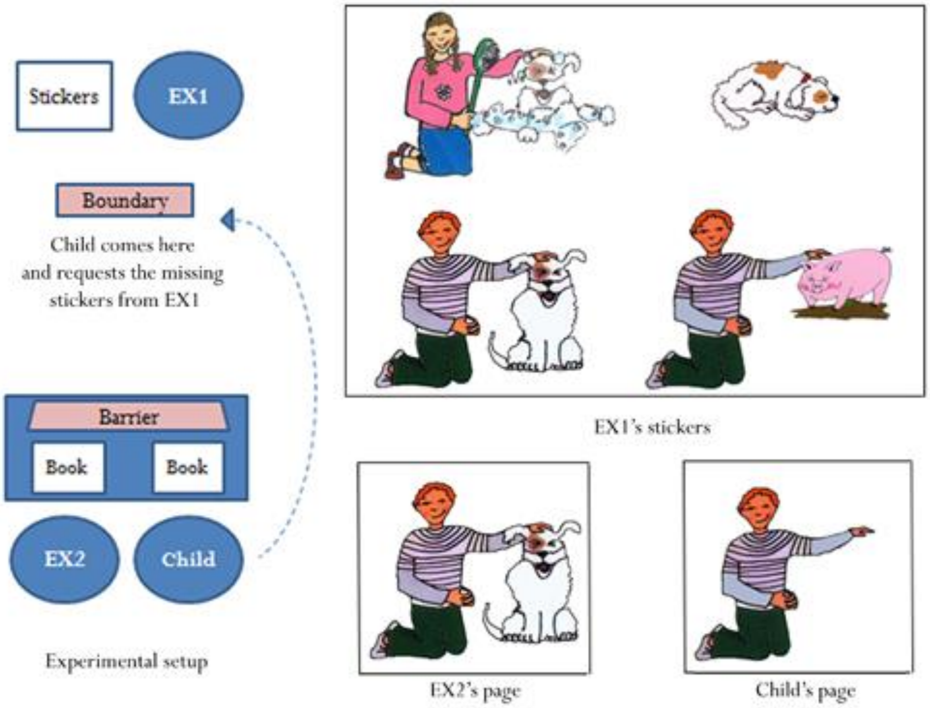

Figure 1.1. An overview of the experimental setup with the complete and incomplete page versions and the stickers used for an example item.

As seen in Figure 1.1, for each item, children were presented with the target picture pair (e.g., the boy petting the dog) along with the same-actor-and-action-but-different-undergoer pair (e.g., the boy petting the pig), same-undergoer-but-different-actor-and-action pair (e.g., the girl washing the dog), and another picture where the missing entity was depicted engaged in another action (e.g., the dog sleeping).

Introduction and pretest. Before the main experiment, Experimenter 1 played a *snap game* to verify the children’s knowledge of the concept of sameness. Experimenter 1 laid six identical card pairs depicting different dinosaurs on the table and then pointed to each of the different cards by asking the child "can you show me the card that is the same as this one?". Each child completed this task successfully.

Then, Experimenter 2 assessed children's knowledge of the meaning of verbs that correspond to the actions in the picture-books by presenting them pictures of different actors and undergoers of the actions than the ones in the picture books. Our goal was to assess whether children were able to produce the words for the depicted actions (e.g., "bite") that can be later used to identify referents (e.g., "the man that the shark bit"). A picture either depicted an action between two people, or a person and an animal, or a person and an object. [1] For each picture, Experimenter 2 provided the beginning of a sentence like *bu adam arabasını (VERB+yor)* 'this man is (VERB+ing) his car', and expected the child to produce the required verb. If the child did not produce the verb, Experimenter 2 named the action. The children mostly correctly produced the target verbs, sometimes substituting them with near-synonyms such as 'clean' instead of 'wash'. Then, children were again presented with the last three pictures they saw along with the versions where the entity that the agent acted upon was missing. Children's task was to take the missing sticker from a cardboard that Experimenter 2 held. With this

[1] The following percentages show the proportion of children aged 36 months who could produce the target verbs according to parental reports measured with TİGE, the Turkish version of the MacArthur-Bates Communicative Development Inventory (Aksu-Koç et al., 2009): *öp*- 'kiss':94.8%, *ısır*- 'bite':85.7%, *vur*- 'hit':84.4%, *kovala*- 'chase':no information, *yıka*- 'wash':90.9%, *besle*- 'feed':63.6%, *sev*- 'pet':100.0%, *it*- 'push':70.1%, *yala*- 'lick':no information, *tekmele*- 'kick':no information, *bin*- 'ride':83.1%, *gıdıkla*- 'tickle':83.1%, *tut*- 'hold':85.7%, *kaldır*- 'lift':89.6%, *taşı*- 'carry':61.0%.

task, children were familiarized to the procedure of getting stickers and completing a picture book.

For the pretest phase, the child and Experimenter 2 sat next to a child-sized table, and Experimenter 1 stood next to a cardboard with pictures attached to the wall on the other side of the room. Experimenter 2 placed two picture books on the table, one in front of the child, and the other in front of herself. She explained that there were missing pictures in the child's book, and to make the pages the same, the child had to go to Experimenter 1 and ask for the missing sticker by describing it. A cardboard was placed on the table as a barrier, and the child was told that Experimenter 1 cannot see the books, so the child had to explain the missing sticker to Experimenter 1 very well. When asking for the sticker, the children had to stand behind a cardboard on the ground to render their pointing behavior ambiguous (see Appendix A for a list of items used in the pretest, the modeling, and the posttest phases).

If the child just pointed, or described the sticker just with demonstrative pronouns or spatial constructions without a head noun (e.g., *şu/bu/o* 'this one/that one' or *şuradaki/üstteki* 'the one over there/the one on top'), then the experimenter asked for further clarification by asking the child "Which one do you want? Can you say more?". If the child only uttered a word like *adam* 'man', then a distractor picture that matched the description was offered. If the child accepted the incorrect sticker, Experimenter 2 compared the sticker with the picture on her book and told the child in a surprised tone that the two pictures were not the same. Then, the child was encouraged to make another attempt to describe the missing picture to Experimenter 1. Experimenter 1 requested the incorrect sticker from the child and placed it back on the cardboard. The same distractor picture was not again offered upon an ambiguous description. Only if all the alternatives were exhausted, the child was given the correct sticker after just naming the character in the picture. Sometimes, children explicitly asked for an incorrect sticker. In those cases, the incorrect sticker was given.

Modeling. Children were randomly assigned to one of the modeling conditions. After the completion of the pretest, Experimenter 2 explained that the child will now complete another picture book, but this time she was going to play with Experimenter 2 only. Then Experimenter 2 presented the complete and missing versions of the picture book prepared for the modeling phase. For each item, Experimenter 2 presented a cardboard with target and distractor pictures. The child was asked to describe the missing picture. Afterwards, Experimenter 2 produced either (a) an object relative clause construction (e.g., "you selected the horse that the boy is riding") or (b) a demonstrative noun phrase construction (e.g., "you selected that horse") depending on the experimental condition. For each item, the relevant construction was produced one more time when the child attached the sticker on her book (e.g., "let's put the horse that the boy is riding here" or "let's put that horse here" depending on the condition).

Posttest. The posttest had the same format as the pretest.

Adults. Adults only interacted with one experimenter, where they were presented with the pretest, modeling, and posttest items in the same order. They were asked to describe the missing picture to the experimenter sitting next to them and holding the cardboard of target and distractor pictures. They did not receive any feedback from the experimenter unless their descriptions were ambiguous. In that case, the experimenter selected an alternative referent that matched the description. Adults were not tested on the cognitive measures.

Cognitive measures. Children's cognitive skills were measured in the second session using the following tasks:

Contents false belief task. This task was used as a theory of mind measure (Wellman & Liu, 2004). Children were first shown a candy box (Bonibon box) and told "Here is a Bonibon box. What do you think is inside this box?". The child was expected to say "bonibon" and directed by the experimenter to answer so (e.g., by asking "What type of a box is it? What should be inside it?"). Then, the box was opened and the child saw a red crayon inside. The box was closed and the child was asked "So, what was in the box?". A toy figure of a boy named Ahmet was introduced to the child by saying "Here is Ahmet. Ahmet has not seen inside this box. So, what does Ahmet think is in the box? Bonibon or crayon? (the target question) "Did Ahmet see inside this box?" (the memory question). If the target question was answered as "bonibon", and the memory question as "no", then the answer was labeled as correct. [2]

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[2] Children completed another theory of mind task, namely the *Knowledge Access Task*, but we did not analyze these data since only 2 children failed that task.

Digit span tasks. The forward digit span task was used to assess short-term memory and the backward digit span task was used to measure verbal working memory (Wechsler, 1955). In the forward digit span task, the experimenter read aloud a series of digits with a rate of one digit per second, and the child was asked to reproduce what she heard. The task started with three digits, and there were three trials for each length. The number of digits was increased by one if the child had completed at least one trial of a specific length successfully. The task terminated when the child failed to reproduce at least one trial of a specific length. The score was the number of digits of the last successfully reproduced trial. The backward digit span task differed from the forward span such that children were asked to repeat the series from the reverse order, and the first span included two instead of three digits due to the task's additional difficulty.

Word-picture recall task. This task was adapted from the visually cued recall task of Zelazo, Jacques, Burack, and Frye (2002). On the first slide of the task, the child was introduced to a character named Poli and received the following instructions: "This is Poli. Poli is very forgetful so you have to remember the pictures that I am telling you about. Now I am going to read aloud some words for you. After you listen to me, you will point to the pictures of those words, ok?". The task started with reading aloud one word, and the child was expected to show the picture that the word corresponds to. Twelve clip art pictures of objects and animals were shown on each slide. The number of words was increased by one in the next trial. The task terminated when the child failed to point to all necessary pictures in two consecutive trials. At the end, the child received a score of the number of pictures she correctly pointed to in all of the trials.

This task measured short-term memory but it was different from the forward digit span task in that it had both visual and verbal components.

Dimensional change card sort task. In the original version of the task, children are first taught to sort cards according to one dimension (e.g., shape) in the preswitch phase and according to another dimension (e.g., color) in the postswitch phase. This task (Zelazo, 2006) is a measure of executive functions and is mainly categorized as a cognitive flexibility or set shifting task (Diamond, 2013), but is also related to inhibitory control to suppress attention to the irrelevant dimension of the stimuli according to the current rule (e.g., ignoring shape when sorting according to color) and working memory to keep the rules in mind (Doebel & Zelazo, 2015). According to a meta-analysis, half of the children around age 4 can pass the standard version of the task (Doebel & Zelazo, 2015).

In the computerized version we used, children first sorted a rabbit and a ship according to shape by pressing left or right arrow keys to indicate the position of the picture in four practice trials. Then, in four practice trials, children sorted stimuli according to the color (white or brown). A word (‘shape’ or ‘color’) along with each item was presented auditorily to indicate the sorting dimension. During the practice trials, children received automated feedback on whether they made a correct selection. Then, the preswitch phase was presented with five color trials (yellow or blue). If the child was successful in at least three of these trials, the postswitch phase was given with five shape trials (truck or ball). Again if the child was successful in at least three of the trials, the experiment processed to the mixed block where 30 color and shape trials were presented. Accuracy and reaction times were logged. Children passed the DCSS if they passed the preswitch and postswitch phases (i.e. at least 3 correct answers in 5 trials in each phase).

Transcription and Coding

The video recordings of the pretest and the posttest were transcribed by the first author and two research assistants by following the rules in the CHAT manual (MacWhinney, 2000). Pointing behaviors and other gestures were indicated in the transcriptions. Transcriptions of the research assistants were checked for errors and missing information by the first author.

Uniquely Identifying Initial Expressions

Each initial description was coded according to whether the information presented in the description was sufficiently specific to identify the target referent: (a) an *exact specification* (i.e. the description is sufficiently informative to select the correct sticker), (b) an *underspecification* (i.e. the sticker cannot be identified uniquely because the description corresponds to more than one sticker), (c) an *overspecification* (i.e. the description leads to unique identification but includes redundant information), or (d) a *misspecification* (i.e. the child explicitly asked for an incorrect sticker, e.g., asking for the dad instead of the boy).

The Number of Description Attempts

The number of description attempts was used as a quantitative measure of communicative repair skills. It corresponded to the number of referring expressions produced by the child until she received the correct sticker for that item (see Figure 1.2 for examples). In some occasions, after children produced a description and before the experimenter reached for a sticker, children revised that description. Such a revision was counted as an additional attempt.

Message Ambiguity

Following Coon et al. (1982), we calculated a message ambiguity score reflecting the number of referents an expression corresponded to. For example, if the child's description was "the dog" for the target picture in Figure 1.1, then the message ambiguity score was 3 as there were three stickers (i.e. dogs) that the child's message corresponded to. The description attempts were considered cumulatively, i.e. if the child's next attempt was "the one below", then this attempt was scored as 1 since "the dog below" would uniquely identify the target referent. Message ambiguity for the descriptions that follow an initial ambiguous description was used as a qualitative measure of communicative repair skills. The values of message ambiguity ranged from 1 (e.g., "the dog that the boy pets") to 7 (e.g., "that one"), and the higher values indicated more ambiguity. For misspecifications, message ambiguity was not coded.

	Initial Descriptions		Communicative Repair		
	Initial Referring Expression	**Initial Message Ambiguity**	**Number of Description Attempts**	**Subsequent Message Ambiguity**	**Content**
Example 1					
Attempt 1: “The dog”	underspecification	3	3 attempts		Naming the referent
Attempt 2: “His one eye is brown.”				3	Action
Attempt 3: “The tip of his toenails is brown.”				1	Location
Example 2					
Attempt 1: “A man pets the dog, the dog is missing.”	exact specification	1	1 attempt		Action
Example 3					
Attempt 1: “I want the pig.”	misspecification	-	2 attempts		Naming the referent
Attempt 2: “I think it’s a dog. He pets the dog.”				1	Action
Example 4					
Attempt 1: “The white dog that the boy pets”	overspecification	1	1 attempt		Physical attribute, Action, Object relative clause

Figure 1.2. Coding scheme with example description attempts (examples are based on the stimuli shown in Figure 1.1).

Content of Referential Descriptions

We coded each description attempt for its content to examine how the content of the descriptions changed with respect to the modeling condition. Each description attempt was coded according to whether it contained a description of (a) an action (e.g., "the boy pets the dog, I want the dog"), (b) a location (e.g., "the dog below"), (c) physical and/or emotional attributes (e.g., "the dog with the white fur"), (d) naming the referent (e.g., "that dog"), and (e) an object relative clause. These categories were not mutually exclusive as a referential expression could include multiple types of descriptions (see Example 4 in Figure 1.2). Sometimes, children expressed themselves only with gestures without verbal expressions. For instance, if the child did not produce the word but made a gesture for it as in "the bear doing this (hitting gesture) to the man", then it was still coded as a description of an action.

Interrater Reliability

The first author coded the entire set of children's utterances (N=2,094). A research assistant then coded 1,376 (66%) of the children's utterances independently by coding for whether the initial descriptions were uniquely identifying, and the content. The interrater reliability for the raters was calculated with Cohen's *kappa*. For initial referring expressions, it was κ=.894 (95% CI, .847 to .941) for exact specification, κ=.946 (95% CI, .922 to .970) for underspecification, κ=.638 (95% CI, .430 to .846) for overspecification, and κ=.701 (95% CI, .525 to .877) for misspecification. For the content of the descriptions, kappa was calculated as κ=.922 (95% CI, .897 to .947) for containing an action verb, κ=.976 (95% CI, .964 to .988) for containing a location, κ=.861 (95% CI, .826 to .896) for containing a description of physical and/or emotional attributes of the characters, κ=.974 (95% CI, .960 to .988) for naming the referent, and κ=.657 (95% CI, .541 to .772) for containing an object relative clause. Disagreements were resolved by discussion.

Results

We first provide descriptive information about children's initial referring expressions, communicative repair behaviors, performance on cognitive tasks, and the content of their descriptions. Then, we report our findings pertaining to mixed-effects analyses where we examined the change in the quality of children's initial descriptions and communicative repair in relation to the modeling condition and performance on the cognitive tasks.

Descriptive Analyses

Uniquely identifying initial expressions. In the pretest, children's descriptions were predominantly ambiguous (see Table 1.1). Fourteen children in the demonstrative noun phrase feedback- and 16 children in the relative clause feedback condition could not provide an unambiguous description in their initial attempts in the pretest. Children in the relative clause feedback condition had a lower proportion of uniquely identifying initial descriptions (i.e. exact and overspecifications) in the pretest, but there was no difference between the conditions (p=.15).

Table 1.1

The Distribution of Uniquely Identifying and Ambiguous Initial Referring Expressions

	Demonstrative noun phrase feedback condition		Relative clause feedback condition		Adults
	Pretest	Posttest	Pretest	Posttest	
Exact specification	21%	35%	13%	43%	63%
Overspecification	1%	4%	-	4%	28%
Underspecification	73%	57%	78%	44%	6%
Misspecification	5%	4%	8%	8%	3%

In both of the conditions, there was an increase in the initial descriptions that were uniquely identifying and a decrease in underspecifications. Children in the relative clause feedback condition ($M_{pretest}(SD)$=13.3(16.6), $M_{posttest}(SD)$=47.6(29.5)) demonstrated a greater increase in uniquely identifying initial descriptions from pre- to posttest than children in the demonstrative noun phrase feedback condition ($M_{pretest}(SD)$=21.8(27.5), $M_{posttest}(SD)$=39.0(28.7)) (see panel A of Figure 1.3). [3] Only within the relative clause feedback condition, age was positively correlated with this change, $r(30)=.48$, $p=.007$. Adults' initial expressions were uniquely identifying 91% of the time.

[3] Mixed ANOVA analyses with time as within-subjects and condition as between-subjects factor showed that the change in exact specifications was greater in the relative clause feedback condition than in the demonstrative noun phrase feedback condition, $F(1, 57)=6.9$, $p=.011$, $\eta^2=.11$. The change in the descriptions that were coded as overspecification was similar across conditions and significant from pretest to posttest, $F(1, 57)=8.6$, $p=.005$, $\eta^2=.13$. The decrease in underspecifications was greater in the relative clause feedback condition, $F(1, 57)=6.9$, $p=.011$, $\eta^2=.11$.

The number of description attempts. As seen in panel B of Figure 1.3, the number of description attempts declined from the pretest to the posttest in the demonstrative noun phrase feedback ($M_{pretest}(SD)$=2.5(0.9), $M_{posttest}(SD)$=2.1(0.6)) and the relative clause feedback conditions ($M_{pretest}(SD)$=2.7(1.1), $M_{posttest}(SD)$=1.9(0.7)). Overall, the number of description attempts in the pretest and the posttest were correlated, $r(59)=.61$, $p<.001$. Unlike children, the adults usually needed about one attempt (M=1.1) to describe the missing sticker.

Message ambiguity. In both the relative clause feedback ($M_{pretest}(SD)$=2.3(0.6), $M_{posttest}(SD)$=1.8(0.6)) and the demonstrative noun phrase feedback ($M_{pretest}(SD)$=2.4(0.6), $M_{posttest}(SD)$=1.9(0.6)) conditions, overall (i.e. initial + subsequent) message ambiguity scores declined from the pretest to the posttest. These scores were correlated between the two time points, $r(59)=.53$, $p<.001$. Panels C and D of Figure 1.3 show initial and subsequent (i.e. following an ambiguous initial description) message ambiguity scores that we used to assess children's initial description and repair skills, respectively. When collapsed across conditions, children showed less ambiguity in their subsequent attempts ($M(SD)$=1.9(0.7)) than in their initial attempts ($M(SD)$=3.0(1.0)) in the pretest, $t(58)=9.5$, $p<.001$.

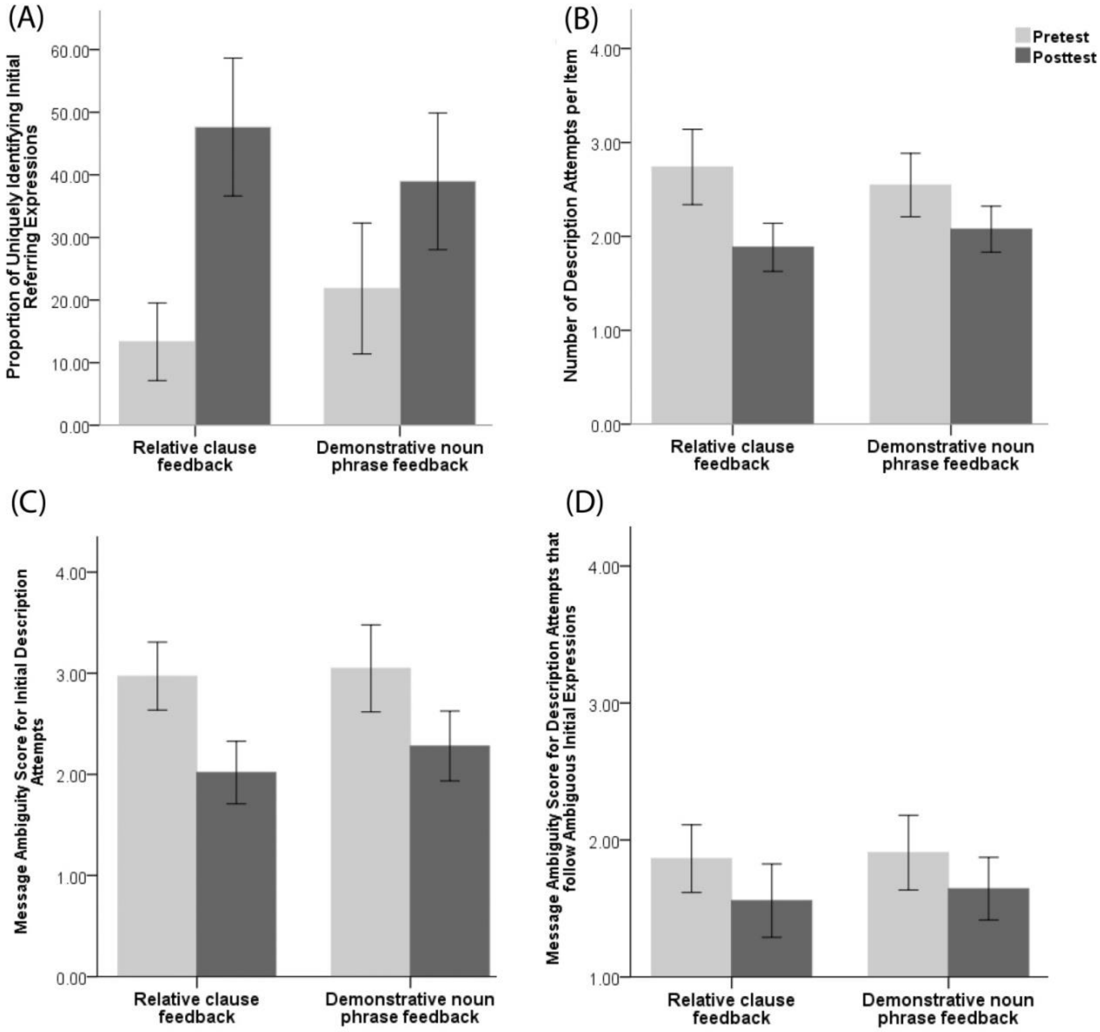

Figure 1.3. (A) The proportion of uniquely identifying initial descriptions, (B) the number of description attempts per item, (C) message ambiguity for initial descriptions, and (D) message ambiguity for descriptions following an initial ambiguous expression in each of the feedback conditions in the pretest and the posttest.

