The interpretation of logical connectors by monolingual and bilingual children

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Declaration

The research presented in this dissertation is my original work and it has not been submitted for a higher research degree in any other institution. In addition, I certify that all the information resources and the literature used are indicated in the thesis. The research presented in this thesis has gained Macquarie University Ethics approval (Ref: 5201100766D).

I also certify that the dissertation comprises of original piece of research and it has been written by me. My supervisors, Stephen Crain and Rosalind Thornton gave me extensive feedback in the writing process of this dissertation. Any help or assistance that I have received in my research work and the preparation of the dissertation itself has been appropriately acknowledged right after the abstracts of the papers.

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Abstract

This dissertation investigated the scope relations assigned by English-, German- and Turkish-speaking monolingual and bilingual children. Across languages, disjunction is assigned different interpretations in negative sentences and in sentences with the temporal term *before*. For instance, the English (and German) sentence *A did not eat B or C* licenses the 'conjunctive' interpretation that A did not eat B <u>and</u> did not eat C. On this interpretation, negation takes scope over disjunction (NOT > OR). In adult Turkish, if the disjunction phrase is marked with accusative case, then disjunction takes scope over negation (OR > NEG), yielding the 'disjunctive' interpretation that A either did not eat B <u>or</u> did not eat C. Scope relations between disjunction and the temporal term *before* also differ across languages. In English (and German), the sentence *A reached the finish line before B or C* requires A to reach the finish line before both B and C. In Turkish, the corresponding sentences are true in this circumstance, and also in other circumstances.

Adopting a learnability principle called the Semantic Subset Principle, the experimental hypothesis was that children, across languages, would initially adopt the strongest (subset) interpretation of both kinds of sentences, in order to guarantee language learnability regardless of the scope assignments preferred by adults. These predictions were evaluated in three experiments using the Truth Value Judgment Task, testing monolingual children acquiring German, English, and Turkish, and Turkish-English bilingual children. On the proposed account, both groups of Turkish-speaking children were expected to initially assign interpretations that do not match those of the adults, whereas the interpretations assigned by German- and English-speaking children were expected to match those of adults. As predicted, both monolingual and bilingual children were found to initially assign a strong subset reading to disjunction in all three languages, both when disjunction appeared in the scope of negation and when it appeared in the scope of the temporal term *before*. This meant that the interpretations assigned by Turkish-speaking children differed from those of adults.

Chapter 1

Case in Turkish and German

Turkish

Case in Turkish

The two languages under investigation in this dissertation are German and Turkish. Turkish is an agglutinative language, rich inflectional morphology and a relatively free word order. German is a Germanic language also with a rich nominal inflectional paradigm and also known to be a V2 language. Turkish entertains a six-way distinction in case marking whereas German presents a four-way distinction.

Turkish is proposed to entertain 6 cases (e.g. Kornfilt, 1997): nominative, accusative, dative, locative, ablative and genitive. The suffixes used for these cases are given in the following:

(1) Nominative –∅[1]

Accusative –(y)I

Dative –(y)A

Locative –DA

Ablative –DAn

Genitive –(n)In

The nominative is used with the subjects as in (2). Nominative is the only case that subjects allow in addition to the genitive. The accusative case is used to express the function of direct object canonically as in (3). The dative is typically used with indirect objects, benefactives and goals as given in (4). The locative and the ablative are used for locational arguments and source arguments, respectively as in (5) and (6). Finally, the genitive is the case of the subjects of nominalized clauses and possessors as in (7). Thus, it is a case exclusively of the nominal domain.

(2) Dora uyu-du.

[1] In the examples to come –∅ indicates 'zero marking'.

Dora sleep-past.3Sg

'Dora slept.'

(3) Polis hırsız-ı yakala-dı.

Police thief-ACC catch-Past.3Sg

'The police caught the thief.'

(4) Ali ev-e gel-di.

Ali ev-Dat come-Past.3Sg

'Ali came home.'

(5) Diplomat-lar otel-de kal-dı-lar.

Diplomat-Pl hotel-Loc stay-Past-3Pl

'The diplomats stayed at the hotel.'

(6) Dora keman-ı Ali-den al-dı.

(7) Dora violin-Acc Ali-Abl take-Past.3Sg

'Dora took the violin from Ali.'

(8) Dora-nın ev-i-ne git-ti-k.

Dora-Gen house-Nom-Dat go-Past.1Pl

'We went to Dora's house.'

Accusative case in Turkish

After introducing the case paradigm in Turkish, we now focus on accusative case marking in Turkish. In the examples below the direct object *bir araba* (9) is bare but the direct object *bir arabayı* in (10) is accusatively marked.

(9) Dora bir araba kiralamak istiyor.

Dora a car rent want

‘Dora wants to rent a car.’

(10) Dora bir araba-(y)ı kiralamak istiyor.

Dora a car-ACC rent want

‘Dora wants to rent a certain car.’

Enç (1991) argues that the direct object maker *─(y)ı* determines whether objects are specific or not. When objects carry the accusative case marker as in *bir arabayı* in (10) the object requires a specific reading, otherwise the object in question is left bare as in *bir araba* in (9) (see also von Heusinger & Kornfilt, 2005).

When uttered out of the blue, the direct object *bir araba* which carries the accusative case *─(y)ı* as in (10) may only have a wide scope reading over the verb of propositional attitude *kiralamak* ‘to rent’. Example (9) does not carry accusative case and the sentence entails that Dora wants to rent some car though not a particular one. This interpretation is assumed to emerge when the object DP has narrow scope over the verb of propositional attitude *kiralamak*.

Turkish has 6 cases, but not all cases are created the same. In the Generative linguistic literature cases are categorizes as either structural or inherent (Chomsky, 1981; 1986). One way to tease apart whather a case is structural or inherent is passivization (see e.g. Haider 1985; Woolford, 2006). If arguments marked with certain cases preserve their case marking under passivization, then, they are said to have inherent case. On the other hand, when arguments marked with certain other cases fail to retain their case, then, they are said to have structural case. Among the nouns in the object position in Turkish, arguments marked with dative, locative and ablative cases preserve their case marking in passivization, whereas arguments marked with accusative do not (see also Uzun, 2000: pp.196-199 & Sezer, 1991: pp. 46-49)

Compare (11) and (12) with (13). Take, for instance, accusative case, which is classified as a structural case in Turkish (11):

(11) Halk Atatürk-ü çok sev-iyor

People Atatürk-Acc much love-Prog.3Sg.

'The people love Atatürk very much.'

(12) Atatürk (halk tarafından) çok sev-il-iyor.

Atatürk (by people) much love-Pass-Prog.3Sg.

'Atatürk is loved very much (by the people).'

The object *Atatürk* in (11) is a theme argument, and it carries accusative case. In (12), it becomes the subject of the passive sentence, and the case it bears changes to nominative. The *θ-role* that it bears is still theme. Thus, the change of the object relation to the subject relation for this argument, results in a change in the case it bears. Compare this to the behaviour of dative case, which is classified as an inherent case as in (13) and (14):

(13) Bir kadın biz-e saldır-dı.

A woman 1Pl-Dat attack-Past.3Sg.

'A woman attacked us.'

(14) Biz-e (bir kadın tarafından) saldır-ıl-dı.

1Pl-Dat (a woman by) attack-Pass-Past.3Sg.

'We were attacked by a woman.'

In (13), the goal argument *biz 'us'* bears dative case. In (14), the same argument still carries dative apart from the fact that it is uttered in a passive sentence. The *θ-role* that it bears is still goal. Thus, there is a strict link between the case of this argument and its *θ-role*. The point here is that the the association between the inherent case that a noun phrase bears and the *θ-role* that that noun phrase bears is constant throughout a given derivation.

Suspended Affixation in Turkish

Turkish also displays a phenomenon also known as *suspended affixation*, in which an affix takes scope over two or more preceding words as in the following (Lewis, 1967). Kabak

(2007:335) claims that inflectional morphemes in the following conjunction phrases with ‘ve’ (and) are free to be suspended as examplified in the following:

(15) kedi ve köpek-ler-im-i

cat and dog-Pl-1S.Poss-Acc

‘my cats and dogs (Acc.)’