Content of referential descriptions. In the pretest, children in both conditions mostly just named the referent or mentioned its location. In the posttest, children in the relative clause feedback condition produced more object relative clauses and action verbs than the children in the demonstrative noun phrase feedback condition (see Table 1.2). Eighty-six out of the 182 object relative clauses (47%) children produced were incorrectly formed (e.g., the genitive marker omitted or the subject relative suffix instead of the object relative suffix used). The task could elicit object relative clauses from adults as 6 out of 11 adults produced these structures in 21% of their descriptions. Unlike children, adults mostly referred to the physical and emotional attributes of the target characters.

Table 1.2

Content of Referential Expressions Based on All Description Attempts

	Demonstrative noun phrase feedback condition		Relative clause feedback condition		
	Pretest	Posttest	Pretest	Posttest	Adults
Correctly formed object relative clause	1%	2%	2%	11%	21%
Incorrectly formed object relative clause	4%	2%	4%	5%	-
Location	33%	34%	32%	23%	2%
Action	20%	25%	17%	34%	44%
Physical & emotional attributes	15%	15%	18%	12%	31%
Naming the referent	28%	22%	27%	15%	1%

Cognitive measures. Table 1.3 summarizes the performance on the cognitive measures. Correlations between cognitive measures, age, and measures taken from the referential communication task can be found in Appendix B.

Table 1.3

Children's Performance on the Cognitive Tasks

	Demonstrative noun phrase feedback condition	Relative clause feedback condition
Passing Rates		
Contents False Belief	8 out of 26	7 out of 25
Dimensional Change Card Sort	19 out of 25	18 out of 26
Means(Standard Deviations)		
Forward Digit Span	4.1(0.9)	4.1(1.2)
Backward Digit Span	1.7(1.1)	1.9(1.0)
Word-picture Recall	15.7(5.7)	16.1(5.5)

Note. In the Dimensional Change Card Sort task, reaction times (RTs) were not analyzed since some children pressed the key as quickly as possible but others first pointed at the pictures and then pressed the key. Trials with RTs less than 200 ms were excluded. Children's performance in the mixed block was not analyzed further due to the lack of a correlation between this measure and children's performance in the referential communication task.

Mixed-effects Analyses

Mixed-effects analysis [4] was used to analyze the change in initial descriptions and attempts at communicative repair from pre- to posttest with respect to the modeling conditions. Mixed-effects models make it possible to simultaneously include all factors (e.g., item- and subject-related factors) that may have an effect on the outcome variable (Baayen, Davidson, & Bates, 2008). These factors may be modeled as fixed or random. In the models that we constructed, fixed effects included condition (relative clause feedback or demonstrative noun phrase feedback) and time (pretest or posttest) along

[4] We used *lme4, LMERConvenienceFunctions, lmerTest, and MuMIn* packages in R (Barton, 2015; Bates, Maechler, Bolker, & Walker, 2015; Kuznetsova, Brockhoff, & Christensen, 2014; Tremblay & Ransijn, 2013).

with participant characteristics (age and cognitive measures). Random effects corresponded to the factors randomly sampled from a much larger population (Baayen, 2008), namely participants and items. If not noted otherwise, all the models had by-subject random intercepts and slopes for time and by-item random intercepts and slopes for condition. For each outcome variable, we constructed multiple models with different fixed effect structures (e.g., models with different interaction terms), and compared these to determine the model that provided the best fit for the data. Age and the scores on the memory tasks were used as continuous measures and were scaled (i.e. the mean value was subtracted from each value and the result was divided by the standard deviation).

Uniquely identifying initial expressions. First, we constructed different models to predict whether children's initial referring expressions (both in the pretest and the posttest) on each trial were uniquely identifying. Since the outcome variable was coded in binary terms, we used logistic mixed models. Model 1 included age, time, condition, and all the cognitive scores as fixed effects. Model 2 additionally had an interaction term between condition and time. A likelihood ratio test comparing Model 1 (*AIC*=823.4, *BIC*=892.5) and Model 2 (*AIC*=820.1, *BIC*=893.8) in terms of model fit indices Akaike (AIC) and Bayesian information criteria (BIC) showed that Model 2 significantly improved model fit, $\chi^2(1)=5.3$, $p=.021$. AIC values of Model 2 were lower than alternative models that had either an interaction between time and age, or age and condition instead of time and condition, indicating better model fit. Models that included further interaction terms between fixed effects (e.g., time and age, or cognitive measures and condition) did not improve model fit. The predictive accuracy of Model 2 was high (*C*=0.87, D_{xy}=0.75). The time and condition interaction term, time, and the word-picture recall task were significant predictors (see Table 4). Backward digit span task was close to significance (*Estimate*=0.43, *SE*=0.21, *p*=.058). In other words, from pretest to posttest, there was a greater increase in uniquely identifying descriptions in the relative clause feedback than in the demonstrative noun phrase feedback condition. Furthermore, children who were more proficient in recalling verbal information in relation to visual stimuli provided more uniquely identifying initial descriptions.

The number of description attempts. To assess children's communicative repair skills, we first constructed models with the number of description attempts as the outcome variable. Model 3 had age, condition, time, and the cognitive scores as fixed factors. The correlation between the by-item random intercept and slope was -1 indicating that the model overfitted the data. Hence, random effects structure was simplified and Model 4 that only allowed for the by-item random intercept (and not the slope) parameter was preferred. Models with further interaction terms between fixed effects did not provide a better fit. Model 4 accounted for 43% of the variance with fixed effects explaining 21%. Time was a significant predictor indicating that children in both conditions needed less number of description attempts in the posttest. Children's performance on the backward digit span, word-picture recall, and the Dimensional Change Card Sort tasks significantly predicted the number of attempts (see Table 1.4). Hence, children who could repeat more digits backwards, better match verbal information to visual stimuli and recall this information, and had more proficient cognitive flexibility skills needed less number of attempts to describe a referent.

Message ambiguity. We first constructed models with message ambiguity for *initial* descriptions as the outcome variable. Time, age, condition, and cognitive measures were entered into the model (Model 5) as fixed effects. Model 6 that additionally had an interaction term between age and condition provided better fit (*AIC*=2096.3, *BIC*=2172.8) than Model 5 (*AIC*=2136.2, *BIC*=2208.3), $\chi^2(1)=41.8$, $p<.001$, and other models with different interaction terms between fixed effects. Model 6 explained 51% of the variance in the outcome variable with fixed effects explaining 20%. Time, word-picture recall, and Dimensional Change Card Sort tasks were significant predictors (see Table 1.4) such that the ambiguity in initial messages decreased from pretest to posttest and with more proficient skills of cognitive flexibility and recalling words in relation to visual stimuli.

Then, we constructed models with message ambiguity for *subsequent* descriptions following an initial ambiguous description as the outcome variable to assess the role of the modeling conditions and children's cognitive skills in their communicative repair abilities. In Model 7, time, age, condition, and cognitive measures were taken as fixed effects. Model 8 that had an additional interaction term between age and condition provided better fit (*AIC*=897.7, *BIC*=967.5) than Model 7 (*AIC*=900.8, *BIC*=966.4), $\chi^2(1)=5.0$, $p=.025$, and other models that had interactions between fixed effects. Model 8 explained 39% of the variance with 28% of the variance attributed to fixed effects. Age, age and condition interaction, forward digit span, backward digit span, word-picture recall, and Dimensional Change Card Sort tasks were significant predictors (see Table 1.4). The interaction term indicated that the message ambiguity scores showed greater variation with respect to age in the relative clause feedback condition; older children benefited more from the relative clause modeling condition. Unexpectedly, message ambiguity increased with scores on the forward digit span task. In line with our expectations, children, who repeated more digits backwards, better recalled verbal information in relation to visual stimuli, and demonstrated more proficient cognitive flexibility skills, produced less ambiguous messages.

Table 1.4

Details of the Best Fitted Mixed-effects Models for Initial Descriptions and Communicative Repair

Outcome variable	Fixed effects			
Initial Descriptions				
Uniquely identifying initial descriptions	Time + Age + Condition + Time:Condition + FB + FDS + BDS + WPR + DCCS			
	Significant predictors:			
		Estimate	***SE***	***p***
	Time	2.15	0.49	<.001
	Time:Condition	1.22	0.50	.013
	WPR	0.43	0.21	.042
Initial message ambiguity	Time + Age + Condition + Age:Condition + FB + FDS + BDS + WPR + DCCS			
	Significant predictors:			
		Estimate	***SE***	***p***
	Time	-0.98	0.24	<.001
	WPR	-0.17	0.08	.049
	DCCS	-0.58	0.20	.006
Communicative Repair				
Number of description attempts	Time + Age + Condition + FB + FDS + BDS + WPR + DCCS			
	Significant predictors:			
		Estimate	***SE***	***p***
	Time	-0.62	0.13	<.001
	BDS	-0.17	0.08	.033
	WPR	-0.17	0.07	.026
	DCCS	-0.45	0.17	.012
Subsequent message ambiguity	Time + Age + Condition + Age:Condition + FB + FDS + BDS + WPR + DCCS			
	Significant predictors:			
		Estimate	***SE***	***p***
	Age	-0.14	0.06	.023
	Age:Condition	0.20	0.09	.024
	FDS	0.12	0.05	.016
	BDS	-0.18	0.05	.001
	WPR	-0.24	0.05	<.001
	DCCS	-0.32	0.11	.005

Note. ":" denotes interaction, e.g. Time:Condition denotes an interaction between time and condition. In all the models that were constructed, outliers were identified (below or above 2.5 *SD* of the residual error) and removed, and the models were refit. Multicollinearity in the selected models was assessed by calculating the kappa statistic, which indicated low collinearity (< 8). FB: Contents false belief, FDS: Forward digit span, BDS: Backward digit span, WPR: Word-picture recall, DCCS: Dimensional Change Card Sort.

Discussion

Does the input provided by adults in child-directed interactions facilitate children's development of the ability to produce referentially informative utterances? Which socio-cognitive abilities of children play a role in effective referential communication? These were the two main questions of the present study. We showed that exposure to object relative clauses modeled by adults led to referentially clearer verbal descriptions in preschoolers, and children with relatively more advanced short-term memory and executive function skills displayed relatively more communicative competence in producing and revising referential descriptions.

Effects of Adult Models of Speech

Similar to previous referential communication studies (e.g., Deutsch & Pechmann, 1982), we found that children's initial verbal descriptions were mostly inadequate. Exposure to relative clauses that unambiguously resolve referential ambiguity improved children's acuity of initial descriptions more than exposure to demonstrative noun phrases. Differently from previous studies that also showed beneficial effects of hearing relative clauses on children's initial referring expressions (Matthews et al., 2007; Sarılar et al., 2015), we examined children's subsequent descriptions following an ambiguous attempt, in other words, how they repaired communication breakdown. Exposure to relative clauses did not provide children an additional gain in terms of the number of description attempts they needed or did not lead to less ambiguous messages in children's repair attempts. Instead, hearing relative clauses seemed to help children with their *initial* descriptions but did not provide them a better comparison or monitoring strategy when their initial expressions failed.

The greater increase in uniquely identifying initial expressions in the relative clause feedback condition has at least three potential explanations. First, these children could have produced relative clauses that unambiguously identified referents more easily due to their exposure to these linguistic constructions. Indeed, they produced more object relative clauses after the modeling session than the children who heard demonstrative noun phrases (a similar finding to Sarılar et al., 2015). However, only 16% of their descriptions contained object relative clauses. Thus, hearing relative clauses eased the production of the same type of construction for some but not all the children. Secondly, the content of relative clauses may have provided children a useful strategy such as mentioning the action that takes place between the characters in the target picture pair. Since missing stickers corresponded to the characters that underwent an action, a relational description that involved the agent and the action had a greater chance to be uniquely identifying. The greater increase in the production of action verbs in the relative clause feedback condition supports this argument. Children in the demonstrative noun phrase feedback condition also produced relational expressions but this relation mainly encoded the location of the referent (e.g., the boy next to the girl). Finally, hearing a longer message might have led children to be more verbal in general. We observed an increase in redundant messages from pre- to posttest, however this increase did not differ with respect to condition, and only 4% of the initial descriptions in the posttest were redundant. In previous studies that found an increase in children's redundant descriptions after hearing longer messages from adults (e.g., Whitehurst et al., 1981), it may have been easier for children to be redundant (e.g., using two adjectives instead of one adjective) because of the nature of the experimental stimuli. Adults, however, produced redundant initial descriptions (28% of the time) much more frequently than children, as in previous studies (e.g., Deutsch & Pechmann, 1982).

In the pretest, children were usually uninformative in their referential expressions; mostly they either just named the referent or mentioned its location with respect to distractors. Although modeled with a demonstrative noun phrase (a construction similar to just naming the referent), children who heard these structures named the referent to a lesser extent in the posttest. This finding stresses the importance of the listener's non-verbal feedback in the form of picking an alternative referent upon an ambiguous description. That children benefited from non-verbal feedback is also demonstrated by the finding that in the pretest, i.e. before children heard any adult models of speech, they showed communicative repair by producing less ambiguous messages following an ambiguous initial one. We think that the effects of non-verbal feedback were comparable across conditions as children in both modeling conditions did not show a difference in terms of the number of description attempts and message ambiguity in the pretest and their change from pre- to posttest. [5]

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[5] Children in both conditions also did not differ in terms of the proportion of attempts where they requested the sticker with demonstrative pronouns only (e.g., "that one"). Hence, they equally heard the experimenter asking for further clarification.

Mentioning the location remained the predominant strategy in the demonstrative noun phrase feedback condition in the posttest, but children in the relative clause feedback condition started to produce more action verbs and more object relative clauses. The increased production of object relative clauses can be a result of structural priming; the phenomenon that people tend to repeat recently heard or produced language structures (Bock, 1986). Structural priming effects may have been exercised here, since more children in the relative clause feedback condition who did not use any object relative clauses in the pretest produced them in the posttest. Further, the majority of the uniquely identifying initial descriptions with an object relative clause was produced by children who heard relative clauses. Structural priming can ease production by reducing the time to plan utterances and can further serve as an implicit learning mechanism (Pickering & Ferreira, 2008). For the children who were affected by structural priming, it can be said that they already have developed an abstract representation of the object relative clause. Nevertheless, producing object relative clauses was not easy as evidenced by the large proportion of incorrectly formed utterances. Producing object relative clauses was also not the most favored option of adults who preferred to mention actions and physical and emotional features of the referents. One reason for other linguistic constructions to be favored by adults is their simplicity. Another reason can be the avoidance of object relative clauses when describing the relationship between two animate entities (e.g., Kidd, Brandt, Lieven, & Tomasello, 2007; Uzundag & Küntay, in preparation).

Cognitive Skills and Referential Communication

The present study showed that short-term memory, working memory, and cognitive flexibility were important for preschool-aged children's production of referential expressions. The finding that short-term memory is relevant for referential communication was novel and unexpected. Previous research (Bacso & Nilsen, 2017; Wardlow & Heyman, 2016) used a combined score of forward and backward digit span tasks (a measure of short-term and working memory, respectively) to reflect working memory and did not report on the relation between short-term memory and referential communication. Although the forward digit span task did not significantly predict children's referential skills, we found that the word-picture recall task, another short-term memory measure, was related to both children's initial descriptions and their attempts at communicative repair. This finding suggests that the ability to integrate visual and verbal information was necessary to succeed in the referential communication task.

Previous research noted that "preschoolers do not realize the importance of describing the differences between a referent and the surrounding events with which it might be confused" (Sonnenschein & Whitehurst, 1984, p. 193). Recent work with eye-tracking verified that children sometimes fail to notice nonreferents that are similar to the referent (Rabagliati & Robertson, 2017). We expected children with greater working memory capacity to compare the target referent to competitors more easily and thus produce initial messages with lower ambiguity. Unlike previous studies that reported a role of working memory in children's initial descriptions (Bacso & Nilsen, 2017;

Wardlow & Heyman, 2016), we did not observe a similar relation but only a trend. We ran additional analyses to understand this discrepancy: When we used a combined score of digit span tasks as used in these previous studies, working memory still did not predict children's initial descriptions. However, when the Dimensional Change Card Sort task was not included as a predictor in the model, then the combined digit span score emerged as a significant predictor for uniquely identifying initial descriptions. It must be noted that this model provided a poorer fit to the data than the model that also had the Dimensional Change Card Sort task as a predictor. This finding suggests that differences in the measurement of cognitive skills and the analysis method may be relevant to this discrepancy, and the simultaneous inclusion of relevant predictors is important and changes our interpretation of how children's cognitive skills relate to their referential abilities.

Although previous research did not find working memory predictive of communicative repair (Bacso & Nilsen, 2017), we found both working memory and cognitive flexibility to be relevant. We suggest that children with higher working memory capacity were more successful in repairing their ambiguous communication since they could more proficiently keep in mind previous ambiguous expressions along with effective description strategies, use the listener's non-verbal feedback of providing an alternative sticker, and monitor the expressions they produced for ambiguity. Cognitive flexibility seemed to provide children with an advantage in switching between different strategies of describing a referent (e.g., mentioning the action instead of its location) and noticing different distinguishing properties of the referent from competitors. To pass the Dimensional Change Card Sort task, children also needed to use their inhibitory control skills to inhibit their attention to the irrelevant dimension of the stimuli. The finding that passing this task predicted the number of description attempts and the degree of ambiguity in messages may also indicate that inhibitory control may have facilitated the suppression of attention to the properties of the referent the mentioning of which led to an ambiguous description in a previous attempt. A lack of an interaction between cognitive measures and modeling conditions suggested that children with more proficient cognitive skills did not benefit more from the relative clause modeling. Here, verbal skills might have been more relevant such that children with more knowledge about vocabulary, morphology, and syntax could have been benefited more from hearing relative clauses. Future research should control for children's verbal ability.

We expected theory of mind to play a role in referential communication but it was not predictive of children's communicative skills. One explanation relates to children's inability to engage their theory of mind skills under heavy cognitive load. Previous studies showed that adults produced fewer referring expressions that were adjusted to the perspective of the listener under high cognitive load or time pressure (Horton & Keysar, 1996; Roßnagel, 2000). Similarly, when more cognitive resources were required to complete a task, four-year-olds found it more difficult to detect ambiguity (Nilsen, Graham, Smith, & Chambers, 2008). We assume that the sticker selection task posed a relatively high cognitive load due to the necessity of comparing similar stimuli and monitoring the ambiguity of one's own messages for the addressee.

Another explanation is that possessing mentalizing skills is not sufficient unless the speaker can use these skills to guide communicative behavior (Nilsen & Fecica, 2011). Finally, the referential communication task required children to understand that the interlocutor did not have visual access to the sticker books due to the presence of a barrier. This type of understanding is related to Level 1 perspective-taking where one judges what someone is able to see in her visual field (Flavell, 1978). With the theory of mind task, we measured a more complex type of perspective-taking. Hence, this may be another reason why the false belief task was not related to the outcomes in the referential communication task.

Conclusion

We showed that preschoolers' referential expressions were positively affected by hearing complex linguistic constructions that provide informative and distinctive content about referents, and children's short-term memory and executive functions were associated with their communicative skills. There are practical implications to be drawn from these findings. Typically developing children can benefit from hearing more complex language in the child-directed input or from receiving training to improve their cognitive skills. It has been shown that training working memory and executive attention is possible in preschool-aged children (Rueda, Checa, & Cómbita, 2012; Thorell, Lindqvist, Nutley, Bohlin, & Klingberg, 2009), although the generalization of this training to distantly related tasks seems to be limited (Simons et al., 2016). Finally, considering the finding that children who were exposed to a syntactically more complex language by their teacher in preschool showed greater syntactic growth over a year

(Huttenlocher, Vasilyeva, Cymerman, & Levine, 2002), it can be argued that exposing children to complex structures such as relative clauses may aid children in their development of communication skills.

CHAPTER II

The Acquisition and Use of Relative Clauses in Turkish: An Analysis of Spontaneous Interactions

There is a body of research on young children's acquisition and use of relative clauses in various typologically diverse languages (e.g., Arnon, 2010; Brandt, Diessel, & Tomasello, 2008; Courtney, 2006; Hamburger & Crain, 1982; Ozeki & Shirai, 2010. The order of acquisition of different types of relative clauses, their frequency in child speech, and even their function in child-caregiver interaction differ across languages (e.g., Chen & Shirai, 2015; Kirjavainen, Kidd, & Lieven, 2016; Ozeki & Shirai, 2007). Here we investigate the acquisition and use of relative clauses by Turkish-speaking children (aged 0;8 to 5;4) via examining their spontaneous conversations with their caregivers and peers. Turkish is a head-final and morphologically rich language presenting different characteristics from Indo-European and East Asian languages that have been studied. There is no detailed study of Turkish-speaking children's productions of relative clauses in terms of their semantic and syntactic features simultaneously. The present study attempts to fill this gap by examining longitudinal child-caregiver talk and cross-sectional peer interactions and the relations between child speech and caregiver input.

The Acquisition of Relative Clauses

Experimental studies focused on the differences of processing subject and non-subject relative clauses by speakers of various languages. Subject relatives modify a head noun that functions as the subject of the relative clause (e.g., *the book that was on the shelf*), object relatives modify the direct object (e.g., *the book that I lost*), and oblique relatives modify an oblique element (e.g., *the book that the baby played with*). Earlier studies found an advantage in processing subject relatives over object relatives in many languages (e.g., Spanish: Betancort, Carreiras, & Sturt, 2009; English and German: Diessel & Tomasello, 2005; Hebrew: Friedmann & Novogrodsky, 2004). This advantage may not be universal and is not always found in some other languages (Basque: Carreiras, Duñabeitia, Vergara, de la Cruz-Pavía, & Laka, 2010; Gutierrez-Mangado, 2011; Finnish: Kirjavainen et al., 2016; Japanese: Suzuki, 2011).

Studies of spontaneous speech in diverse languages focused on the development in the complexity of children's productions over time, and how children's use of relative clauses was affected by the caregiver input and the properties of the studied language. Diessel and Tomasello (2000) and Diessel (2004) examined spontaneous speech of four English-speaking children between the ages of 1;9 and 5;2. Children produced subject relatives most frequently (53%), followed by object (33%) and oblique relatives (14%). This distribution of frequencies of different types of relative clauses does not mirror the caregiver input as object relatives were more frequent (58%) than subject relatives (34%) in child-directed speech. Subject relatives seem to be easier to produce for English-speaking children since English is a language with strict word order, and subject relatives have a very similar surface structure to simple sentences in terms of word order (e.g., *subject relative clause*: the man that laughs, *simple sentence:* the man laughs). Children's early productions of relative clauses were structurally simple in that 73% of these conveyed a single proposition. The majority of the relative clauses occurred in presentational constructions as attached to the predicate nominal of a copular clause (e.g., that is the sugar that goes in there) or to an isolated noun phrase (e.g., another picture I made). The simplicity of the earliest relative clauses is further indexed by the relatively high amount of intransitive verbs. As children grew older, they produced more complex structures where they used more transitive verbs within relative clauses and less presentational structures as matrix clauses.

Spontaneous speech studies were also conducted in Japanese where five children's speech data up to the age of 3;11 were analyzed (Ozeki & Shirai, 2007, 2010). English and Japanese are typologically different languages where relative clauses are placed prenominally in Japanese and postnominally in English. Furthermore, there is no overt marker for Japanese relative clauses either syntactically or morphologically. According to Comrie (1998, 2002), many East Asian languages have attributive clauses –instead of relative clauses– that are attached to a head noun without further syntactic operations (e.g., movement). Contrary to English-speaking children, Japanese-speaking children produced subject, object, and oblique relatives with similar frequencies; a pattern very similar to the distribution in the speech of the mother of one of the children. It was argued that since different types of relative clauses do not necessitate syntactic operations at different levels of complexity as in English, their ease of production was similar. Instead of producing relative clauses in presentational constructions, children usually uttered them as the subject of matrix clauses or attached them to isolated noun phrases to ask about an object that they could not find or wanted more information about.

Mandarin Chinese, similar to Japanese, has prenominal relative clauses but differs from Japanese in that they are overtly marked with a grammatical morpheme. Chen and Shirai (2015) analyzed four children's and their caregivers' speech longitudinally until the age of 3;5. Children's productions were in general low in complexity as more than half of their relative clauses were not attached to a matrix verb. However, as children's morphosyntactic abilities developed (indexed with their MLU levels), they produced more relative clauses attached to a matrix verb. Object relatives emerged first and remained the most frequent type in child speech. It was suggested that object relatives were easier to produce than other types of relative clauses for Mandarin-speaking children since these were the most frequent in the input and most similar to simple sentences in terms of word order. Although object relatives were also more frequent than subject relatives in the English input, English-speaking children produced subject relatives more than object relatives. This difference between English and Mandarin led Chen and Shirai to argue that the role of input frequency has a less prominent role in children's acquisition of relative clauses who speak relative clause languages like English. They suggested that in languages that possess a relative clause system (as opposed to attributive clauses), subject relatives are syntactically simpler than non-subject relatives and thus were acquired earlier independent of their input frequency.

Findings from Finnish contradict these arguments (Kirjavainen et al., 2016; Kirjavainen & Lieven, 2011). Finnish is a head-initial language with relative pronouns inflected for case and number. An analysis of a Finnish-speaking child's interaction with her caregivers between 1;7 and 3;5 showed that subject and object relatives were almost equally frequent in child and caregiver speech, and oblique relatives were the most frequent. Furthermore, unlike English-speaking children, Finnish-speaking children did not demonstrate a processing advantage for subject relatives in experiments (Kirjavainen et al., 2016). It was suggested that several differences between English and Finnish may be contributing to these findings. Firstly, English has a strict word order which may lead speakers of English to have a greater bias to assign a subject role to the initial noun. If this initial analysis fails to be correct as in the case of non-subject relatives, then the speaker needs to reanalyze the utterance; a process which can lead to errors and/or slower response times. Secondly, since Finnish relative pronouns are inflected, as soon as the relative pronoun is heard, the thematic roles are clear for the listener. In English, on the other hand, the relative pronouns *that* and *which* can be used in both subject and non-subject relatives. Overall, the case of Finnish shows that the subject relatives are not always easier to process than object relatives in head-initial languages. In line with data from other languages, Finnish data further shows that the child's relative clauses were less complex than her caregivers' in terms of transitivity and number of overt arguments. Moreover, the child mostly uttered relative clauses without a matrix verb.

In Hebrew, another head-initial and morphologically rich language, children used correct verbal inflections, mostly uttered transitive verbs and produced relative clauses within matrix clauses. However, they still showed a gradual path of development where they erroneously used resumptive pronouns, and produced more complex relative clauses over time in terms of their semantic content (e.g., by starting to talk about future, possible, and necessary events). The most frequent type of relative clause in child speech between the ages of 2;2 and 6;3 were object relatives (49%) followed by subject (38%) and oblique relatives (13%) (Arnon, 2011). The ease of producing object relatives seems to be related to their high frequency in child-directed speech (Arnon, 2010).

The corpus studies on relative clauses summarized above primarily showed the importance of input frequency for children’s productions. In all the languages examined –except English– there was a strong similarity between the frequencies of different types of relative clauses (i.e. subject, object, and oblique relatives) in child and caregiver speech. These findings show that the structures that are more frequent in caregiver speech may be easier to acquire and produce for children. That input frequency plays a role in children’s comprehension and production skills is also indicated by children’s relative ease in processing object relative clauses with pronominal subjects and inanimate head nouns in experiments (Arnon, 2010; Kidd, Brandt, Lieven, & Tomasello, 2007), since this is the most frequent pattern found in child-directed speech and adult conversations (Kidd et al., 2007; Reali & Christiansen, 2007). One of the main factors that sets English apart from other previously studied languages is that English has a strict word order and almost no inflection. Hence, unlike in morphologically rich languages, word order is the most important cue to assign thematic roles and make sense of the relative clause structure (Slobin & Bever, 1982). This difference seems to explain why English-speaking children find subject relatives, which are structurally similar to simple sentences, easier to produce, although they are less frequent than object relatives in the input.

Another common finding of these corpus studies was that children's relative clauses were simpler than their caregivers' productions in several ways. Japanese-, Mandarin-, and Finnish-speaking children mostly produced relative clauses without attaching them to a matrix verb, and English-speaking children usually produced a copular matrix verb. Hence, the majority of children's relative clauses conveyed a single proposition to the addressee. Other features that signaled low complexity were the predominant use of intransitive verbs in English, generic head nouns in Japanese, and the low number of verbal arguments in Mandarin and Finnish. To conclude, the acquisition of relative clauses as observed in diverse languages does not seem to be an all-or-none accomplishment but rather a gradual development.

Relative Clauses in Turkish and their Acquisition

Turkish is different from the languages that have been studied in several important ways. Firstly, Turkish differs from head-initial languages like English, Finnish, and Hebrew in that it has prenominal relative clauses that do not require a relative pronoun. Turkish also differs from Mandarin Chinese and Japanese in that it marks relative clauses morphologically and is classified as a relative clause language as opposed to an attributive clause language (Comrie, 2002). Turkish is an agglutinative head-final SOV language with a relatively flexible word order. According to Dryer's (2013) world atlas of languages, Turkish is among the 15% of languages that place both the object before the verb and the relative clause before the head noun. Examples 1 to 3 demonstrate a subject, an object, and an oblique relative clause in Turkish.

(1)	*kedi-den*	*kaç-an*	*kuş*
	cat-ABL[6]	flee-SRC	bird
	'the bird that fled/is fleeing from the cat'		
(2)	*kız-ın*	*gör-düğ-ü*	*kuş*
	girl-GEN	see-NSRC-3SG.POS	bird
	'the bird that the girl saw/is seeing'		
(3)	*kız-ın*	*kork-tuğ-u*	*kuş*
	girl-GEN	fear-NSRC-3SG.POS	bird
	'the bird that the girl is/was afraid of'		

Nouns and verbs in Turkish relative clauses possess inflectional markers. Subject relatives (in OVS order) are denoted with the *–(y)An* suffix whose main function is to

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[6] We used the following abbreviations in glossing the examples: ABL: ablative, ACC: accusative, AOR: aorist, AUX: auxiliary, DAT: dative, FUT: future, GEN: genitive, INT: interrogative, LOC: locative, NEG: negative, NSRC: non-subject relative clause marker, OPT: optative, P.COP: past copula, PERF: perfective, PL: plural, POS: possessive, PRON: pronominalizer, PSB: possibility, SG: singular, SRC: subject relative clause marker.

mark subject relatives. [7] Non-subject relatives (in SVO order) are marked with the *–DIK* suffix which has further functions like marking subordination and adverbial clauses (Göksel & Kerslake, 2005). In non-subject relatives, the subject is further denoted with the genitive suffix, and the *–DIK* marker is followed by a possessive suffix that marks agreement with the subject. The verbs constructed with the affixes *–(y)An* and*–DIK* are in non-finite form, and the tense indicated within the relative clause is inferred from the context. Either time adverbials or a compound verb form that involves the auxiliary *ol-* can be used along with the tense and aspect markers on the verb to provide information about the time of the event.

Another construction that Turkish corpus studies focused on is the locative construction that does not contain a verb and is formed by combining the pronominalizer *–ki* suffix with the locative suffix *–DA* (see Example 4) (Altınkamış & Altan, 2016; Slobin, 1986). These grammatical forms can be used to identify referents spatially or temporally, and are thought to correspond to reduced relatives in English (Erguvanlı, 1980).

(4)	*ağaç-ta-ki*	*kuş*
	tree-LOC-PRON	bird

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[7] The capital letters in the suffixes denote the phonemes that can change due to vowel harmony, voicing, and devoicing. A limited use of the *–An* suffix is found in adverbial constructions such as *sen gelene kadar*, ‘until you come’.

'the bird on the tree'

Experimental studies conducted with Turkish-speaking children point to an advantage in processing subject relative clauses. In an elicitation task, 3-year-olds produced subject relatives 56% and object relatives 29% of the time (Ekmekçi, 1998). Six-year-olds still struggled with the production of object relative clauses as 55% of their responses contained object relatives as opposed to 82% that contained subject relatives. Similar results have been obtained in another study where children aged between 5 and 8 and adults were presented with pictures of animals engaged in an action and asked to identify a particular animal by describing it (e.g., the camel that the cow is hitting) (Özge, Marinis, & Zeyrek, 2010). Both children and adults produced more subject than object relatives, and the production of subject relatives was more accurate. Participants avoided using object relatives by producing other types of structures like conjoined clauses (*hani inek onu kovalıyor ya işte o koyun* 'you know the cow is chasing it, that sheep') or passive sentences (*itilen koyun* 'the sheep that is being pushed'). The avoidance of using relative clauses when describing pictures was also observed for children aged between 5 and 9 (Özcan, 2000), and preschool-aged children and adults (see Chapter I). In another picture-cued elicitation task, children aged between 3 and 8 years produced subject relatives more accurately than object relatives (Yumrutaş, 2009). In their erroneous responses, children usually maintained the word order of object relatives, but used the subject relative clause marker instead (see Özcan (2000) and Chapter I for similar findings obtained in a referential communication task). It was argued that it is not the case that subject relatives are acquired earlier in Turkish, but children associate the *–(y)An* marker with relativization and generalize it to non-subject relatives. In terms of comprehension of relative clauses, Turkish-speaking children showed a similar asymmetry between subject and object relatives. In sentence-picture matching or sentence-character matching tasks, children of preschool and primary school ages gave more correct answers to subject relatives compared to object relatives (Kükürt, 2004; Özge, Marinis, & Zeyrek, 2009). Similar to findings in other languages (Arnon, 2010; Kidd et al., 2007), comprehending object relatives was difficult only if the described relationship took place between two animate entities, i.e. the relationship was reversible. If a non-reversible relationship between an animate and an inanimate entity was described (e.g., the ice cream that the child is holding), then children performed close to ceiling.

Overall, experimental studies conducted with Turkish-speaking children in preschool and primary school years showed that children find object relatives more difficult than subject relatives in comprehension and production tasks when a relation between two animate entities is described. That the non-subject relative marker also has other functions in the language, and the existence of the genitive and possessive suffixes in the non-subject relative construction are thought to pose difficulties in processing non-subject relatives for children (Özge et al., 2010; Slobin, 1986). Apart from the morphological complexity, input frequency may be another factor affecting children's processing such that structures that are less frequent in the input may be more difficult to process for children in experimental settings. We will now turn to two corpus studies in Turkish that found a different order of frequencies of subject and object relatives in child-directed speech.

There are only two studies that examined Turkish-speaking children's spontaneous speech for the production of relative clauses. Slobin (1986) analyzed the speech of 57 Turkish-speaking and 57 English-speaking children whose ages ranged from 2 to 4;8. Children's interactions with the experimenters were recorded during their conversations and the periods when children were engaged in psycholinguistic tasks. Overall, Turkish-speaking adults and children produced relative clauses less frequently than English speakers. In child speech, there were 96 relative clauses in English and 42 in Turkish. In his analysis, Slobin (1986) regarded locative constructions (see Example 4) as subject relatives. If these are disregarded, then only 14 subject and 5 non-subject relatives were found in Turkish-speaking children's speech. Turkish-speaking adults produced 22 relative clauses where 15 of these were subject relatives. English-speaking children showed a more accelerated growth curve in terms of the number of relative clauses they produced with increasing age. It was suggested that relative clauses are a late accomplishment in Turkish, and children master these constructions after the age of 4;8, the oldest age group examined.

Altınkamış and Altan (2016) provided the first analysis of the use of Turkish relative clauses in spontaneous child-caregiver interactions. They examined longitudinally collected data of five children between the ages of 1;0 and 2;4 and four children between the ages of 2;0 and 3;6. Additionally, they used cross-sectional data from 21 children (between 9 months and 3 years of age) that included children's interactions with their mothers during free-play, toy-play, and book-reading (reading a wordless picture book) activities. Relative clauses were scarce in child speech— in fact, only two examples uttered by the same child were provided. Contradicting Slobin's (1986) findings, non-subject relatives (N= 151) were more frequent than subject relatives (N= 71) in child-directed speech. Locative constructions, which are assumed to be simpler than relative clauses, were the most frequent category in the input (N= 399).

In sum, studies about the acquisition of Turkish relative clauses were mainly experimental, and studies of spontaneous speech found contradictory results and did not provide information about children's use of relative clauses in relation to the input they receive. The goals of the current research were to investigate the age of emergence and patterns of use of relative clauses by Turkish-speaking children in relation to child-directed speech in a crosslinguistic framework with reference to similar studies in other languages. We examined data from a younger (up until 36 months) and an older group (43-64 months) of children to see both emergence and further development of the construction within a wide age range. Specifically, we investigated which types of relative clauses (e.g., subject vs. object relative clauses) were more frequent in child and child-directed speech, which types emerged earlier in child speech, the differences between high-SES and low-SES caregivers in terms of their use of relative clauses, and the complexity of children's relative clauses in terms of various semantic and structural dimensions.

Method

Corpora

We employed two different corpora to study both early and late child speech. The corpus of child-caregiver interactions contained longitudinal recordings of spontaneous speech from eight children and their caregivers (e.g., mother, grandmother, babysitter) (KULLDD corpus: Küntay, Koçbaş, & Taşçı, 2015). Seven children were followed from 8 to 36 months, and one child was recorded between 8 and 21 months. Four of the children were from low-SES families (parental educational attainment of 8, 8, 5, and 5 years), and four were from high-SES families (parental educational attainment of 15, 11, 15, and 21 years). Children were video-recorded bimonthly in their home environment while engaging in daily activities like eating and playing. The duration of each recording was one hour. Table 2.1 gives information about the amount of child and caregiver speech for each individual child in the KULLDD corpus.

For studying child speech from older children (late child speech), we used a peer interaction corpus, which was originally collected to study children's conflict management strategies (Köymen, 2005). This corpus contained video-recorded peer interactions of triads of 78 children between 43 and 64 months of age while they were carrying out game-like tasks assigned by the researcher in their preschool. Children mostly came from high-SES families: 65 children had at least one parent with a degree from university or vocational college, and the remaining 13 children had at least one parent with a degree from high school. During data collection, 22 target children (11 girls) were selected randomly, and each triad of children was formed on the basis of

Table 2.1

Properties of the Longitudinal Corpus of Child-Caregiver Interactions

					Number of utterances		Mean number of utterances per session	
Child	Sex	SES	Age Range (in months)	Number of sessions	CS [a]	CDS	CS	CDS
C1	F	low	8-36	57	10,058	6,513	176.5	114.3
C2	F	low	8-36	56	17,758	26,205	317.1	455.4
C3	M	low	8-36	41.75	14,393	16,143	338.7	379.8
C4	M	high	8-36	40.5	14,613	23,194	360.8	572.7
C5	F	high	8-36	51	13,467	19,734	264.1	386.9
C6	F	high	8-36	46	13,291	22,217	295.4	493.7
C7	F	low	8-36	51	11,602	26,156	227.5	512.9
C8	F	high	8-21	28	7,078	22,808	252.8	814.6

[a] CS: Child speech, CDS: Child-directed speech.

teacher's reference with two of the target child's friends with who she or he spends a considerable amount of time with. Each target child participated in a same-sex triad (composed of the target child and two same-sex peers) and a mixed-sex triad (composed of the target child, a boy, and a girl). Triads of children engaged in four different tasks. Two of these tasks were collaborative where children had to do the task together (building something out of legos, and drawing), and two of them were competitive such that there would be a winner (playing with memory cards and playing a game). Each task's duration was approximately 15 minutes. The experimenter only intervened if there was a risk of physical injury.

Coding

For the corpus of child-caregiver interactions, each utterance that contained a relative clause formed with the affixes *–(y)An*, *–DIK*, *–mIş*, *–EcEK* or a locative construction formed with the *–DAki* affix was extracted from child speech and child-directed speech via an R script. Since the morphological coding of the corpus is not yet completed, we made the searches in the 'FLO' transcription lines, which are simplified versions of the main CHAT lines with markers of retracing, errors, and overlaps removed. We searched for the lines that had a word either ending with or containing the suffixes that mark relative clauses or the combination of these suffixes and other suffixes that mark case, possession, and plural: *en, an, eni, anı, ene, ana, ende, anda, enden, andan, enin, anın, enle, anla, enim, anım, enimiz, anımız, eniniz, anınız, enler, anlar, dık, dik, duk, dük, tık, tik, tuk, tük, dığ, diğ, duğ, düğ, tığ, tiğ, tuğ, tüğ*. Utterances with these markers that convey different meanings (e.g., adverbial clause: *istediğin kadar al* 'take as much as (you) want'), song lyrics, and idiomatic expressions were excluded. Since the CHAT format was not employed in the transcription of the peer interaction corpus, the first author manually checked all the transcripts (nearly 26,000 utterances) to locate the utterances that contained relative clauses and locative constructions. Following the coding scheme in previous corpus studies (Chen & Shirai, 2015; Diessel & Tomasello, 2000; Kirjavainen & Lieven, 2011; Ozeki & Shirai, 2007), relative clauses in child and child-directed speech were first coded according to (a) the syntactic role of the head noun in the relative clause, and (b) the syntactic role of the head noun in the matrix clause in which the relative clause is located, as will be elaborated below. Then, to assess the complexity of the relative clauses and allow for a crosslinguistic comparison, we coded for (c) whether the subject of the relative clause was pronominal or lexical (e.g., *gördüğüm kitap* 'the book that (I) saw' vs. *kadının gördüğü kitap* 'the book that the woman saw'), (d) whether the head noun was missing (e.g., *gelenler* '(the ones) that are coming' versus *gelen insanlar* 'people that are coming'), and (e) whether the head noun (if overt) was a generic noun such as *yer* 'place', *şey* 'thing', or *biri* 'one'. Finally, we coded for (f) the animacy of the head noun. Characters in books and toys that could be perceived as animate were coded as animate entities.

Syntactic role of the head noun in the relative clause. With respect to the syntactic role of the head noun in the relative clause, an utterance was either classified as a subject relative, direct object relative, oblique relative, or genitive relative. These categories are exemplified in Examples 5 to 8 below. Indirect object relatives were not found in the data.

(5) SU = subject relative

(Child 5, 31 months)

[orman-da	*yaşa-yan]*	*bir*	*ördek*	*var*
forest-LOC	live-SRC	a	duck	exist

'There is a duck that lives in the forest.'

(6) DO = direct object relative

(Child 6, 35 months)

[pişir-diğ-im-i]	*bu*	*tabağ-a*	*koy-a-lım*	*mı*
cook-NSRC-1SG.POS-ACC	this	plate-DAT	put-OPT-1PL	INT

'Shall we put the one that I cooked on this plate?'

(7) OBL = oblique relative

(Child 6, 29 months)

[Selin'in	*oyna-dığ-ı-nı]*	*getir*
Selin-GEN	play-NSRC-3SG.POS-ACC	bring

'Bring the one that Selin played with.'

(8) GEN = genitive relative

(Child, 59 months)

aslında	*[kuyruğ-u*	*böyle*	*ol-an]*	*bir*	*balık*	*da*	*ol-abil-ir*
in.fact	tail-3SG.POS	like.this	exist-SRC	a	fish	also	be-PSB-AOR.3SG

'In fact, it may also be a fish whose tail is like this.'

Syntactic role of the head noun in the matrix clause. We coded the role of the head noun within the minimal matrix clause that contained the relative clause or locative construction. The following categories were used:

(9) PN = predicate nominal

(Child, 54 months)

bu	*zaten*	*[benim*	*kreş-te*	*yap-tığ-ım]*	*şey*
this	anyway	I-GEN	kindergarten-LOC	do-NSRC-1SG.POS	thing

'This is the thing that I did in the kindergarten anyway.'