(16) Almanya ve Avustralya-dan

Germany and Australia-Abl

‘from Germany and Australia’

(17) ev ve ofis-ler-de

home and office-Pl-Loc

‘in houses and offices’

(18) Dora ve Derin-le

Dora and Derin-Com

‘with Dora and Derin’

(19) Dora ve Derin-in

Dora and Derin-Gen

‘Dora and Derin’s’

Kabak (2007: 339) claims that in the use of personal pronouns there is a tight phonological cohesion between affix suspension and the morphological base of the word as observed in coordinate constructions with two conjuncts as in ‘ve’ (and) and ‘hem…hem de’ (both…and) as in (20) and (21) respectively and with two disjunctions as in ‘veya’ (or) and ‘ya… ya da’ (either…or) as in (22) and (23) respectively:

(20) Ben ve sen-den nefret ed-iyor.

I and you-Abl hate Aux-Prog

‘S/he hates me and you.

(21) Hem ben hem de sen-den nefret ed-iyor.

Both I both also you-Abl hate Aux-Prog

'S/he hates me and you.

(22) Ben veya sen-den nefret ed-iyor.

I or you-Abl hate Aux-Prog

'S/he hates me or you.

(23) Ya ben ya da sen-den nefret ed-iyor.

Either I or you-Abl hate Aux-Prog

'S/he hates either me or you.

The same phonological allomorph of the ablative case *–den* is used both for I and you both in the disjunct and the conjunct phrases exemplified above. Thus, affix suspension is tolerated on the personal pronouns I and you which are inflected with the ablative case. However, when the same pronouns are inflected with the dative case they do not have the same allomorph as exemplified in sentences with conjunction as in (24) and (25) and sentences with disjunction as in (26) and (27). In the following sentences affix suspension is not allowed due to phonological constraints:

(24) *Sen ve ban-a yardım et-ti.

You and I-Dat help-Past

Intended meaning: 'S\he helped you and me.'

(25) *Hem sen hem de ban-a yardım et-ti.

Both you both also I-Dat help-past

Intended meaning: 'S\he helped both you and me.'

(26) *Sen veya ban-a yardım et-ti.

You or I-Dat help-past

Intended meaning: 'S\he helped you or me.'

(27) *Ya sen ya da ban-a yardım et-ti.

Either you or I-Dat help-past

Intended meaning: 'S\he helped either you or me.'

When inflected with the dative-case, the allomorph of the 1st and 2nd person pronouns, namely *san* and *ban* can never be used without the dative case. In other words, allomorphs are not morphological words, so they cannot be left bare in non-final conjuncts (i.e., *san ve ban-a (you and I-Dat) is ungrammatical).

Case in German

Unlike Turkish, German bears a three-way distinction on nouns, feminine, masculine and neutral. German has both a definite and an indefinite article which need to be inflected depending on the case they bear. Turkish, on the other, lacks a definite article but uses an indefinite article which is also used as the numeral one. Unlike Turkish, German has a four-way distinction carried on nouns: Nominative, accusative, dative and genitive as given in the Table below:

Table 1: Case inflections of the German definite article

	Singular			Plural
	Masculine	Feminine	Neuter	
Nominativ	der	die	das	die
Accusativ	den	die	das	die
Dative	dem	der	dem	den
Genitive	des	der	des	der

(28) Der Mann tanzt.

The-Nom man dances.

'The man dances.'

(29) Ich habe den Zaun zerbrochen.

I-Nom have the fence-Acc broken

'I broke the fence.'

(30) Er parkt das Auto vor dem Haus

He parks the car in.front.of the-DAT house

‘He parks the car in front of the house.’

(31) Des Blauwals Lebensraum ist der Ozean.

The-Gen blue whale-Gen habitat is the ocean.

'The habitat of the blue whale is the ocean.'

References

Chomsky, N. (1981). *Lectures on Government and Binding*. Dordrecht: Foris.

Chomsky, N. (1986). *Knowledge of language: its nature, origins and use*. New York: Praeger.

Enç, M. (1991). Semantics of Specificity. *Linguistic Inquiry*, 22, 1–25.

Haider, H. (2006). Mittelfeld phenomena (Scrambling in Germanic). In M. Everaert & H. C. van Riemsdijk (Eds.) *The Blackwell companion to syntax volume 3* (pp. 204–274). Malden, MA: Blackwell Publishing.

von Heusinger, K. & Kornfilt, J. (2005). The case of the direct object in Turkish: Semantics, syntax and morphology. *Turkic Languages*, 9, 3–44.