(10) NP = isolated noun phrase

(Child, 46 months)

[gül-en]	*insan*
laugh-SRC	human

'person who laughs'

(11) SUBJ = subject

(Child, 57 months)

[iste-yen-ler]	al-sın
want-SRC-PL	take-3SG.OPT

‘Those who want (it), take (it).’

(12) OBJ = object

(Child, 45 months)

[ben-de ol-an-lar-ı] al-ma

I-LOC be-SRC-PL-ACC take-NEG

‘Don’t take the ones that I have.’

(13) OBL = oblique element

(Child 5, 32 months)

[balık-lar-ın kullan-dığ-ı] şey-e bak

fish-PL-GEN use-NSRC-3SG.POS thing-DAT look

‘Look at the thing that the fish use.’

(14) ADJ = adjunct

(Child 8’s mother, 21 months)

[inek-ler-in ol-duğ-u] market-ten al-mış-tı-m

cow-PL-GEN be-NSRC-3SG.POS store-ABL buy-PERF-P.COP-1SG

‘I bought (it) from the store where the cows are.’

Interrater reliability. For the corpus of child-caregiver interactions, the first author coded each relative clause and locative construction in child and child-directed speech (N= 924) and a graduate linguistics student independently coded 45% of the data. The interrater reliability was calculated with Cohen's *kappa*, and it was κ= .950 (95% CI, .925 to .975) for the syntactic role of the head noun in the relative clause, κ= .851 (95% CI, .812 to .890) for the syntactic role of the head noun in the matrix clause, κ= 1.0 for pronominal subject, κ= .995 (95% CI, .985 to 1.0) for the overt presence of the head noun, κ= .989 (95% CI, .975 to 1.0) for generic head noun, and κ= .958 (95% CI, .927 to .989) for animacy.

For the peer interaction corpus, the first author coded all the relative clauses and locative constructions (N= 218), and a graduate linguistics student coded 23% of the data. The interrater reliability for the raters was κ= .973 (95% CI, .920 to 1) for the syntactic role of the head noun in the relative clause, κ= .828 (95% CI, .712 to .944) for the syntactic role of the head noun in the matrix clause, κ= 1.0 for pronominal subject, κ= .961 (95% CI, .885 to 1) for the overt presence of the head noun, κ= .961 (95% CI, .885 to 1) for generic head noun, and κ= .854 (95% CI, .695 to 1) for animacy. All disagreements were resolved by discussion.

Results and Discussion

Frequency

We identified 27 child-produced and 425 child-directed utterances that contained relative clauses in the child-caregiver interaction corpus. Children's utterances that contained relative clauses were coded as productive if the caregiver did not produce the same verbal form in the preceding 15 utterances. On that basis, 23 out of 27 relative clauses were evaluated as productive; the entire set of children's productions was used in the following analyses. For each child, Table 2.2 shows the number and proportion of relative clauses within child and caregiver speech. The age range for a relative clause to emerge in a productive use varied between 2;5 and 2;11 across children. In the peer interaction corpus, 50 out of 78 children produced at least one relative clause (*M*= 2.0, *SD*= 2.5, Range= 0−12). In total, 155 relative clauses were found in late child speech that almost corresponded to 0.6% of all child speech.

As seen in Table 2.2, relative clauses were just emerging in child speech before 36 months. Child 5, who produced more relative clauses than the other children, produced 10 out of 13 relative clauses by using the same verb *yaşa-* 'live' where 7 of these were recorded in one session and 3 were recorded in another session. Turkish relative clauses comprised only 0.03% of child speech as opposed to 0.23%, 0.95%, and 0.05% in English, Mandarin Chinese, and Finnish, respectively (Chen & Shirai, 2005; Diessel & Tomasello, 2000; Kirjavainen & Lieven, 2011). [8] If only data of two English-speaking children that were followed until a similar age as in the present study (3;1 and 3;3) were examined, then relative clauses in these children's speech comprised 0.09% and 0.21% of their total speech. Thus, corroborating previous findings (Altınkamış &

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[8] There was no report of the overall frequency values in Japanese (Ozeki & Shirai, 2007). For English, Diessel (2004) did not report on the frequency of relative clauses in child-directed speech.

Altan, 2016; Slobin, 1986), the acquisition of relative clauses occurs late in Turkish-speaking children's language development.

Table 2.2

Number and Proportion of Relative Clauses and the Age of Emergence in the Corpus of Child-Caregiver Interactions

	Number of relative clauses		% of Relative clauses		Age of First Productive Use
	CS	CDS	CS	CDS	
Child 1	3	9	0.03	0.14	2;8
Child 2	2	26	0.01	0.10	2;11
Child 3	2	40	0.01	0.25	2;10
Child 4	2	89	0.01	0.38	2;9
Child 5	13	64	0.10	0.32	2;7
Child 6	4	68	0.03	0.30	2;5
Child 7	1	33	0.01	0.13	2;9
Child 8	-	96	-	0.42	-
Total	27	425	0.03	0.26	

Note. Child 8, who was followed until 21 months, did not produce a relative clause in the recordings. CS: Child speech, CDS: Child-directed speech.

In caregivers' speech, relative clauses were also less frequent in Turkish (0.26%) compared to Finnish (0.45%) and Mandarin (1.72%). The fact that Turkish-speaking caregivers did not produce relative clauses frequently may suggest that they turn to simpler alternative structures when speaking to children as opposed to when speaking to adults. Therefore, we first checked the proportion of relative clauses in adult-to-adult conversations in the corpus of child-caregiver interactions. We found that when speaking to other adults, relative clauses constituted 1.11% (N= 402) of adult speech; a ratio much higher than in child-directed speech. Thus, adults used fewer relative clauses when addressing children than when addressing adults. Then, we searched the corpus for alternative structures that children and adults may have used as a substitute for relative clauses. Slobin (1986) argued that by using the discourse particles *hani* and *ya* (roughly translated as 'you know') to refer to the shared information between the child and the listener, children may avoid using relative clauses (e.g., *hani ev var ya böyle damı* 'you know there is a house with a roof like that' instead of using the relative clause *böyle damı olan ev* 'a house that has a roof like that'). We searched for the use of *hani* in the longitudinal corpus and only found two instances of this type of use in child-directed speech. Hence, the use of modifiers with these discourse particles does not seem to explain the low frequency of relative clauses in child and child-directed speech. We then examined the frequency of locative constructions (see Example 4) that may be used as another alternative structure under certain circumstances. Previous corpus and narrative elicitation studies showed that locative constructions were more frequent than relative clauses in Turkish-speaking children's speech (Dasinger & Toupin, 1994; Slobin, 1986). We found that before 36 months of age, children produced more locative constructions (N= 50) than relative clauses (N= 27). In late child speech, locative constructions were not as frequent (N= 63) as relative clauses (N= 155). And finally in child-directed speech, locative constructions (N= 422) were as frequent as relative clauses (N= 426). Hence, Turkish speakers seem to use locative constructions, which are morphosyntactically simpler than relative clauses, whenever the referent can be identified with these structures spatially (*yerdekini sen al* 'you get the one on the floor'), temporally (*bizim* *çocukluğumuzdaki şarkılar* 'the songs in our childhood'), or deictically (*buradaki kelebek* 'the butterfly over here').

The Relation of SES to Caregiver Input

We observed individual differences between children in terms of the amount and proportion of relative clauses they heard from their caregivers. The frequency of relative clauses in child-directed speech varied with respect to the SES of the families that was indexed by parental education. When the proportions of relative clauses in child-directed speech in high- and low-SES families were compared with an independent samples t-test after applying arcsine transformation to the proportions, results showed that children growing up in high-SES families heard more relative clauses (M= 0.36%, SD= 0.05) than children growing up in low-SES families (M= 0.15%, SD= 0.07), $t(6)$= 4.61, p= .004, d= 3.45. Although SES was related to the frequency of relative clauses in child-directed speech, it was not related to the age of first productive use. The relation of SES to children's productions was not assessed in the peer interaction corpus as parental education was mostly similar across children.

Syntactic Role of the Head Noun in the Relative Clause

SU relatives were most frequent (N= 17) followed by DO (N= 6) and OBL (N= 4) relatives in early child speech. Table 2.3 shows the individual uses of children and their caregivers. The predominance of SU relatives is due to one child's (C5) more frequent use of these structures compared to other children. Among the remaining children, two could produce both types of relatives; two produced only SU; and two produced only DO relatives. Hence, by looking at this data, we cannot say that Turkish-speaking children find SU relatives easier to produce than DO relatives as was observed in experimental studies (e.g., Özge et al., 2010). OBL relatives were produced by two children only, and GEN relatives by none, which were also missing in three of the children's input. In general, locative constructions were more frequent than relative clauses in child and caregiver speech.

Table 2.3

Uses of SU, DO, OBL, and GEN Relatives and Locative Constructions (LOC) by Younger Children and their Caregivers

	SU		DO		OBL		GEN		LOC	
	CS	CDS	CS	CDS	CS	CDS	CS	CDS	CS	CDS
Child 1	1	3	2	5	-	1	-	-	4	16
Child 2	1	6	1	13	-	6	-	1	8	46
Child 3	1	13	-	21	1	6	-	-	6	30
Child 4	2	44	-	27	-	7	-	11	7	54
Child 5	12	34	1	23	-	6	-	1	13	97
Child 6	-	19	1	35	3	11	-	3	11	80
Child 7	-	17	1	11	-	5	-	-	-	43
Child 8	-	29	-	50	-	15	-	2	1	56
Total	17	165	6	185	4	57	0	18	50	422

Note. CS: Child speech, CDS: Child-directed speech.

Whether children heard more SU or DO relatives varied between children such that some children heard more SU relatives and others heard more DO relatives. Overall, DO relatives (43%) were slightly more frequent in caregiver speech than SU relatives (39%). These findings were in line with previous findings for Turkish caregiver speech (Altınkamış & Altan, 2016), but differed from Slobin's (1986) findings showing a higher frequency for SU relatives. In late child speech, SU (46%, N= 71) and DO (45%, N= 69) relatives were produced with almost equal frequencies.

Figure 2.1 shows a very similar distribution of different types of relative clauses for late child speech and caregiver speech.

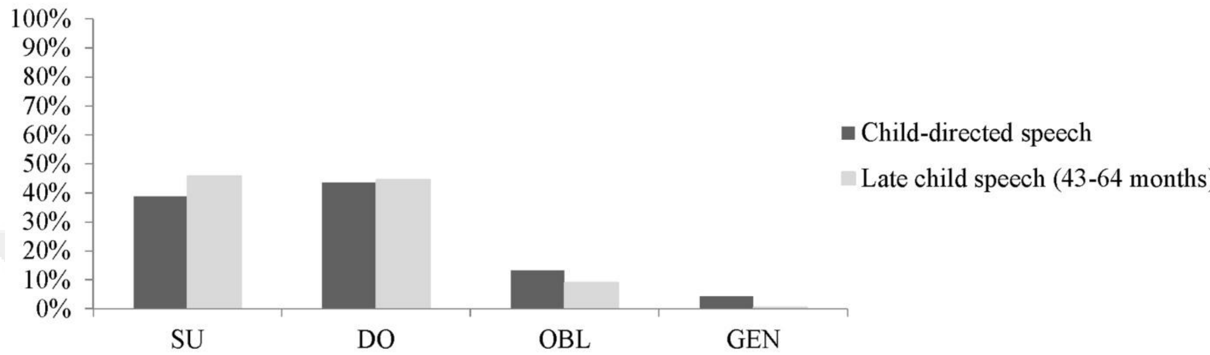

Figure 2.1. Relative clauses by the syntactic role of the head noun in the relative clause.

This similarity shows that more frequently heard structures were produced by the children more easily. Input frequency was shown to be an important factor to be associated with children's productions in other languages as well: Table 2.4 summarizes the frequency distributions in child and caregiver speech in Turkish and other languages where corpus studies were done. In terms of the kinds of syntactic role of the head noun in the relative clause, children's use was heavily affected by child-directed speech in all the studied languages except English. Turkish-speaking children acted like their Finnish-, Japanese-, Hebrew-, and Mandarin-speaking counterparts in that they produced a type of relative clause more frequently if they heard it more frequently. English differs from these languages in that it is a strict word order language with limited inflectional morphology; it may be that SU relatives were easier to produce for young English-speaking children than DO relatives, because the thematic roles are easily identifiable via word order.

OBL relatives were not very frequent in late child speech (9%) and caregiver speech (13%), and before 36 months, four instances of OBL relatives were produced. Children and caregivers produced OBL relatives for marking a location (e.g., *senin olduğun yerde* 'in the place where you are'), direction (e.g., *kaçacak bir yerin yok* 'there is no place that you can run to'), instrument (e.g., *Banyo yaptığın şeye mi benzettin?* 'Does it look like the thing that you bathe with?'), source (*aldığın yere koy* 'put (it) where you got (that) from'), and time (e.g., *hani kedinin seni tırmaladığı gün* 'you know, the day that the cat scratched you'). GEN relatives, which are probably most difficult to process due to their different information structure (e.g., in Example 8, the verb in the relative clause is about the possessed item (tail) rather than the head noun (fish)), were missing in early child speech, and constituted only 1% of the relative clauses in late child speech and 4% in caregiver speech.

Table 2.4

Crosslinguistic Comparison of the Use of Relative Clauses in Child and Caregiver Speech

	Syntactic role in relative clause		Syntactic role in matrix clause	
	CS [a]	CDS	CS	CDS
Turkish [b]	SU-DO-OBL (46%, 45%, 9%)	DO-SU-OBL (43%, 39%, 13%)	OBJ-SUBJ-OBL-NP-PN (54%, 20%, 6%, 6%, 3%)	OBJ-SUBJ-OBL-NP-PN (39%, 29%, 10%, 10%, 3%)
English [c]	SU-DO-OBL (53%, 33%, 14%)	DO-SU-OBL (58%, 34%, 8%)	PN-NP-OBJ-OBL-SUBJ (49%, 24%, 21%, 5%, 1%)	PN-OBJ-NP-OBL-SUBJ (46%, 33%, 16%, 4%, 1%)
Finnish [d]	OBL-SU-DO (44%, 28%, 28%)	OBL-SU-DO (42%, 29%, 28%)	NP-OBJ-PN-OBL-SUBJ (51%, 18%, 15%, 10%, 0%)	PN-OBJ-NP-OBL-SUBJ (35%, 31%, 17%, 9%, 3%)
Hebrew	DO-SU-OBL [e] (49%, 38%, 13%)	DO-SU [f] (69%, 31%)		
Japanese	SU-OBL-DO (36%, 35%, 28%)	SU-OBL-DO (36%, 29%, 26%)	NP-SUBJ-PN-OBJ-OBL (34%, 33%, 14%, 11%, 8%)	NP-SUBJ-OBJ-OBL-PN (31%, 27%, 23%, 12%, 7%)
Mandarin [g]	DO-SU-OBL (62%, 19%, 10%)	DO-SU-OBL (59%, 18%, 8%)	NP-SUBJ-OBJ-PN-OBL (53%, 17%, 14%, 12%, 5%)	NP-SUBJ-OBJ-PN-OBL (29%, 29%, 18%, 13%, 11%)

Note. SU: Subject relative, DO: Direct object relative, OBL: Oblique relative, PN: Predicate nominal, NP: Isolated noun phrase, SUBJ: Subject, OBJ: Object, OBL: Oblique element. The proportions of different categories are listed in a descending order.
a. CS: Child speech, CDS: Child-directed speech. b. Turkish data is based on late child speech (43-64 months). The percentages for the syntactic role in the matrix clause do not add up to 100% since the adjunct category is not presented here. c. Diessel (2004). d. Kirjavainen & Lieven (2011). e. Arnon (2011). f. Arnon (2010): Only transitive subject and object relative clauses were reported by this study. g. Chen & Shirai (2015).

Syntactic Role of the Head Noun in the Matrix Clause

Before 36 months of age, the head noun of the relative clauses usually functioned as the subject of a matrix clause (N= 13). Less frequently, the head noun was used in isolation (N= 5), functioned as the object (N= 5), the adjunct (N= 2), the oblique element (N= 1), or the predicate nominal (N= 1). Table 2.5 shows individual uses for each child and his/her caregivers. The higher frequency of SUBJ relatives is due to C5's more frequent use of this category than other children. In general, the productions of the caregivers of different children were similar such that the head noun mostly functioned as the object of the matrix clause followed by its subject function.

Table 2.5

Individual Uses of PN, NP, SUBJ, OBJ, and OBL Relatives by Younger Children and their Caregivers

	PN		NP		SUBJ		OBJ		OBL	
	CS	CDS	CS	CDS	CS	CDS	CS	CDS	CS	CDS
Child 1	0	0	0	3	2	1	1	3	0	2
Child 2	0	1	1	5	1	5	0	8	0	5
Child 3	0	0	0	2	1	12	1	17	0	8
Child 4	0	1	1	9	1	24	0	37	0	10
Child 5	1	1	2	4	8	20	1	30	1	3
Child 6	0	1	0	6	0	21	2	25	0	7
Child 7	0	0	1	2	0	15	0	13	0	1
Child 8	0	9	0	11	0	25	0	32	0	5
Total	1	13	5	42	13	123	5	165	1	41

Note. CS: Child speech from the corpus of child-caregiver interactions, CDS: Child-directed speech.

For late child speech and child-directed speech, Figure 2.2 shows the proportion of relative clauses by the syntactic role of the head noun in the matrix clause. Mainly, the head noun functioned as the object or the subject of the matrix clause with other uses being less frequent. Children and adults demonstrated a very similar usage of relative clauses, as also shown by a strong correlation, *r*(5)= .93, *p*= .023. The most frequent combination of the syntactic role of the head noun in the relative and matrix clauses was the combination of DO and OBJ relatives meaning that the head noun of object relative clauses mostly functioned as the object of the matrix clause.

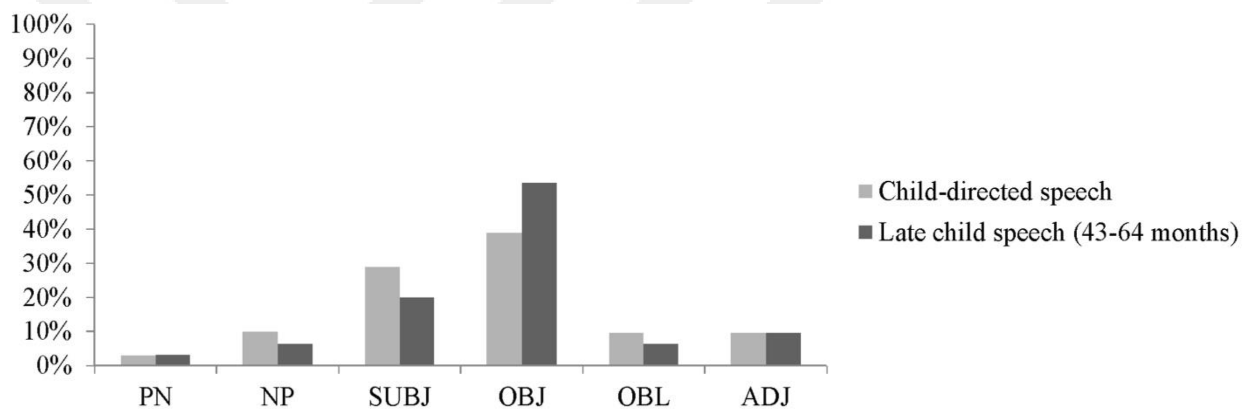

Figure 2.2. Relative clauses by the syntactic role of the head noun in the matrix clause.

As seen in Table 2.4, how children and caregivers speaking different languages use relative clauses with respect to the syntactic role of the head noun in the matrix clause differs across languages. In all the languages except Turkish, children mostly uttered relative clauses in isolation, attached to a noun phrase or as the predicate nominal of a copular matrix clause (i.e. NP and PN uses were frequent). Children's preference for NP and PN relatives in other languages were explained by the high frequency of these relatives in the input, their relative simplicity, and the pragmatic function they serve in child speech (e.g., producing NP relatives to answer caregivers' questions) (Chen & Shirai, 2015; Diessel & Tomasello, 2000; Kirjavainen & Lieven, 2011). NP and PN relatives were regarded as relatively simple since they convey a single meaning to the addressee. In the speech of English-speaking children, 73% of the utterances that contained relative clauses conveyed a single meaning where the corresponding proportions were 66% for the Finnish-speaking child, 65% for the Mandarin-speaking children, and 44% for the Hebrew-speaking children. In Turkish, in addition to the NP and PN relatives, we also considered the utterances where the relative clause was attached to an existential verb (see Example 5) as relatively simple and mono-propositional structures. Before 36 months, we found that 16 out of 27 relative clauses produced by children conveyed a single meaning. In late child speech, we found an increase in complexity such that only 28% of the children's utterances that contained relative clauses were composed of single propositions. Hence, we can say that the relative clauses produced by older Turkish-speaking children were located in more complex structures than the relative clauses produced by children speaking other languages shown in Table 2.4. We suggest that several factors in combination are responsible for this difference. One of the reasons for this greater complexity may be related to children's tendency to use the relative clauses in a way that adults use these structures (see Figure 2.2). In child-directed speech, NP and PN relatives were not common and the head noun mostly functioned as the object or the subject. Another reason may be that children in the peer interaction corpus (43−64 months) were older than the children analyzed in studies conducted in Finnish (19−41 months), Japanese (up to 47 months), and Mandarin (up to 41 months), although the age range of English-speaking children (up to 62 months) was similar. Finally, the fact that Turkish is a prenominal language might have affected children's productions as will be discussed in more detail in the General Discussion section.

Complexity

Since Turkish-speaking children and adults find object relative clauses difficult to comprehend and produce than subject relative clauses in experiments (Ekmekçi, 1998; Özge et al., 2010; Yumrutaş, 2009), a relatively high frequency of object relative clauses was unexpected for spontaneous conversations. However, object relatives produced in spontaneous speech were semantically and structurally different from the ones used in the experiments. In experimental settings, children are usually asked to describe a relation between two animate entities by using a lexical subject (e.g., *the camel that the cow is hitting*). For spontaneous speech we found that all of the object relative clauses produced by the caregivers, 88% produced by the older children and 4 out of 6 object relative clauses produced by younger children had pronominal subjects (e.g., *okuduklarımız* 'the ones that we read'). In this respect, Turkish children's usage patterns were similar to English- and German-speaking children's (Kidd et al., 2007). Furthermore, inanimate head nouns were found in 94% and 97% of object relatives in caregiver and late child speech, and in all object relatives produced by younger children (before 36 months). This finding was similar to findings in English, Finnish, and German (Diessel, 2009; Kidd et al., 2007; Kirjavainen et al., 2016).

Previous studies showed that the use of pronominal instead of lexical subjects and inanimate instead of animate head nouns reduces the processing complexity of object relative clauses (Arnon, 2010; Kidd et al., 2007). Hence, these findings firstly indicate that children hear and produce simpler constructions than what they have been tested on in experiments. Secondly, there is a close correspondence between children's productions and what they hear in their daily interactions. Finally, across diverse languages, object relative clauses have similar properties (i.e. pronominal subjects and inanimate head nouns) related to their discourse functions, such as linking new information in the matrix clause to old information presented in the relative clause (Fox & Thompson, 1990).

When we look at subject relatives, we see a different pattern about the animacy of the head noun. Previous research in English and Finnish spontaneous speech showed that inanimate heads were more common in subject relatives in child speech although the gap between the use of animate and inanimate head nouns tends to be smaller compared to the object relatives (Diessel, 2009; Kirjavainen et al., 2016). In a similar vein, we found that 52% of subject relatives in caregiver speech and 57% in late child speech had an inanimate head noun. However, when children were just starting to produce relative clauses, they associated subject relatives with animate agents as 16 out of 17 subject relative clauses they produced before 36 months contained an animate head. This finding may be related to younger children's tendencies of associating animate entities with the agent role and thus, the subject of the relative clause. Unlike object relatives, subject relatives almost always had lexical subjects instead of pronominal ones (99% of subject relatives in caregiver speech and 100% in child speech).

We further assessed the complexity of the relative clauses by the overt presence of the head noun (see the table in Appendix C for more detailed information). We assumed that headless relative clauses would be easier to produce since the entity they refer to can easily be identified perceptually or from previous mention (Göksel & Kerslake, 2005). In early child speech, 11 out of 27 relative clauses were headless. Relative clauses in late child speech were also simpler than the ones in the input, with 67% of the relative clauses in late child speech and 35% in caregiver speech being produced without an overt head noun. The reason that caregivers mostly used an overt head noun may be to ease young children's understanding of which entity the relative clause structure refers to. For the high proportion of headless relative clauses in older children's speech, context may be an explanatory factor such that they produced relative clauses to refer to entities that are contextually available in the here-and-now. Indeed, 80% of the children's headless relative clauses modified an inanimate referent which usually corresponded to the presented materials (e.g., *aynı olmayanları almışsın* 'you took the ones that are not the same') and what children were planning to do with those materials (e.g., *ben yapmayacağım senin yaptığını* 'I will not do what you did').

Another feature of the relative clauses in late speech that indicated low complexity was that their majority was constructed with early acquired and highly frequent verbs. The verbs *yap*- 'do' and *iste*- 'want' were found in 62% of the DO relatives, and the verb *ol*- ‘be’ was found in 59% of SU relatives. [9] A similar pattern was not found in early child speech. Finally, in 49% of the relative clauses in late child speech that had an overt head noun, the head noun was generic such as ‘thing’, ‘place’, ‘or (some)one’. It might be that children used these relative clauses when they referred to something general instead of specific (e.g., *bundan yapacak bir şey bulalım* ‘let’s find something that we can do with this’) or when they had a difficulty in naming the referent (e.g., *Şu çizgili şöyle olan şeyi mi?* ‘(Do you mean) the thing that is like that with the stripes?’). Generic head nouns were in general less frequent in child-directed speech (see the table in Appendix C).

General Discussion

We investigated the acquisition and use of relative clauses by Turkish-speaking children by examining their spontaneous speech in relation to child-directed speech and in comparison to children speaking typologically different languages. We focused on the syntactic role of the head noun in the relative clause and in the matrix clause, and on the complexity of children’s relative clauses. We showed that (1) the production of relative clauses in Turkish early child speech is relatively late compared to other languages, (2) how frequently children hear relative clauses varies in caregiver speech with years of parental education, (3) children’s relative clauses are very similar to those in the input

[9] According to TİGE, the Turkish version of the MacArthur-Bates Communicative Development Inventory (Aksu-Koç et al., 2009), 93.5% and 92.2% of Turkish-speaking children aged 36 months could produce *iste*- ‘want’ and *yap*- ‘do’.

in terms of the distribution of the syntactic role of the head noun in the relative clause and the matrix clause, but (4) relatively simple in terms of various semantic and structural criteria.

Late Acquisition

Supporting previous findings in Turkish (Altınkamış & Altan, 2016; Slobin, 1986), we found that the acquisition of relative clauses by Turkish-speaking children as evidenced in their semi-naturalistic conversations is a late accomplishment. In 95,182 utterances produced by seven children that were followed until 36 months of age, we only found 27 relative clauses. This is relatively sparse compared to other languages where studies of spontaneous speech are available (e.g., Diessel & Tomasello, 2000; Kirjavainen & Lieven, 2011). We suggest that the sources of this late acquisition are (1) the low frequency of relative clauses in the input, and (2) the morphosyntactic difficulty of Turkish relative clauses. Turkish-speaking children heard a relatively low amount of relative clauses in caregiver speech. Only 0.26% of caregivers' utterances contained relative clauses compared to 1.72% in Mandarin and 0.45% in Finnish (Chen & Shirai, 2015; Kirjavainen & Lieven, 2011). That the frequency of a construction affects its acquisition has been shown in various studies for words, inflectional morphology, and syntactic structures (see Ambridge, Kidd, Rowland, & Theakston, 2015, for a review).

Similar to Turkish-speaking children, the Finnish-speaking child also did not produce or hear relative clauses as frequently as children speaking other languages shown in Table 2.4. This finding seems to be related to the morphological difficulty of relative clauses in both of these languages. In Finnish, there are three relative pronouns which can be inflected for 15 different cases. In Turkish, the proper use of relative clauses necessitates the acquisition of the suffixes that mark subject and non-subject relatives and the knowledge of which inflectional case markers go with which types of relative clauses. Furthermore, that the –*DIK* suffix, which marks non-subject relative clauses, is a subordinating suffix also marking adverbial clauses (e.g., *baktığımızda* ‘when (we) look(ed)’) and verbal nouns (e.g., *gittiğinizi biliyorum* ‘(I) know that you left’) (Göksel & Kerslake, 2005) may render the acquisition of its relative clause marking function difficult. We observed that older children, who possessed more knowledge about morphosyntax of their language than younger children, produced more relative clauses in spontaneous speech. An additional difficulty in the acquisition of Turkish relative clauses may stem from the deviation of the word order of relative clauses from the canonical word order. For German and Basque (which is a free word order language), it has been shown that sentences that deviate from the canonical word order were more difficult to process indicated by both behavioral and neurological data (Erdocia, Laka, Mestres-Missé, & Rodriguez-Fornells, 2009; Rösler, Pechmann, Streb, Röder, & Hennighausen, 1998). Finally, the fact that Turkish relative clauses are non-finite structures may also affect the speakers’ use of these structures since non-finite constructions are less frequent in spoken data and more frequently found in written texts (Kerslake, 2007). These difficulties associated with the production of relative clauses may have led Turkish-speaking children to avoid producing relative clauses and use simpler alternative structures like locative constructions when appropriate.

The Case of Object Relative Clauses

It has been found in experiments that Turkish-speaking children find it difficult to comprehend and produce object relatives compared to subject relatives (e.g., Ekmekçi, 1998; Özge et al., 2009, 2010; Yumrutaş, 2009). Based on these experimental findings and previous observations showing that Turkish-speaking children produced more subject relatives than object relatives when talking with an experimenter (Slobin, 1986), Turkish was thought as a language with strong subject primacy (e.g., Chen & Shirai, 2015). However, we observed that preschool-aged children produced object relative clauses as frequently as subject relative clauses. We suggest that there are two reasons why children produced object relatives easily in spontaneous speech, namely (1) the semantic and structural properties of object relatives in spontaneous speech, and (2) their high frequency in child-directed speech. Firstly, the semantic content and structure of object relatives differed vastly from those used in experimental settings. In experiments, children are usually asked to describe a relation between two animate entities (e.g., Özge et al., 2010). On the contrary, the majority of the object relative clauses produced by the children in spontaneous speech described a relation between an inanimate and an animate entity where the subject was usually marked with a pronoun (e.g., *Bakabilir miyim yaptığına?* 'May I look at what you did?'). The combination of an inanimate head noun with a pronominal subject was shown to reduce the processing difficulty associated with object relative clauses for child and adult speakers (Kidd et al., 2007; Mak, Vonk, & Schriefers, 2006; Traxler, Morris, & Seely, 2002), since this combination is highly frequent in conversations and discourse appropriate (Fox & Thompson, 1990). Object relative clauses with pronominal subjects serve to link new information in the main clause to the information in the relative clause, which is already established in the discourse via the pronominal subject.

The high frequency of object relative clauses in child-directed speech may be another factor that eased children's productions of object relative clauses. As shown in Table 2.4, children speaking different languages generally produced the more frequent structures in their input more frequently in their own speech. Another explanation for the abundance of object relative clauses in late child speech is that the context favored their production. Since children were engaged in activities (e.g., drawing) where they paid attention to the stimuli they were presented with, the use of object relatives might have been prompted to refer to these stimuli. When children produced object relatives, they talked about the actions they did or were planning to do (e.g., *Benim yaptığımı yapabilir misin?* 'Can you do the thing that I did?'), referred to the objects on the table (e.g., *hemen benim istediklerimi vereceksin* 'you will give me what I want at once'), and referred to their conversations (e.g., *sen anlamıyorsun ki dediğimi* 'you don't understand what I said'). When they produced subject relatives, they referred to the objects (e.g., *Aynı olmayanları açıyor muyuz?* 'Do we flip the ones that are not the same?'), and what they did with those objects (e.g., *iki tane ağzı olan ata benzemiş* 'it looks like a horse that has two mouths'). Additionally, they also referred to themselves and the two other children in the room (e.g., *Bunun eşini bulan var mı?* 'Is there anyone who found the match for this?'). Hence, both subject and object relatives were successfully used to refer to the presented stimuli, but children may have produced more object relatives to refer to the actions they did or were planning to do.

Syntactic Role of the Head Noun in the Matrix Clause

Language characteristics affect how speakers use relative clauses within matrix clauses. As seen in Table 2.4, relative clauses that modified the subject of a matrix clause were fairly frequent in prenominal languages Turkish, Japanese, and Mandarin, and highly infrequent in postnominal languages English and Finnish. Previous research suggested that speakers of postnominal languages may avoid using relative clauses that modify a noun in the subject position of a matrix clause to avoid producing center-embedded structures. It was hypothesized that center-embedded clauses (e.g., the juice [that the child spilled] stained the rug) would pose more processing difficulty than left- or right-branching clauses (e.g., the child spilled the juice [that stained the rug]) (Chomsky, 1961; Kuno, 1974). Indeed, participants provide erroneous responses when paraphrasing center-embedded sentences (Larkin & Burns, 1977), and they need more time to judge center-embedded sentences for acceptability than right-branching ones where the former is further associated with greater memory load indicated by additional brain activity (Stromswold, Caplan, Alpert, & Rauch, 1996). That speakers avoid center-embedded clauses also explains why center-embedded PN relatives (see Example 9) are less frequent in prenominal compared to postnominal languages (see also Dasinger & Toupin (1994) for similar findings in Turkish). Based on these findings, one would expect OBJ relatives (i.e. where the head noun is the object of the matrix clause) not to be very frequent in Turkish since they lead to center-embedding as well. However, contrary to this expectation, the head noun mostly functioned as the object of the matrix clause in both caregivers' and children's productions. This discrepancy can be explained by the fact that Turkish allows for the dropping of the subject and has a relatively free word order. Following Ozeki and Shirai (2007), we coded OBJ relatives as center-embedded only if the relativized noun phrase was not at the sentence initial position (e.g., *sen anlamıyorsun ki dediğimi* 'you don't understand what I'm saying'). Then, only 34% of the OBJ relatives and 26% of all relative clauses in late child speech were center-embedded. Hence, supporting our other findings, children opted for simpler constructions when producing relative clauses.

The Role of Input

We assessed the role of input in children's productions via (1) examining the similarity of children's relative clauses to the ones in the input, and (2) comparing the input of high- and low-SES caregivers. We observed that older children's productions were affected by the ambient language such that both subject and object relative clauses were highly frequent in their language as in child-directed speech. Children also followed their caregivers' use regarding the function of the head noun in the matrix clause such that the head noun mostly functioned as the subject or the object of the matrix clause. In terms of the semantic and structural properties such as the animacy of the head noun, and whether the subject of the relative clause was pronominal or lexical, children's productions were also highly similar to the input (for similar results in other languages, see Arnon (2010) and Kirjavainen et al. (2016)).

We found that there was a difference between children growing up in high- and low-SES families in terms of the proportion of relative clauses they heard from their caregivers. High-SES children were exposed to more relative clauses than low-SES children. This difference may be related to the contexts that elicit the production of relative clauses. For instance, shared reading may ease the relative clause production and occur in high-SES families more frequently (Yarosz & Barnett, 2001). Another explanation is that high-SES families produce more complex language when addressing children. Previous research showed that the complexity of parental input measured by the frequency of multiclause structures was greater in middle-SES than in low-SES families (Huttenlocher, Vasilyeva, Cymerman, & Levine, 2002). More data are needed to examine the relation of SES to children's production of relative clauses.

Conclusion

By using a relatively large corpus of data, our study has shown that Turkish relative clauses, which are morphosyntactically difficult and relatively rare in the caregiver input, emerge late in children's spontaneous speech. Preschool-aged children, who were linguistically more advanced than younger children, produced relative clauses more frequently and in more complex structures that conveyed more than a single meaning to the addressee. Children's use of relative clauses was very similar to adults' use in terms of the syntactic function of the head noun in the matrix clause and in the relative clause, and the use of animate and inanimate entities within relative clauses. However, children's productions were still less complex such that most of the relative clauses were constructed with a limited set of verbs indicating that the use of relative clauses was still developing in preschool years. Our findings further suggest that language characteristics have an impact on adult speech which in turn affects child speech, and highlight the importance of studying diverse languages.

CHAPTER III

Functions of Turkish Evidentials in Early Child-Caregiver Interactions: A Growth Curve Analysis of Longitudinal Data

It is often important to convey and determine where knowledge, beliefs, and memories come from, using source monitoring abilities (Johnson, Hashtroudi, & Lindsay, 1993). Source monitoring devices in communication are used to indicate when, from whom, and through which means a speaker obtained the information being conveyed. Languages offer different means to communicate source of knowledge, and it is the linguistic marking of evidentiality that serves to specify the type of source of information conveyed in an utterance (Bybee, 1985). Evidentiality is a special grammatical system found approximately in one quarter of the world's languages, and usually implemented via closed-class verbal affixes and particles (Aikhenvald, 2004). In languages with evidentials, a distinction is made between directly and indirectly obtained information, where the latter category usually includes information obtained via language, oral or written, and information obtained through making an inference (de Haan, 2001). In some languages there may be even finer distinctions specifying the type of source of directly acquired (e.g. vision, audition) or indirectly acquired (e.g. second-hand, folklore) information (Plungian 2001; Willett, 1988).

Turkish is a language with evidential markers, where one has to choose between two verbal morphemes *–DI* and *–mIş* when uttering a sentence with past reference. The speaker has to specify in any sentence with reference to a past event whether the information conveyed in a sentence was accessed directly or indirectly. While the past tense inflection -*DI* is neutral, expressing what the speaker takes to be factual knowledge, it is considered to be a direct experience marker in view of its opposition to the evidential *–mIş* within the tense-aspect-modality system. To illustrate, if you wish to express that the professor arrived at her office, you have to make a choice between the sentences presented in the examples below. Example (1) indicates that the speaker has first-hand information about the content, such as observing the professor walking into her office.

(1) Hoca ofis-in-e gel-**di**.
professor office-POSS-DAT come-PAST.3SG
'The professor came to her office (I saw her).'

If the speaker does not see the professor entering her office but infers this upon seeing that the door of her office is open, then the sentence in example (2) with the *–mIş* morpheme is the correct choice. The *inference* meaning that *–mIş* encodes is different from logical deduction from existing knowledge, but is rather based on some observable evidence, implying that the speaker made an inference about a process that led to that evidence. In Example (2), seeing the office door open is the evidence for the speaker to make the assumption that the professor arrived at her office.

(2) Hoca ofis-in-e gel-**miş**.
professor office-POSS-DAT come-PAST-EVID.3SG
'The professor came to her office (I inferred it from evidence/I heard it from someone).'

Finally, the speaker can also obtain information about the professor from other people or sources such as newspapers or television. When conveying this *hearsay* information, again the verbal form in Example (2) is used. Moreover, unlike *–DI*, the event time can be non-past In example (3), the event time is specified by the future marker *–EcEk,* and the particle *–mIş* just indicates hearsay.

(3) Hoca ofis-in-e gel-ecek-**miş**.

professor office-POSS-DAT come-FUT-EVID.3SG

'The professor will come to her office (I heard it from someone).'

The functions of the *–mIş* particle are not limited to inference and hearsay. This verbal affix is particularly interesting because it is also used to talk about the nonfactual realm as in stories, folktales, and pretend play, and in directly encountered states of affairs experienced by the speaker as new or unexpected information. By pragmatic extension, it is used in the expression of surprise, irony, and compliment (Aksu-Koç & Slobin, 1986; DeLancey, 2001; Slobin & Aksu, 1982). Hence, the *–mIş* affix expresses different degrees of psychological distance to the event encoded in language, and therefore, it is a marker of speaker stance as well as information source (Aksu-Koç, 1988, 2016; Johanson, 2003).

The only existing observational study conducted on the acquisition of Turkish evidentials (Aksu-Koç, 1988) examined the speech of three children between 21 and 30 months while interacting with an experimenter. This study revealed that the children first produced the direct experience marker –*DI* before 2 years of age, and the production of the –*mIş* affix came only a few months later. The indirect experience marker was usually first used in contexts of shared attention with the caregiver to talk about perceptually available states or properties of objects just noticed as new information. The inferential function emerged later and was at first used for simple inferences based on changes of state in familiar objects. Children then started using the form in its hearsay function and thus could convey information obtained from other sources.

Experimental studies conducted on the comprehension and production of the –*DI* and –*mIş* markers showed that children are able to produce these suffixes in experimental environments at later ages than in spontaneous speech. To examine use of the inference function, Aksu-Koç (1988) presented children events with toys where they either viewed all phases of an event or just the end state of an event and therefore had to infer the process that led to the end state. The ability to use the form in its hearsay function was examined in a task where children had to role play for one doll and report information heard from another doll to a third doll. Children used the direct experience marker -*DI* at earlier ages and more correctly compared to the indirect experience marker -*mIş*. The inferential function of the –*mIş* marker was found to be produced prior to its hearsay function, as was found for semi-naturalistic interaction data. Similar findings were reported by Ögel (2007). In Ozturk and Papafragou's study (2016), children watched videos of the end state of an event in the inference condition (e.g. a child looking sad and holding an ice cream cone while looking at an ice cream on the floor) and videos of someone telling an event in the hearsay condition. Contrary to Aksu-Koç's (1988) findings, children were more successful in using hearsay at earlier ages than inference, and overall children did not perform very well even at the later ages of 6 and 7. Finally, Ünal and Papafragou (2016) used a similar version of Aksu-Koç's tasks (1988) and observed that 3-year-olds were in general successful in producing the indirect experience marker in inference trials. However, comprehension followed production, which was taken to reflect the lack of perspective-taking skills necessary to reason about the nature of the speaker's information source.

When we turn to crosslinguistic investigations of spontaneous speech, we see different patterns for different languages with the common finding that the markers for direct experience emerge earlier than the markers indicating indirect experience. Lee and Law (2000) examined spontaneous speech of three Cantonese-speaking children for a year, with the starting ages of observation ranging from 1;7 to 2;8. Only three instances of the hearsay marker were found, and children did not use the inference marker at all. Both hearsay and inference markers were also rare in child-directed speech as opposed to the frequent direct experience marker. Choi (1991) looked at three Korean-learning children's speech (aged between 1;8 and 2;11) in their home environment and observed a similar order of acquisition where the marker for direct experience emerges first before 2 years of age and is followed by the appearance of the hearsay/indirect experience marker between 2;0 and 2;6 years. Japanese children also begin acquiring these markers of their language between 2;0-3;0 years of age (Clancy, 1985; Matsui & Yamomoto, 2013; Shirai, Shirai & Furuta, 2000). Finally, Quechua-speaking children start producing the direct experience marker first around 2 years of age, but with the purpose of conveying certainty (Courtney, 2008). Then at around age 4, they use this form to convey information directly obtained while marking information gained through inference with a different form. The hearsay marker was rare in child speech between 4 and 8 years of age.

Our goal in this paper is to pursue a comprehensive observational study in Turkish by making use of a relatively large, regularly collected longitudinal corpus of child-caregiver interactions, and provide answers to the following questions: (1) How frequently is the indirect experience marker *–mIş* used in child-caregiver interaction and how does this frequency change over time, (2) how are different functions of *–mIş* distributed in child and caregiver speech, (3) in which order do these different functions emerge in child speech and does this order depend on the input the child receives. Additionally, we also closely examined nonfactual uses that were very common in the child-caregiver interactions but have yet not received much attention as a separate category in the literature. Finally, we explored whether the evidential usage differs in families with different socioeconomic standing.

Corpus

In this study we used a longitudinal video corpus that was established to investigate the development of communication and language skills in Turkish-speaking children (Küntay, Koçbaş, & Taşçı, 2015). The corpus consisted of video recordings of 8 children (between 8 and 36 months) and their transcriptions during communication with their caregivers (e.g. mother, grandmother, babysitter) in their home environment. For this study, we examined the data of 6 children (4 girls and 2 boys), since the data of one child was terminated at the 21st month when the evidential marker was just emerging and the recordings of one other child were not yet fully transcribed at the time of the analysis. Three of the children came from low SES families (parental educational attainment of 8, 8, and 5 years), and three came from high SES families (parental educational attainment of 15, 11, and 15 years, respectively). The families were each visited for a one-hour recording of daily activities (e.g. eating, playing) twice a month for 29 months (see Table 3.1 for duration of recording for each child).

Coding

We first extracted utterances that contain the suffix *–mIş* from the transcriptions. An R script was written to obtain the utterances from the sample that contained the allomorphs of *–mIş* (*mış, miş, muş, müş*), pronunciations that included a lengthened vowel (*mı:ş, mi:ş, mu:ş, mü:ş*), and child-like pronunciations (*mıç, miç, muç, müç*). All utterances produced by the researcher and found in adult-to-adult conversations were eliminated, leaving only child speech (CS) and child-directed speech (CDS). Utterances where the particle was used in its participial function (e.g. *kuru-muş çiçek* 'dried flower') and when it had an aspectual usage preceding another tense-aspect-modality marker (e.g. *git-miş-ti* 's/he had gone') were separated and not coded since the particle is devoid of its evidential meaning in these contexts (Göksel & Kerslake, 2005; Slobin & Aksu, 1982). The few utterances which contained an idiom with an evidential were coded as *idioms* but not analysed further.

Each remaining utterance was coded in terms of which source of information it denotes, and which pragmatic function it conveys. If an utterance contained more than one *–mIş*, each was coded with respect to these dimensions. The first and the second authors each coded half of the utterances and checked the coding of the other half. In the case of unresolved disagreements after discussions, the third and the fourth authors were consulted. The following sections provide more details about coding. Figure 3.1 summarizes the coding scheme.

Source of Information

We coded each evidential usage of the *–mIş* particle in terms of four categories of source of information: (1) perceptual, (2) inference, (3) hearsay, and (4) nonfactual. A *perceptual*-usage was coded when the utterance was about the here and now. The purpose of the speaker is to indicate a feature of an object or event that is either in active joint attention of the child and the caregiver or to draw the addressee's attention to such a feature of an object, event, or person (e.g. *baba gel-miş* 'daddy came (home)' upon seeing the father at the door, C2, CDS, 11 months). [10] The perceptual usage shows that the indirect experience marker can be used in circumstances where the speaker has direct access to an event or information. In situations where the speaker wishes to indicate a new observation, a new experience, or a revision of the speaker's earlier belief, the perceptual function of *–mIş* can be used instead of the direct experience

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[10] Example format is as follows: Turkish utterance - 'English translation' - Explanation of the context if necessary - Abbreviation of child identifier whose data contains this utterance - Whether the utterance comes from CS or CDS - Age of the child when the utterance was recorded.

marker –*DI* (Göksel & Kerslake, 2005; Slobin & Aksu, 1982).

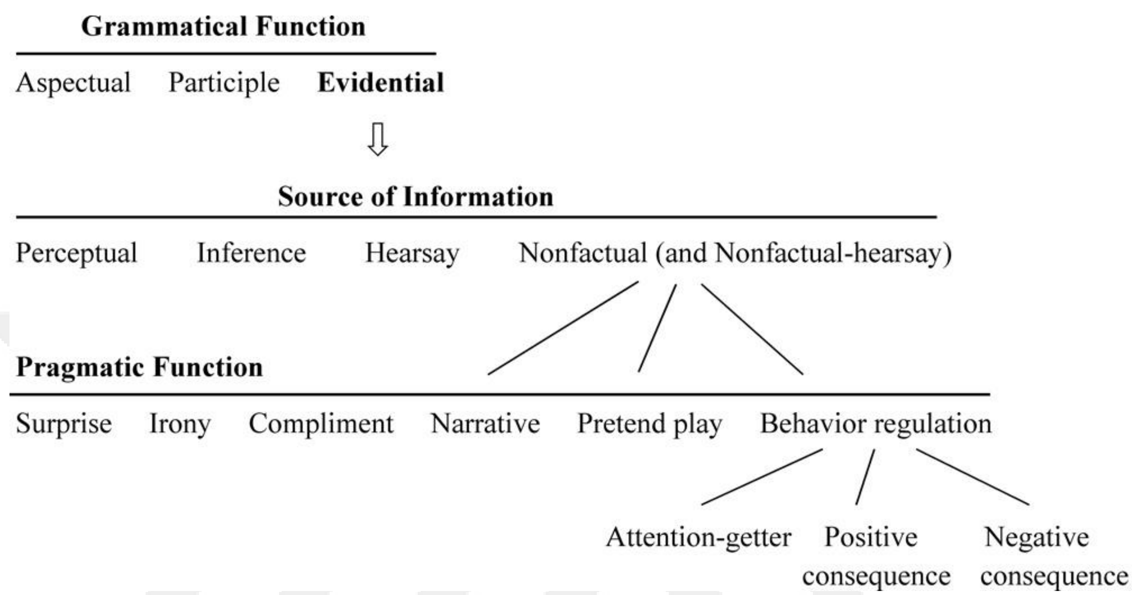

Figure 3.1. Coding scheme for each utterance containing the *–mIş* particle.

The *inferential* function was coded when talking about a past process inferred from a present observation (e.g. *abla mı al-mış bunu?* 'did she buy this?' while looking at a new object in the living room after the arrival of the researcher, C1, CDS, 33 months). The *hearsay* function was coded if the utterance contained information acquired from another person or source via speech (e.g. *babam bana bir şey al-mış ama eve gelince gösterecek-miş* 'daddy (reportedly) bought me something but he is (reportedly) going to show it to me when he gets home', C5, CS, 36 months). An utterance was coded as *nonfactual* if it contained information that does not have any basis in reality. Utterances that contained storytelling, children's songs, and nonfactual events in the play environment such as role assignment fell under this category (e.g. *sen öğretmen-miş-sin tamam mı?* 'you'll be the teacher, ok?', C6, CS, 36 months).

As we show with this corpus for the first time in the literature, another function of the nonfactual *–mIş* is to regulate the addressee's behavior. This can be done in several ways, for instance the speaker may direct the addressee's interest to an event, person, object, or idea to divert attention away from the current focused behavior or object (e.g. *su kalma-mış bit-miş* 'we are out of water' to stop the child from playing with water, C3, CDS, 20 months). We classified such utterances under the nonfactual category. Sometimes, nonfactual information is presented in hearsay form where the speaker acts as if she acquired the presented information from another source (e.g. *ablanın başı ağrıyor-muş* 'she has a headache' to stop the child from making noise with his toys, C4, CDS, 28 months). We coded these utterances as *nonfactual-hearsay* and analysed them under the nonfactual category. An alternative coding for some of the nonfactual utterances could be treating them under the hearsay category. Matsui and Yamamoto's analysis (2013) of the use of the Japanese sentence-final hearsay particle *tte* in imaginary quotations in one child's interaction with her mother is an example. Here, imaginary quotations refer to utterances that the speaker produces, as if quoting the utterances of imaginary participants such as toys and animals. We preferred a different coding scheme for this type of utterances, since we think that the nonfactual category is essential in child-caregiver interaction, and some of the nonfactual utterances (e.g. events in pretend play) cannot be classified under the hearsay category.

Finally, speakers sometimes made errors in indicating source of information, using the evidential *–mIş* instead of *–DI* for the events that they directly experienced (e.g. *şunu ısır-mış* '(she) has bitten this one' when showing her finger that her cousin bit, C1, CS, 32 months).

Pragmatic Function

Each evidential utterance was further coded as to whether it conveys a pragmatic function. Based on the literature about Turkish evidentials and our observations in the present corpus, we used the following categories for coding pragmatic function: (1) narrative, (2) pretend play, (3) behavior regulation of the addressee, (4) surprise, (5) irony, and (6) compliment.

We coded each nonfactual utterance as narrative, pretend play, or behavior regulation of the addressee. Utterances that fell under other source of information categories did not always possess one of the pragmatic functions listed in Figure 3.1. Telling a story or a tale, inventing a story by looking at a picture or an object, singing children's songs were treated as *narrative*. Talking about imaginary events and features in the play environment was classified as *pretend play*. Finally, utterances aimed at changing the addressee's behavior were coded as *behavior regulation of the addressee*. We identified three major ways of regulating the addressee's behavior through the usage of the evidential marker. These are orienting the addressee's attention to something other than their current focus, talking about positive outcomes of desired behavior, and mentioning negative outcomes of undesired behavior. So, we coded these different categories as (1) attention-getter (e.g. *kuş gel-miş*, 'the bird came' to distract the child from taking the pacifier, C3, CDS, 17 months), (2) positive consequence (e.g. *sen onu ye çıkacak-mış*, 'if you eat that, (the rabbit) will come out' to encourage the child to eat some food, C1, CDS, 31 months), and (3) negative consequence (e.g. *abla* *gör-müş yiyor-muş ufak bebekleri*, 'she (=research assistant) saw that it eats small babies' to stop the child from leaving the room with her bicycle, C5, CDS, 27 months). Attention-getters were not only used in nonfactual but also in perceptual and sometimes in inferential and hearsay utterances (e.g. *bak burada neler var-mış* 'look what we've got here' to make the child look up when drinking water, C5, CDS, 8 months).

Utterances that were classified as perceptual, inference, and hearsay sometimes conveyed surprise (e.g. *ne yap-mış-sınız evime* 'what have you done to my house', C6, CDS, 20 months), irony (e.g. *ne güzel şeyler öğret-miş* '(she) taught you some nice things' after the child uttered some dirty words, C3, CDS, 30 months), and compliments (e.g. *çok güzel yap-mış-sın anne* 'you did it very well mom' when talking about a drink that her mother prepared, C2, CS, 35 months).

Data Analysis and Presentation

We used growth curve analysis to examine the change of the variables of interest over time. Growth curve analysis is a mixed-effects analysis suitable for longitudinal data and it allows the analysis of individual deviations from the average trajectory. Following the instructions in Singer and Willett (2003), we performed a step-by-step analysis that included building and testing models with increasing complexity.

For each analysis, an *unconditional means model* (i.e. a model without predictors) was constructed first that partitions the total variation across people without regard to time. This model is also referred to as a one-way ANOVA with random effects where children or caregivers are allowed to have different intercepts, i.e. the individual children and caregivers were allowed to differ from each other with respect to their starting points but not the slope of their trajectory in time. This model indicates whether there is systematic variation that is worth exploring with more complex models.

In the second step, two models were constructed and compared statistically. One of these models was a linear regression with time as the predictor variable. The other model was the *unconditional growth model* (i.e. a model that has only time as the predictor variable) that allows the partitioning of the variation across both people and time. This growth model has time as a fixed effect and allows children/caregivers to have random intercepts. Comparison of these two models clarifies whether including random effects is necessary at all. If the comparison is not significant, then the linear regression model is preferred. If including random effects provides an advantage, then in the next step, a more complex model is built which additionally allows for random slopes, in other words, different slopes for different children/caregivers. Another comparison between the growth model with random intercepts and the growth model with random intercepts and slopes determines whether the latter model provides an improvement over the former. If it does, then one can include level-2 predictors (i.e. between-subjects factors such as SES) if necessary and/or change the geometric form of the model from linear to polynomial if based on the distribution of data points one is led to believe that a polynomial form would better fit the data. For instance, a second-order polynomial (i.e. quadratic) model fits a quadratic function to data points instead of a line. A comparison between linear and quadratic models based on a likelihood ratio test that compares the goodness of fit of the two models determines which form provides a better fit for the data.

The growth curve model analyses were run with an R script utilizing *nlme* and *lme4* packages (Bates, Maechler, Bolker, & Walker, 2014; Pinheiro, Bates, DebRoy, Sarkar, & R Core Team, 2016). Graphics were created with packages *lattice* (Sarkar, 2008), *directlabels* (Hocking, 2014), and *ggplot2* (Wickham, 2009). Model comparisons for random effects were done by using the *RLRsim* package (Scheipl, Greven, & Kuechenhoff, 2008) (see Supplemental Material in Appendix D for an example R script with comments).

We first present the analyses for the amount of speech in terms of the number of utterances directed to and produced by each child, and its change over time with the purpose of providing information about individual differences. Secondly, we present our findings about the frequency and proportion of evidentials in CS and CDS by monitoring individual changes over time. Then, we turn to the use of different source of information categories, and when they emerge in child speech. Finally, we present different types of pragmatic uses of the nonfactual category and how caregivers of low- and high-SES differ from each other with respect to these pragmatic functions. Table 3.1 presents the mean number of utterances per session produced by and directed to each child, and the number and proportion of the utterances that contain an evidential.

Table 3.1

Mean Number of Child-Directed and Child-Produced Utterances per Session and the Proportion of Evidentials in Speech for Each Child

Child	Sex	SES	Hours of recordings	Mean number of utterances per session		Total number of evidentials across all sessions		% Evidential *–mIş* within all utterances	
				CDS	CS	CDS	CS	CDS	CS
C1	F	low	57	114.3	176.5	194	360	3.0	3.6
C2	F	low	56	455.4	317.1	900	253	3.5	1.4
C3	M	low	41.75	379.8	338.7	555	128	3.4	0.9
C4	M	high	40.5	572.7	360.8	894	376	3.9	2.6
C5	F	high	51	386.9	264.1	1172	372	5.9	2.8
C6	F	high	46	493.7	295.4	1044	334	4.7	2.5

The corpus from which we extracted the evidential marker included 83,580 child-produced and 113,301 child-directed utterances. 4,759 of child-directed (4.2%), and 1,823 of child-produced (2.2%) utterances contained the evidential *–mIş*, and were further coded.

Results

Amount of Speech in CS and CDS

First, we analysed how the mean number of utterances changes over time in CS and CDS. For CS, the first step in this analysis was to construct an unconditional means model to examine the partitioning of within- and between-person variation. An intraclass correlation coefficient of 0.08, calculated by dividing the between-person variance to total variance, indicated that 8% of the total variation in the amount of speech produced by children was attributable to the differences between children. Then, a linear unconditional growth model was built where the time dimension (8 to 36 months) was included as a fixed effect, and children were allowed to have random intercepts. This random intercept model was significantly different from a linear regression model without random effects ($p < .001$). Hence, the inclusion of random effects provided a better model fit. Next, we checked whether the addition of random slopes would provide a better fit. The model with both random intercepts and slopes to allow for individual variation for starting points and slope of the trajectory in time was significantly different ($p = .014$) from the model with only random intercepts. Furthermore, 69% of the within-person variation was associated with linear time. To calculate this value, the difference between the residual variance in the unconditional means model and in the unconditional growth model with random intercepts and slopes was taken and divided by the residual variance in the unconditional means model. Since plotted graphs of the raw data (see the Figures 3.7 to 3.10 in Appendix E) suggested that a quadratic model would be a better fit, next we built a quadratic model with time as a fixed effect and child random effects on all time terms. We used a second-order orthogonal polynomial to capture the shape of the change in time. Using orthogonal polynomials is beneficial to avoid collinearity problems. Since the linear unconditional growth model is nested within the quadratic model, a comparison of model fit indices of the linear and quadratic models was possible. This comparison showed that the quadratic model provided a better fit with lower AIC and BIC values, $\chi^2(4) = 27.9$, $p < .001$. Adding SES as a predictor in the model did not improve model fit; low- and high-

SES children did not differ from each other significantly with respect to the average amount of speech and trajectory in time. Table 3.2 shows the comparison of different models in terms of model fit. The selection of the models depended on the model fit indices Akaike (AIC) and Bayesian information criteria (BIC) where models with lowest AIC and BIC values were selected for CS and CDS.

In the preferred quadratic model, there was a significant effect of the linear term (*Estimate* = 1927.4, *SE* = 172.3, $p < .001$), indicating an increase in the mean number of utterances over time when averaged across children. The degree of curvature did not vary significantly on the average, i.e. the speed of development did not change across time on the average.

The preferred model is plotted in Figure 3.2. In this figure, the bold line indicates the average curve of the children. The other curves correspond to individual children's growth curves. Although the children did not differ from each other much in the earlier months, the differences began to emerge in later months. Some children increased the amount of their speech slowly but steadily, whereas others showed a faster increase early on followed by a slower increase or a decrease in later months.

Table 3.2

Comparison of Linear and Quadratic Models for the Amount of Speech in CS and CDS (Lower AIC and BIC Values Indicate Better Fit. Best Fitting Models are shown in bold)

Data	Model #	Model	df	AIC**	BIC	logLik
CS	Model 1	Linear model (FE*: time)	6	2060.8	2079.5	-1024.4
	Model 2	Quadratic model (FE: time)	10	2040.8	2072.1	-1010.4
	Model 3	Quadratic model (FE: time and SES)	11	2042.6	2077.0	-1010.3
	Model 4	Quadratic model (FE: time, SES, and time-SES interaction)	13	2040.2	2080.8	-1007.1
CDS	Model 5	Linear model (FE*: time)	6	2233.9	2252.6	-1110.9
	Model 6	Quadratic model (FE: time)	10	2213.3	2244.6	-1096.7
	Model 7	Quadratic model (FE: time and SES)	11	2203.1	2237.4	-1090.5
	Model 8	Quadratic model (FE: time, SES, and time-SES interaction)	13	2204.5	2245.1	-1089.2

**FE: Fixed effect*
**AIC: Akaike information criterion; BIC: Bayesian information criterion

For the amount of speech in CDS, we applied the same analytic procedure. The intraclass correlation coefficient in the unconditional means model indicated that 40% of the total variation was attributable to differences between caregivers. The unconditional growth model with random intercepts for each child's caregivers was significantly different from the linear regression model ($p < .001$). This showed that inclusion of individual variation improved the model fit. Therefore, the unconditional growth model with random intercepts and slopes was built and compared to the model with random intercepts only. The former provided a better fit ($p < .001$), and 14% of the within-person variance was associated with time. Again, the inspection of the plotted raw data suggested that a quadratic model could explain the data better. A model with a second-order orthogonal polynomial with time as a fixed effect and child random effects on all time terms provided a better fit for the data compared to the linear model, χ^2 (4) = 28.5, $p < .001$ (see Table 3.2 for model comparisons). When SES was included as a fixed effect in the model, the new model was significantly different from the model without SES effects, χ^2 (1) = 12.3, $p < .001$. However, a model with SES interaction effects did not provide a better fit.

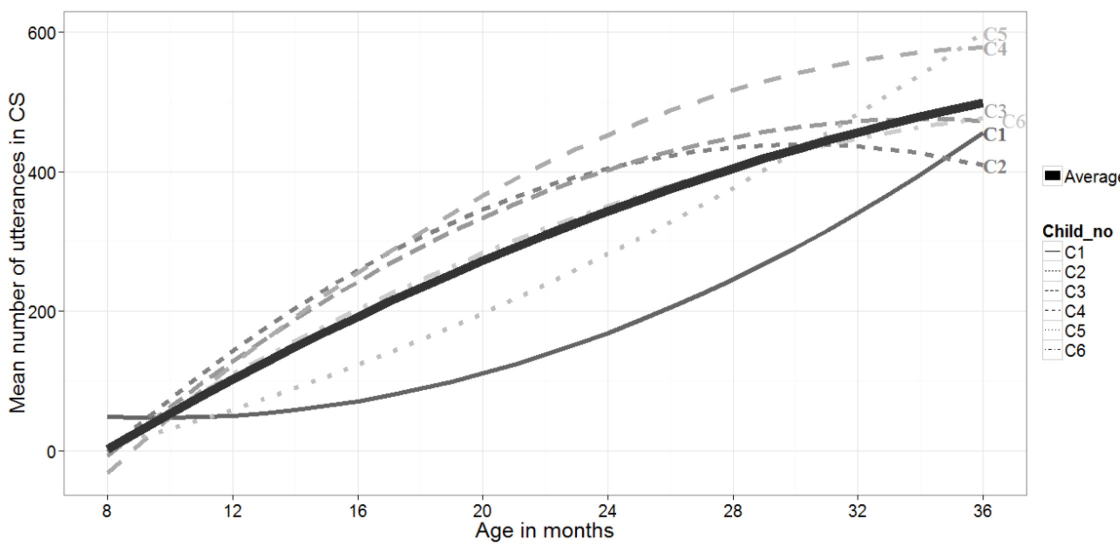

Figure 3.2. Estimated individual growth curves for the mean number of utterances in CS. Average curve is drawn with a bold line.

Therefore, the model with SES and time as fixed effects, and child as random effects on all time terms was selected. The fixed effect for the linear term of time was not significant, i.e. no increase or decrease was observed in the mean number of caregiver utterances over time when averaged across caregivers. The fixed effect for the quadratic term of time was also not significant indicating a stable rate of change across time averaged across children. However, the fixed effect for SES was significant (*Estimate* = -311.5, *SE* = 54.8, *p* = .005) indicating high-SES caregivers had higher amount of speech directed to the children on average than low-SES caregivers.

The model is plotted in Figure 3.3. Caregivers varied greatly in their average amount of speech, and also the form and speed of change over time. As Figure 3.3 shows, C1 is the child who consistently receives the least amount of input from her caregivers. Trajectories for C1, C5, and C6 are similar in that there is a downward trend starting from early months. On the other hand, for C2, C3, and C4, there is an increase in the amount of input in the earlier months, followed by a downward trend in the later months.

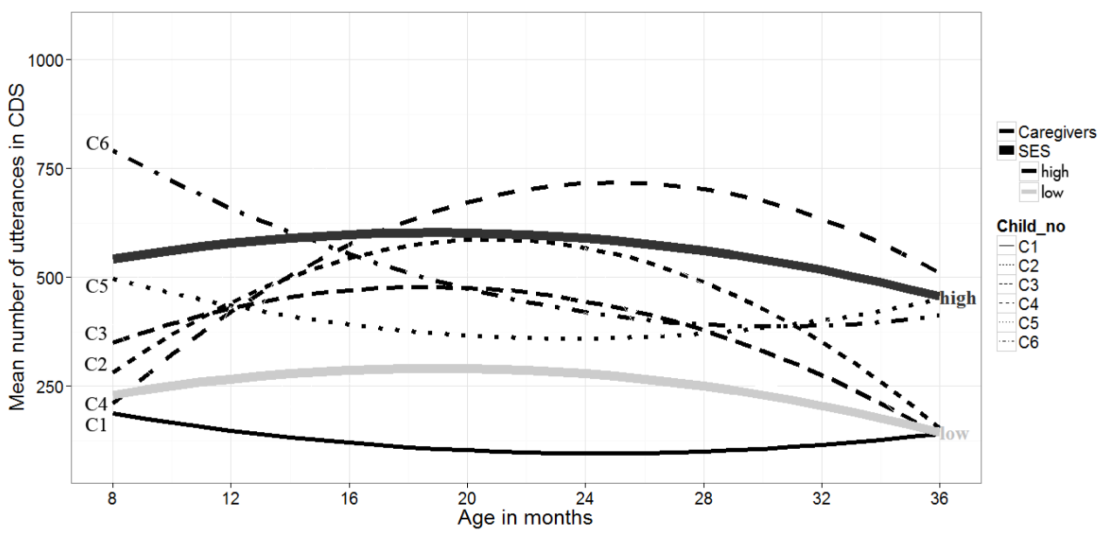

Figure 3.3. Estimated individual growth curves for the mean number of utterances in CDS. Average curves for high- and low-SES families are drawn with a bold line.

Use of the Evidential –mIş in CS and CDS over the Course of Time

Table 3.1 shows the frequencies and proportions of the evidential *–mIş* in CDS and CS for each child. To capture the change in time, we again used growth curve models. For CDS, we first constructed the unconditional means model, which indicated that 6% of the total variation in caregivers' usage of the evidential marker was associated with individual differences among caregivers. The unconditional growth model with time as fixed effect and random intercepts was different from a linear regression model ($p < .001$). In other words, the inclusion of random effects improved model fit. It was calculated that 40% of the within-person variation was associated with time. An improvement to the model was made with random slopes ($p = .007$). In the next step, we built a second-order orthogonal polynomial model with time as fixed effect and child as random effect on all time terms. This model provided a better fit for the data than the linear model, $\chi^2(4) = 41.1$, $p < .001$ (see Table 3.3 for model comparisons). Adding SES as a predictor did not improve model fit.

In the selected quadratic model, fixed effect for the linear term was significant (*Estimate* = 0.22, *SE* = 0.06, $p < .001$), indicating an increase in the percentage of evidentials over time averaged across caregivers. Fixed effect for the quadratic term was not significant meaning that the average rate of change was stable across time.

Table 3.3

Comparison of Linear and Quadratic Models for the Proportion of Evidentials in CDS (Lower AIC and BIC Values Indicate that Model 2 is the Best Fit)

Model #	Model	df	AIC	BIC	logLik
Model 1	Linear model (FE*: time)	6	-732.9	-714.2	372.5
Model 2	Quadratic model (FE: time)	10	-766.0	-734.8	393.0
Model 3	Quadratic model (FE: time and SES)	11	-765.1	-730.7	393.5
Model 4	Quadratic model (FE: time, SES, and time-SES interaction)	13	-762.8	-722.2	394.4

**FE: Fixed effect*
**AIC: Akaike information criterion; BIC: Bayesian information criterion

Caregivers differed from each other with respect to their use of evidentials across time as depicted in Figure 3.4. Caregivers of two children (C1 and C4) showed a steady increase, where caregivers of three children (C2, C3, and C6) showed an increase only after a certain time point. In contrast to other caregivers, C5's caregivers demonstrated an increase up to a time point and then a decrease. This pattern was observed due to the fact that caregivers of C5 produced the evidential *–mIş* much more (10.1%) than other children's caregivers (2.7%) between months 18 and 22. Between these months, C5's caregivers used *–mIş* during pretend play (31.3%) much more than the other caregivers (for C1: 0%, C2: 13.2%, C3: 5.4%, C4: 11.2%, C6: 18.7%).

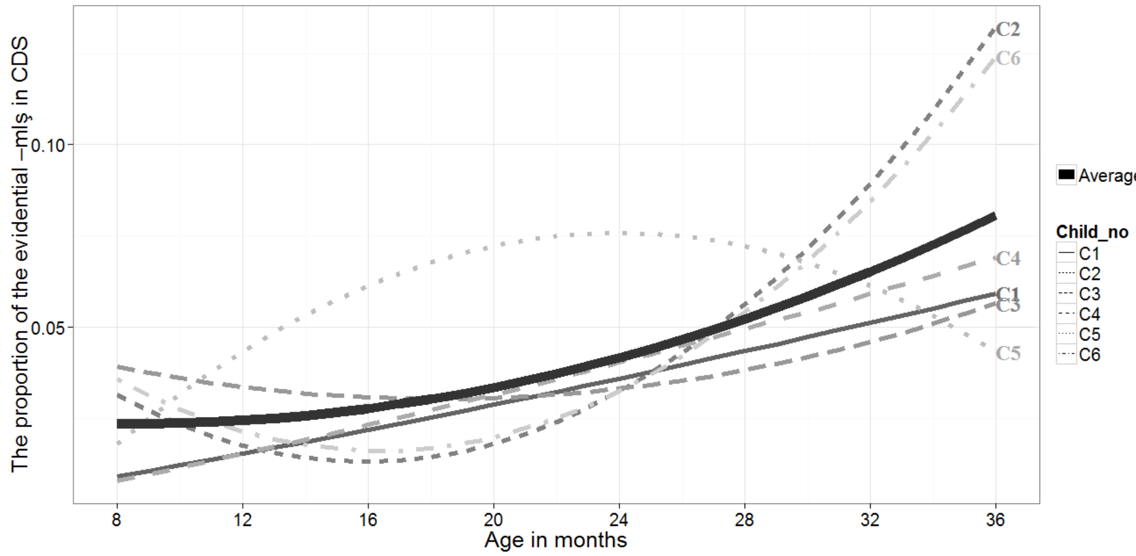

Figure 3.4. Estimated individual growth curves for the proportion of evidentials in CDS. Average curve is drawn with a bold line.

Finally, for child speech, 6% of the total variation in the usage of the evidential marker was associated with individual differences among children in the unconditional means model. However, a comparison of the linear regression model and the unconditional growth model with time as fixed effect and random intercepts for children did not yield a significant difference (p = .07). Thus, including individual deviations among children in the model did not improve model fit, and variations among children were negligible. A linear regression model was sufficient to explain children's use of the evidential *–mIş* over time. In this model, the fixed effect of time was close to significant (*Estimate* = 0.001, *SE* = 0.001, p = .057), indicating an increasing trend in terms of the percentage of the evidential *–mIş* in child speech over time. Figure 3.5 depicts this model where individual data points and a fitted regression line with a positive slope are shown. Time explained a small proportion of variance in children's use of the evidential marker, R^2 = .04. Including SES in the model did not improve model fit.

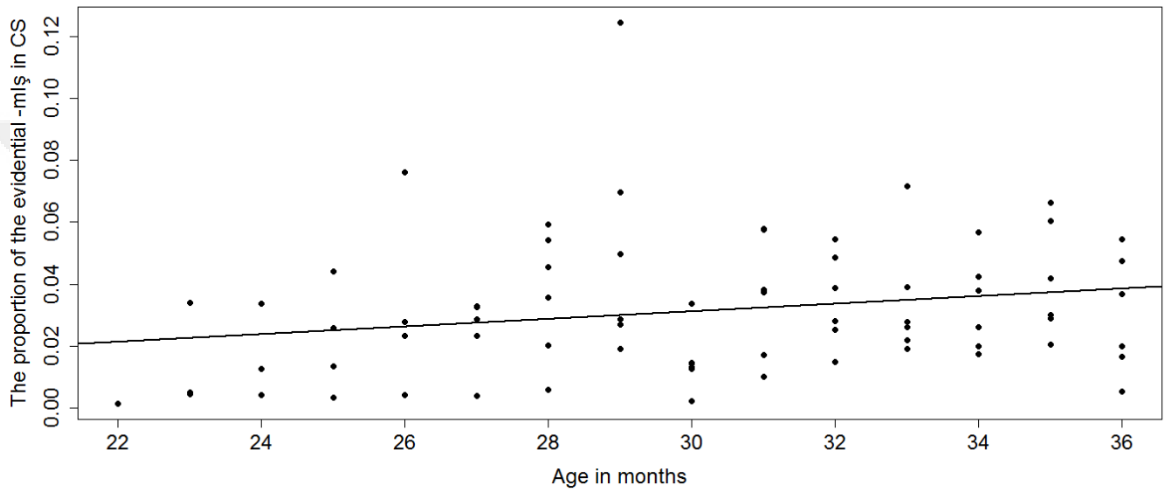

Figure 3.5. A linear regression model for the proportion of the evidential *–mIş* in CS over time. This model does not take individual variation into account. Individual data points and the fitted regression line are shown.

Source of Information

Here we present our analyses about the functions of *-mIş* to convey different types of information source. The interrater reliability for the raters calculated on 14% of evidential utterances was found to be κ = .93 (95% CI, [.91 to .98]), $p < .001$. Table 3.4 shows the distribution of the perceptual, inference, hearsay, and nonfactual uses for each child in CS and CDS.

Mean distributions of different types of source of information are highly similar in CDS and CS (see Table 3.4), indicated by a high Pearson correlation $r(4) = .99$, $p = .005$. On average, nonfactual uses are the most common, followed by perceptual, inferential, and hearsay uses. When we look at individual cases, we again observe that nonfactual uses are the most common followed by perceptual uses. One exception is C1, where nonfactual uses are less frequent compared to the other children, and do not constitute the most common category. The function of inference is more commonly used than hearsay for five children in CDS and four children in CS.

Both children and caregivers committed some errors by using the indirect experience marker instead of the direct experience marker when they speak about events that they directly experienced. Differently from other children, C1 has a high error rate, which is close to 20% in her speech. This high error rate may be due to the low amount of input the child receives from her caregivers with respect to the other children (see Figure 3.3). However, errors in other children's uses do not seem to be related either to the amount of input in CDS (as indicated by the mean number of total utterance and by the lack of a significant Pearson correlation when C1 is removed as an outlier) or to the percentage of the evidential marker *–mIş* in CDS. Another type of error observed early on is the use of the direct experience marker *–DI* in contexts that call for the use of *–mIş* (Aksu-Koç, 1988). Here, we cannot report on these errors since only those utterances marked with *–mIş* were included in the analysis.

Table 3.4

Percent Occurrence of Each Type of Source of Information out of All Utterances Containing the Particle –mIş within CDS and CS for Each Child

	Perceptual %	Inference %	Hearsay %	Nonfactual Uses %	Errors %
CDS					
Average	24.2	15.8	9.9	49.6 (7.7)	
C1	32.5	16.0	19.5	32.0 (12.0)	-
C2	23.3	19.4	8.4	48.9 (11.1)	-
C3	28.2	17.0	10.8	41.1 (9.1)	3.0
C4	18.5	17.7	9.9	53.7 (4.4)	0.1
C5	22.6	13.4	6.6	57.2 (5.6)	0.2
C6	20.2	11.3	4.2	64.3 (4.1)	-
CS					
Average	23.2	13.0	11.6	47.4 (1.8)	
C1	25.3	12.5	24.8	17.7 (0.3)	19.6
C2	26.6	14.6	11.2	46.1 (0.4)	1.5
C3	9.1	3.8	14.4	69.7 (3.0)	3.0
C4	23.3	18.0	4.6	52.3 (1.8)	1.8
C5	28.4	8.9	6.2	54.1 (5.4)	2.5
C6	26.6	19.9	8.1	44.8 (-)	0.6

Note. Values in parentheses denote nonfactual-hearsay uses.

Age of Emergence

All six children were able to produce the indirect experience marker before age 3, but they all started to produce it at different time points. In the analyses we report below, we focused on two time points where (1) children started using the marker appropriately (i.e. not instead of the *–DI* marker to indicate directly experienced events) for the first time and (2) children started using the marker productively, i.e. non-imitatively, for the first time. We defined a productive usage as the ability to produce the marker without using it with the same verbal root found within previous 15 utterances of the caregivers' speech. Table 3.5 lists these two time points in months for each child.

Table 3.5

First Month of Productive Usage for Each Child and for Each SOI Function (First Month of Correct Use Shown in Parentheses)

	Source of information			
Child	Perceptual	Inference	Hearsay	Nonfactual uses
C1	28 (28)	28 (28)	28 (28)	27 (27)
C2	25 (25)	27 (26)	28 (26)	28 (26)
C3	29 (29)	36 (28)	34 (32)	29 (28)
C4	26 (26)	26 (23)	27 (24)	25 (23)
C5	25 (23)	27 (25)	26 (25)	24 (24)
C6	23 (23)	26 (23)	28 (24)	25 (22)

Children used the perceptual and nonfactual functions at first. Inference was productively used at the same time as or after the perceptual usage. No specific order appeared among the emergence of hearsay and inference. For three of the children, inference emerged earlier; for two, hearsay came first; and for one, both functions emerged at the same time.

Children in the high-SES group (M = 22.7, SD = 0.6) produced the marker correctly for the first time at younger ages in comparison to the low-SES group (M = 26.7, SD = 1.5), $t(4)$ = 4.2, p = .013, d = 3.5.

Pragmatic Functions of Nonfactual Usage

Since the number of utterances that were coded as surprise, irony, and compliment was very low (2.9% and 1.1% of the evidentials in CDS and CS), we did not conduct any analyses for these categories of pragmatic function. Instead, we mainly focused on the pragmatic functions of nonfactual uses. The interrater reliability for the raters calculated on 12% of the nonfactual utterances was found to be $\kappa = .98$ (95% CI, [.97 to .99]), $p < .001$.

As we explained before, the following categories were used to code the nonfactual utterances: Narrative, pretend play, attention-getter, positive consequence, and negative consequence. Table 3.6 shows the distribution of these categories in CS and CDS.

Table 3.6

Percent Occurrence of Each Pragmatic Function of the Nonfactual Usage out of All Utterances with Nonfactual Usage, within CDS and CS for Each Child

		Activities		Behavior regulation of the addressee		
Child		Narrative %	Pretend play %	Attention-getter %	Positive consequence%	Negative consequence%
C1	CDS	12.5	7.8	45.3	17.2	17.2
	CS	12.3	83.1	4.6	-	-
C2	CDS	40.9	21.6	18.9	4.6	12.7
	CS	90.2	8.9	-	-	0.8
C3	CDS	7.7	28.9	53.6	1.3	7.7
	CS	38.0	62.0	-	-	-
C4	CDS	56.1	35.1	5.8	1.0	1.4
	CS	63.7	34.3	0.5	-	-
C5	CDS	32.6	49.8	11.8	0.7	4.6
	CS	30.6	66.7	0.5	0.5	1.8
C6	CDS	21.0	68.2	9.0	1.0	0.8
	CS	33.6	64.5	0.7	-	-

Note. Some rows do not add up to 100% since some of the nonfactual uses were idioms and not classifiable under any category.

For further analyses, we merged these functions under two main categories: Since narrative and pretend play uses occurred mostly during book reading, story-telling, and talking about imaginary events in the play environment, these were classified as '*activities*'. On the other hand, since attention-getter, positive and negative consequence uses occurred for directing the addressee's behavior, these were classified as '*behavior regulation of the addressee'*.

Independent-samples t-tests were conducted to compare high- and low-SES groups, where percentages were arcsine transformed. In terms of overall usage, caregivers in the high-SES group (M = 58.4, SD = 5.4) produced more nonfactuals than the low-SES group (M = 40.7, SD = 8.5), $t(4) = 3.0$, $p = .039$, $d = 2.5$. Furthermore, we observed a difference between SES groups in terms of the frequency of nonfactual *–mIş* utterances used for activities and behavior regulation. This significant difference between SES groups is depicted in Figure 3.6, $t\ (4) = 3.9$, $p = .018$, $d = 3.2$, indicating that the caregivers in the low-SES group (M = 59.5, SD = 22.0) tend to use evidential utterances for behavior regulation of the addressee more frequently than the caregivers in the high-SES group (M = 11.9, SD = 4.5).

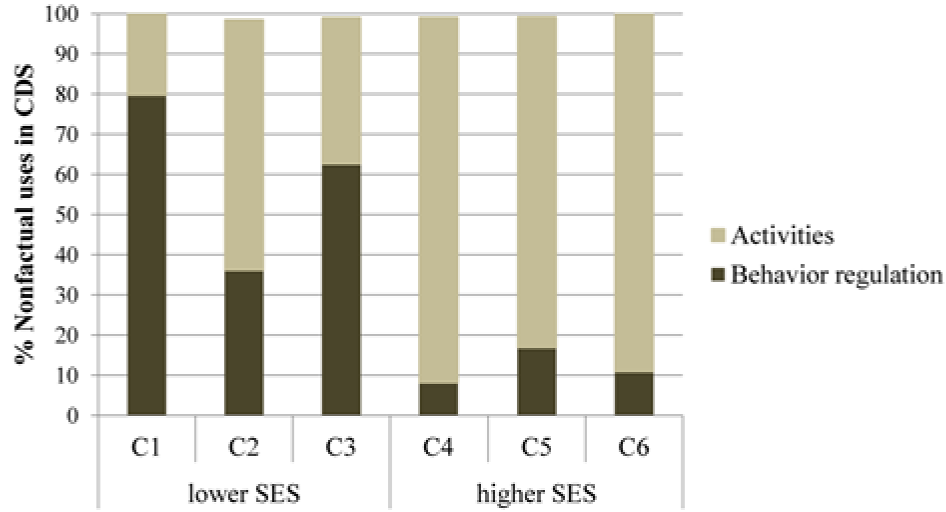

Figure 3.6. Distribution of activity and behavior regulation of the addressee uses of nonfactual utterances in CDS according to SES. Note: Some columns do not add up to 100% since some of the nonfactual uses were idioms and not classifiable under any category.

Discussion

In a first study of its kind examining Turkish evidentials in naturalistic child-caregiver interactions, we investigated the acquisition of the evidential marker *-mIş* by very young children. We described the types and frequency of different functions of the marker in a relatively large longitudinally collected corpus sampled from six children between 8-36 months of age and their caregivers. Using longitudinal and dense samples of naturalistic interactions is rare in the study of evidentials and was needed to chart the development of these multifunctional but not very frequently produced linguistic devices (Matsui, 2014).

Our major question was whether individual differences exist in the development of use of the evidential marker and how child patterns of use compare to patterns in the caregiver input. With respect to the average amount of total speech produced, the children exhibited individual differences. Furthermore, the children were exposed to different frequencies of the evidential marker in the input. There were individual differences with respect to the age of emergence of the evidential marker and its various functions in child speech. Children in the high-SES group produced the *–mIş* marker correctly (i.e. not for directly experienced events) for the first time almost 4 months earlier on the average than children in the low-SES group. This may be due to differences in the overall amount of input that both groups receive, where the high-SES children were exposed to more caregiver speech than the low-SES children in the observed period of time.

The development of use of the evidential marker followed a similar course across children in terms of its proportion within child speech. The proportion of children's use of evidentials within total speech showed an increasing trend over time, i.e. the percentage of the evidential marker increased within child speech over time, but no variation in overall average or rate of change was observed across children.

An ongoing debate in the literature about the acquisition of the Turkish evidential is whether the hearsay or the inference function emerges earlier in child speech. We found that the order of emergence followed a unique pattern for each child, although perceptual uses marking new information and nonfactual uses were in general the first functions to emerge. Contrary to previous proposals (Aksu-Koç, 1988; Ozturk & Papafragou, 2016), Turkish-speaking children do not seem to acquire different evidential functions in a specific order (such as perceptual-hearsay-inference or perceptual-inference-hearsay), though the present results corroborate those of Aksu-Koç (1988) that the perceptual and nonfactual uses emerge earlier than the other two categories. While frequency in child-directed speech appears to account for the earlier emergence of the perceptual and nonfactual uses, it does not fully explain the relative time of emergence of inference and hearsay. More precisely, four out of six children whose input had a higher percentage of utterances in the inference than hearsay function also produced higher proportions of inference than hearsay utterances, and the inferential uses appeared earlier than hearsay uses in their speech. That is, the function of higher frequency in the input was observed earlier in these children's output. The two exceptions to this pattern were children C3 and C1. C3 heard a higher percentage of inference than hearsay utterances in the input but used the evidential for inference at a later time than for hearsay. Child C1's input and output both displayed a higher percentage of hearsay than inference utterances, but both functions emerged at the same time in her speech. Thus, input frequency does not seem to be the sole determining factor of order of emergence of different evidential functions.

Several factors that might explain the later acquisition of inference and hearsay come to mind. The first relates to frequency in that the proportion of inference and hearsay utterances in CDS is much lower (ranging between 4.2 – 19.5%) compared to the proportion of perceptual and nonfactual utterances (ranging between 18.5 – 64.3 %) in the period investigated and it may be that input frequency below a threshold does not have a determining effect on time of emergence, a possibility which needs to be explored in future research.

Another explanation for the lack of a direct reflection of input frequency on the order of emergence of different evidential functions,, a finding similar to the observations in Korean (Choi, 1991) and in Japanese (Shirai et al., 2000), is related to the conceptual complexity of the particular functions. Choi (1991) suggests that the lack of correlation between the frequency of different evidential forms in Korean input and children's order of acquisition of these forms may indicate that the acquisition of evidential forms is the result of an interaction between children's cognitive development and caregiver input. More precisely, she argues that when children are ready to acquire certain concepts, they pay attention to their encoding in the input language. For Japanese, Shirai et al. (2000) have a similar suggestion. Most frequent sentence-final particles in child-directed speech emerged earliest in children's speech but it was suggested that the order of acquisition of less frequent ones depends on children's cognitive development. Children started to use particles that are about the here and now and were able to gradually express the comparison of real situation to their expectations.

Our results also suggest that although high frequency in caregiver input may facilitate the acquisition of some functions (e.g. perceptual and nonfactual use), other functions may be cognitively more demanding. For example, for the decoding of the inferential meaning, contextual cues (e.g. the state of an object resultant from a non-witnessed process) may not be sufficiently helpful at a given point in development. Perceptual utterances, on the other hand, may be relatively easier to process than inference and hearsay utterances because perceptual ones map on to states in the here and now and mark them as information worth noting (e.g. *çanta var-mış burada* 'here is a bag', pointing to the bag on the camera screen, C2, CS, 27 months). Furthermore, their comprehension may be easier because in such contexts the caregiver's perspective is congruent with the child's perspective (e.g. both the mother and child see that the father comes home and the mother utters *baba gel-miş* 'daddy came') reducing the effort for source monitoring and understanding the speaker's mind.

For the early emergence of the nonfactual function, we can propose that the nature of the high frequency input contexts makes a difference. The high frequency of nonfactual utterances in contexts of pretend play (e.g. *çorba yap-mış-sın* 'you made soup', C6, CDS, 26 months) and story-telling is likely to play a facilitative role for acquisition as these contexts are interactive ones that provide the child the opportunity to produce the evidential form as well as to grasp its function of marking the nonfactual domain and the narrative genre. We think that this may also explain why high-SES children produced the evidential marker earlier than low-SES children. In the present data, the predominant nonfactual function in low-SES caregiver speech was that of behavior regulation, which however is not a function appropriate or meaningful for children's use towards their caregivers. In high-SES households however, the predominant use of nonfactual evidential utterances was in contexts of play and narratives which are children's primary domains of talk observed to be shared with adults. The pragmatic (in)appropriateness of a high frequency function for use by children in speech directed at adults thus appears to be another factor that tempers the effects of frequency. For more informed interpretations, future work needs to examine the discourse contexts that different evidential functions are found in. As for inference and hearsay, children were able to use the evidential form for these functions productively and frequently early on as opposed to the findings in Cantonese (Lee & Law, 2000). Although this difference between the learners of these languages may be due to linguistic differences between Turkish and Cantonese, we think that this is a result of the fact that the usage of hearsay and inferential forms were almost null in child-directed input in Cantonese, whereas usage of these functions was frequently found in child-directed input in Turkish.

Overall, we observed some consistencies and some differences between the time of acquisition of different evidential functions and their frequency in different children's speech. These findings lead us to reject the idea that the acquisition of evidentials depends purely on the input or on the cognitive complexity of the different functions. We instead suggested a number of other factors that interactively determine the course of acquisition. One that remains to be considered is the interaction between the child's pattern recognition skills and language structure. The Turkish evidential is a single phonological form with multiple functions such that there is not a one-to-one correspondence between form and function. Since one form corresponds to several functions, children with better pattern recognition abilities may excel in decoding different meanings the marker conveys.

To conclude, our study has shown that the acquisition of the evidential marker in Turkish, a language where evidentiality is an obligatory grammatical distinction deeply situated in everyday discourse, begins early on, although the full development of the multiplicity of functions it presents in adult usage may be a gradual process. We suggest that children's cognitive skills, conceptual readiness, nature of the contexts in which the evidential marker is heard, the pragmatic appropriateness and the relevance of the function for children's communicative interests and input frequency jointly determine the order of acquisition of the different evidential functions in children's speech.

GENERAL CONCLUSION

This thesis examined the development of Turkish-speaking children's communicative skills via experimental and corpus-analytic approaches. In Chapter I, we studied the relation between preschool-aged children's cognitive skills and their referential communication skills, in other words, their ability to describe a referent uniquely in the presence of competitors. We further studied how children's referential expressions were affected by hearing adults' descriptions of referents. Results showed that hearing adults' informative and uniquely identifying descriptions was effective on how children formed their initial descriptions, but not related to the quantity or quality of children's attempts to rectify ambiguous messages. Short-term memory, working memory, and cognitive flexibility were skills that predicted children's communicative repair skills. We argued that these skills helped children to monitor their own messages for ambiguity, compare the target referent to competitors, and think of different ways to describe a referent. Considering the low number of studies investigating children's individual differences in their referential communication skills, our study made contributions to this area of research, especially regarding children's communicative repair skills. Our study showed that children were open and sensitive to adults' way of communicating, and willing to rectify their inadequate descriptions to repair communication. These results suggest that speaking with children about the differences of objects and engaging in play that emphasizes how entities differ from each other (e.g., visually, semantically, functionally) may improve their referential communication skills and indirectly alleviate their communicative problems in social life. This study also implied that children's communication skills are not only related to their language competence but also to their cognitive skills, suggesting that learning to communicate properly is a process that requires various skills and experience. Future research may focus on the relation between children's cognitive skills and their online processing behavior during referential communication by measuring their eye movements.

In Chapters II and III, we conducted acquisition studies via corpus-based methods since there was no study linking Turkish-speaking children's productions of relative clauses and the evidential marker to the input they receive. Although corpus studies do not provide insight about children's comprehension skills, they provide information about the structures that are more frequent, thus enabling us to infer the cognitive and linguistic difficulties of these structures. In Chapter II, we investigated the acquisition of Turkish relative clauses. This acquisition study was the first in Turkish to examine children's processes of acquiring and using relative clauses in relation to child-directed speech and in comparison to other languages. Parallel to the findings in other languages (e.g., Chen & Shirai, 2015; Kirjavainen & Lieven, 2011), we observed that Turkish-speaking children's use of relative clauses was very similar to the use in child-directed speech in terms of the syntactic role of the head noun in the relative clause and the matrix clause, but structurally relatively simpler, indicating an ongoing developmental process in preschool years. Unlike other languages where studies of spontaneous speech are available, the emergence and regular use of relative clauses take place in later ages for Turkish-speaking children. Although morphosyntactic complexity was offered as an explanation for the late acquisition before (Slobin, 1986), with this study, we can also suggest that the adults' avoidance of using relative clauses when speaking to children is another plausible explanation. Future research may test whether more frequent types of relative clauses in spontaneous speech are also easier to comprehend and produce by children and adults in experimental tasks. Moreover, children's eye movements upon hearing different types of relative clauses may be studied to uncover how children misinterpret these structures in comprehension tasks.

Finally, our goal in Chapter III was to study the development of another communicative skill, namely, children's ability to convey the source of information, by examining the acquisition of the Turkish evidential marker *–mIş*. In this first study that investigated the use of this indirect experience marker in longitudinal child-caregiver interactions, we used growth curve analyses which are rarely used in such studies but were very useful to track the change in time. These analyses showed that children followed a similar trajectory in terms of the frequency of the use of the evidential marker in time despite differences in the input. Relatively simple and/or frequent functions of the marker (i.e. perceptual and nonfactual functions) emerged earlier in child speech, but the emergence and use of its other functions (i.e. hearsay and inference) were not determined solely by input frequency. Thus, we suggested that the acquisition of different functions did not only depend on adult speech but also on children's cognitive development and conceptual readiness. Although experimental studies usually focused on the inference and hearsay functions of the evidential marker (e.g., Ozturk & Papafragou, 2016; Ünal & Papafragou, 2016), we observed that the nonfactual use dominated child-caregiver interactions. The evidential marker was used in a nonfactual sense in the play environment, during storytelling and singing, to divert the child's attention, and direct the child to perform a desired behavior. Although we observed that young learners of Turkish produced the evidential marker appropriately almost all of the time, experimental studies found that children make errors, especially in comprehension tasks. It has been proposed that the comprehension of the meaning conveyed by the evidential marker is delayed because children have problems in taking the perspective of the speaker (Ünal & Papafragou, 2016). However, then it is not clear how very young children in our corpus use the hearsay function without problems in daily interactions since this production would also require to track the information source of other people. Future research may focus more on this discrepancy by also measuring children's ability to track information sources in non-linguistic settings.

In Chapters II and III we had the chance to observe the differences between high- and low-SES caregivers and children in terms of the quantity and quality of the speech they produced where SES was indexed by parental education. Supporting previous findings in other languages (see Hoff, Laursen, & Tardif, 2002, for a review), our studies showed that low-SES children were at a disadvantage in terms of the amount and quality/complexity of the speech directed to them. SES differences in terms of the use of the evidential marker appeared in the age of emergence of the marker in child speech, and its pragmatic functions in caregiver speech. Low-SES caregivers used the marker for regulating the behavior of the child more frequently than high-SES caregivers, who produced the marker more during pretend play and storytelling. In terms of the use of relative clauses, SES differences were related to the input frequency such that high-SES caregivers produced more relative clauses. Since relative clauses were just emerging in child speech, we could not assess how SES differences were reflected in child speech. The effects of SES on relative clause acquisition may be examined by future research by measuring quantitative and qualitative aspects (e.g., shared book reading, engaging in activities that require comparing and contrasting objects/pictures) of the input and child-caregiver interaction.

To conclude, this thesis investigated the development of young children's language and communication skills. The main findings obtained from the three studies can be summarized as follows: (1) children's cognitive skills played an important role in their communication skills, (2) how children use language is affected by adults' use of language both in short term (as shown in Chapter I) and long term (as shown in Chapters II and III), (3) language input provided by the caregivers shows differences with respect to parental education, and (4) the development of complex language structures is gradual and not an all-or-none accomplishment.

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APPENDICES

Appendix A

Description of target and distractor pictures used in the pretest, modeling, and posttest phases

Pretest	**Target picture**	**Distractor picture 1**	**Distractor picture 2**	**Distractor picture 3**
1	the old man that the bear is chasing	the old man that the boy is kicking	the boy that the bear is chasing	the old man looking confused
2	the dog that the boy pet	the dog that the girl washed	the pig that the boy pet	the dog lying
3	the girl that the man is pushing	the girl that the bear is hitting	the boy that the man is pushing	the girl laughing
4	the horse that the woman is feeding/giving banana to	the horse that the girl is riding	the monkey that the woman is feeding/giving banana to	a horse of different color
5	the old man that the shark is biting	the old man that the boy is pushing	the girl that the shark is biting	the old man talking on the phone
6	the woman that the boxer is hitting	the woman that the bear is chasing	the old man that the boxer is hitting	the woman jumping

Modeling	**Target picture**	**Distractor picture 1**	**Distractor picture 2**	**Distractor picture 3**
1	the man that the giraffe is licking	the man that the dog is chasing	the girl that the giraffe is licking	the man holding a rabbit
2	the monkey that the girl is feeding/giving banana to	the monkey that the woman is petting	the giraffe that the girl is feeding/giving banana to	the monkey facing the opposite direction
3	the donkey that	the donkey that the woman is	the cow that the	the donkey

	the boy is riding	petting	boy is riding	looking angry
4	the girl that the bear is petting	the girl that the giraffe is licking	the boy that the bear is petting	the girl looking afraid
5	the old man that the man is kicking	the old man that the shark is biting	the girl that the man is kicking	the old man laughing
6	the man that the pig is chasing	the man that the dog is licking	the clown that the pig is chasing	the man reading a book
7	the man that the cat is biting	the man that the boy is pushing	the girl that the cat is biting	the man laughing
8	the woman that the panda is lifting	the woman that the dog is chasing	the man that the panda is lifting	the woman that is waving her hand
9	the girl that the boy is kissing	the girl that the girl is petting	the old man that the boy is kissing	the girl with eyes and mouth open
10	the man that the cat is tickling	the man that the woman is petting	the old woman that the cat is tickling	the man looking confused

Posttest	**Target picture**	**Distractor picture 1**	**Distractor picture 2**	**Distractor picture 3**
1	the girl that the boy is kicking	the girl that the bear is chasing	the old woman that the boy is kicking	the girl smiling
2	the boy that the girl is kissing	the boy that the dog is licking	the old woman that the girl is kissing	the boy smiling
3	the boy that the bear is hitting	the boy that the girl is kicking	the old woman that the bear is hitting	the boy laughing
4	the old woman that the dog is biting	the old woman that the bear is hitting	the old man that the dog is biting	the old woman laughing

5	the woman that the man is tickling	the woman that the bear is petting	the old man that the man is tickling	the woman talking on the phone
6	the girl that the man is lifting	the girl that the woman is pushing	the boy that the man is lifting	the girl walking
7	the old woman that the boy is pushing	the old woman that the dog is biting	the old man that the boy is pushing	the old woman jumping
8	the boy that the cow is licking	the boy that the donkey is chasing	the girl that the cow is licking	the boy dancing
9	the horse that the woman is riding	the horse that the girl is feeding/giving banana to	the cow that the woman is riding	a horse of different color
10	the boy that the donkey is chasing	the boy that the cow is licking	the man that the donkey is chasing	the boy reading a book

Appendix B

Correlations between age, and cognitive and communicative measures

						Pretest			
						Initial Descriptions		Communicative Repair	
	Forward digit span	Backward digit span	Word-picture recall	Contents false belief	Dimensional change card sort	Uniquely identifying initial expressions %	Initial message ambiguity	Number of description attempts	Subsequent message ambiguity
Age	.23	.17	.04	.26	.18	-.02	-.01	-.14	-.13
Forward digit span		.25	.09	-.02	.43*	.16	-.26	-.31*	-.21
Backward digit span			.30*	-.06	.25	.15	-.13	-.36*	-.39**
Word-picture recall				.04	.14	.15	-.10	-.28	-.49**
Contents false belief					-.18 [a]	-.03	-.02	.02	-.07
Dimensional change card sort						.30*	-.40**	-.41**	-.29*

Note. Outliers (above or below mean ± 2.5 SD) were removed.

a. This association between the two dichotomous variables was computed with the phi coefficient.

**p*< .05, ***p*< .01

Appendix C

Complexity Measures of Relative Clauses and Locative Constructions Produced in Late Child Speech and Child-directed Speech

	CS [a]				CDS			
	SU	DO	OBL	LOC	SU	DO	OBL	LOC
Pronominal subject	-	90%	79%	N/A	1%	100%	72%	N/A
Inanimate head	57%	97%	100%	78%	52%	94%	100%	76%
Head noun missing	75%	63%	14%	60%	32%	50%	4%	60%
Generic head [b]	44%	52%	42%	32%	21%	37%	89%	5%

Note. a. CS: Child speech from the peer interaction corpus, b. calculated within the relative clauses/locative constructions that had an overt head noun

Appendix D

```
library(nlme)
library(lme4)
library(RLRsim)

#Unconditional means model:
model1 <- lme(Variable_of_Interest ~ 1, data=data, random= ~ 1 | Child_no,
method="ML", control = lmeControl(opt = "optim"))

#Intraclass coefficient:
tau.sq <- as.numeric(VarCorr(model1)[1,1])
sigma.sq <- as.numeric(VarCorr(model1)[2,1])
tau.sq/(tau.sq+sigma.sq)

#Unconditional growth model:
model2 <- lme(Variable_of_Interest ~ Age, data=data, random= ~ 1 | Child_no,
method="ML", control = lmeControl(opt = "optim"))

#Ordinary least squares regression:
model3 <- lm(Variable_of_Interest ~ Age, data=data)

#Comparison of model2 and model3
exactLRT(m = model2, m0 = model3)

#Unconditional growth model with random intercepts and slopes:
model4 <- lme(Variable_of_Interest ~ Age, data=data, random= ~ Age | Child_no,
method="ML", control = lmeControl(opt = "optim"))

#Comparison of model2 and model4:
m0 <- lmer(Variable_of_Interest ~ Age + (1|Child_no), data = data)
mA <- update(m0, .~. + (0 + Age|Child_no))
mSlope <- update(mA, .~. - (1|Child_no))
exactRLRT(mSlope, mA, m0)

#Quadratic model with orthogonal polynomials:
model5 <- lme(Variable_of_Interest ~ poly(Age, 2), random = ~ poly(Age, 2) |
Child_no, data=data, method="ML", control = lmeControl(opt = "optim"))

#Estimation of the linear model with poly function:
model6 <- lme(Variable_of_Interest ~ poly(Age, 1), random = ~poly(Age, 1) | Child_no,
data=data, method="ML",control = lmeControl(opt = "optim"))

#Comparison of the linear and quadratic models:
anova(model5, model6)
```

Appendix E

Visualization of raw data

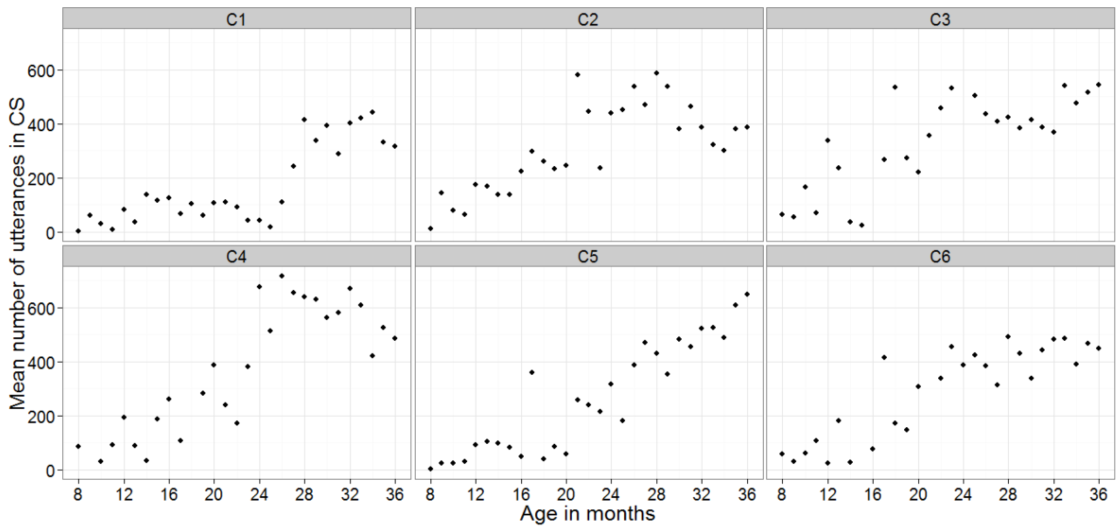

Figure 3.7. Raw data of each child showing the distribution of the mean number of utterances in CS for each time point.

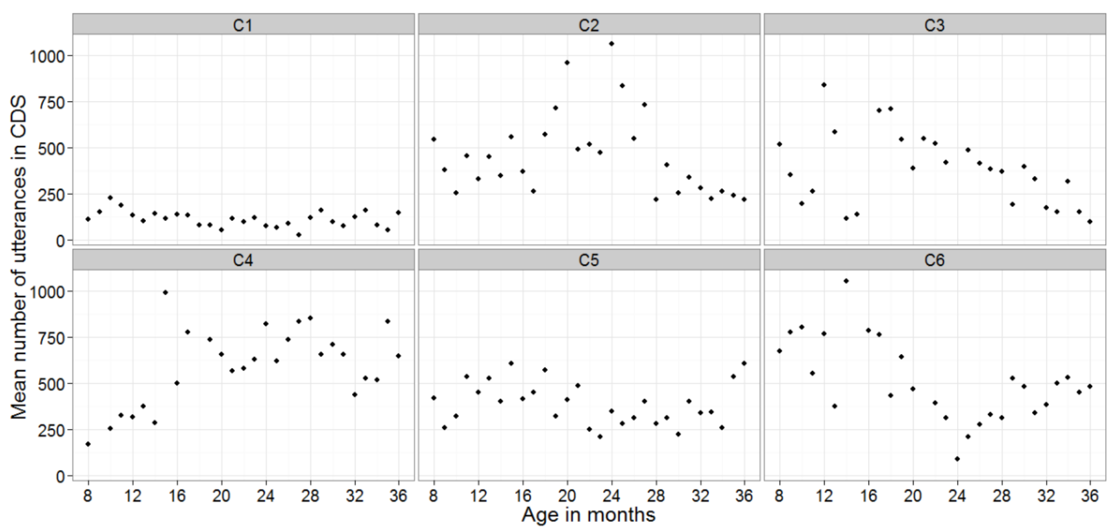

Figure 3.8. Raw data of each child's caregivers showing the distribution of the mean number of utterances in CDS for each time point.

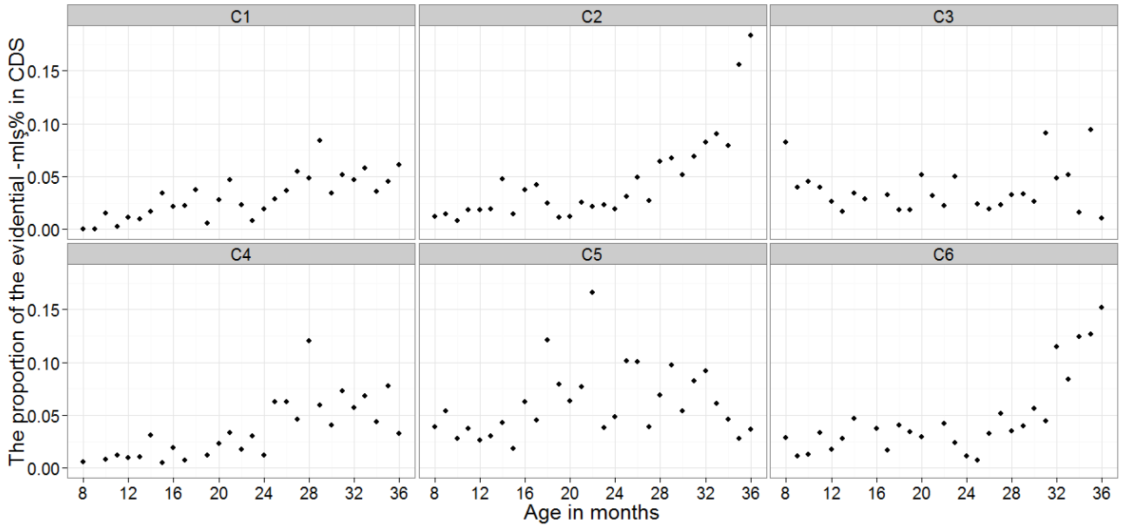

Figure 3.9. Raw data of each child's caregivers showing the distribution of the proportion of the evidential marker *–mIş* in CDS for each time point.

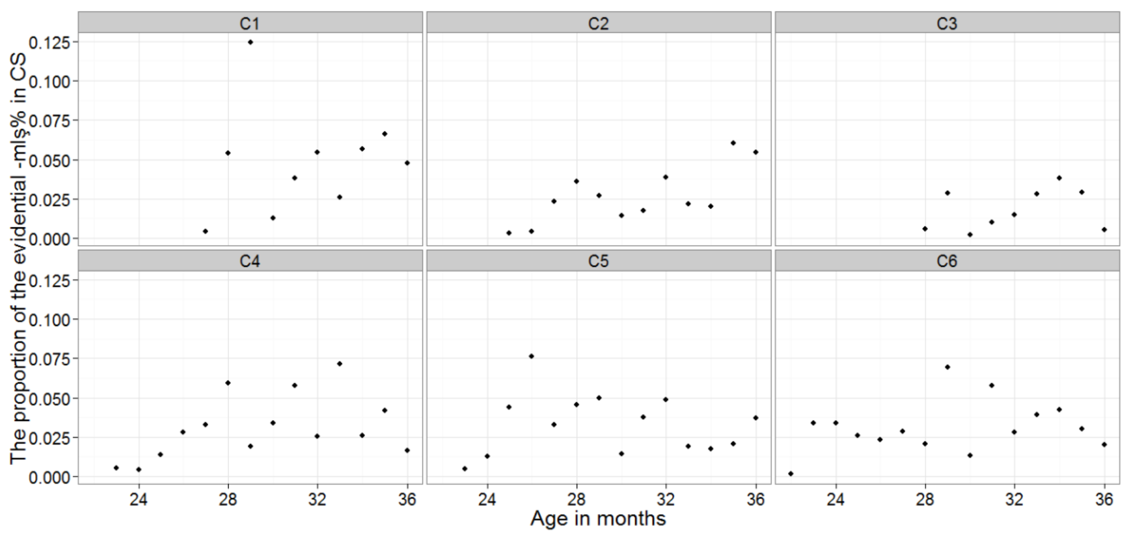

Figure 3.10. Raw data of each child showing the distribution of the proportion of the evidential marker *–mIş* in CS for each time point.