Kabak, B. (2007). Turkish suspended affixation. *Linguistics*, 45 (2), 311-347.

Kornfilt, J. 1997. *Turkish*. London and New York: Routledge.

Lewis, G. (1967). *Turkish Grammar*. Oxford: Oxford University Press.

Sezer, E. (1991). *Issues in Turkish syntax*. Doctoral Dissertation, Harvard University.

Uzun, E. (2000). *Anaçizgileriyle evrensel dilbilgisi ve Türkçe*. Istanbul: Multilingual.

Woolford, E. (2006). Lexical case, inherent case, and argument structure. *Linguistic Inquiry*, 37, 111–130.

Chapter 2

Disjunction and conjunction

Introduction

Logical connectives such as negation (English *not*), conjunction (English *and*), disjunction (English *or*) and temporal expressions such as English *before* are used to express principles of reasoning, similar to the principles of reasoning found in classical logic. It has been argued that the logical connectives used in human languages have the same truth conditions as the corresponding symbolic expressions of classical logic (Crain, 2008; 2012; Crain & Khlentzos, 2008; 2010). Consider the English disjunction operator, *or.* In classical logic, the disjunction operator *or* is assigned the truth conditions of inclusive disjunction. So a sentence of the form 'A or B' is true if just A is true, or just B, and also if both A and B are true.

In human languages, too, sentences with disjunction words are sometimes true in all of these circumstances. This can be illustrated by the following sentence: *We are looking for someone with a degree in Communication* ***or*** *considerable experience in event management.* Applicants would be eligible for the job if they just had a degree in Communication, or just had experience in event management. But applicants would also be eligible if they had both a degree in Communication and experience in event management. However, in many everyday situations, the English disjunction word *or* often appears to have truth conditions associated with exclusive disjunction, such that sentences with disjunction are false when both of the disjuncts are true.

Appearances can be deceiving, however. The fact that disjunction is sometimes interpreted as exclusive-*or* is not due to logic, but rather to principles of pragmatics. Imagine that you are at a dinner party, and the host tells you: *You may have soup or salad.* In this context, the host's sentence is taken to mean that you can either have soup or salad, but not both. According to classical logic, the host could be offering you both soup and salad, but you would not even consider this possibility. Why not? Principles of pragmatics suggest that speakers should be as informative as they can be. To be as informative as possible, speakers use logical expressions that maximize information strength. If the host had meant that you

could have soup and salad, then there is a better way to express this than by using the disjunction operator *or*— the host could have used the conjunction word *and*. So a person who hears the host say *You may have soup or salad* infers that the host is ruling out the option of having both soup and salad.

An important problem is to understand how children acquire such complex facts. Do children learn the range of possible interpretations by attending to the environmental input, or does Universal Grammar scaffold upon the interpretations made available by classical logic? The paths that children follow in acquiring logical expressions have a long history (e.g. Neimark, 1970; Piaget, 1969; Braine & Rumain, 1981). It remains an important topic today and is pursued in this thesis as well.

Today, there are two prominent approaches to language acquisition. One is the so-called usage-based or constructivist approach to language acquisition. On this approach, language learning is viewed as drawing upon domain-general mechanisms, i.e. mechanisms that are used in other domains— for example, statistical learning procedures, stimulus generalization, analogy and so on (Ambridge & Lieven, 2011; Clark, 1971; Goldberg, 2003; Lieven & Tomasello, 2008; Paterson, Liversedge, Rowland & Filik, 2003; Tomasello, 2000; 2003). On this approach, language learners are taken to acquire utterances in context, as pairings of forms and functions. Frequency is an important factor; more frequently appearing constructions are learned before less frequent ones. Proponents of this approach to language acquisition view children as learning linguistic structures, including the interpretations that logical expressions entail, in a sequential piecemeal manner. Notice that, since interpretations of disjunction in circumstances corresponding to exclusive-*or* are highly frequent in the input to children, proponents of the experience-based approach claim that children start out by analysing disjunction as exclusive-*or*, and learn that disjunction is inclusive-*or* later in the course of acquisition (e.g. Morris, 2008).

There is an alternative to the experience-based approach to language development. This is the generative 'Universal Grammar' (UG) approach. On this view, children are endowed with an innate language faculty. This language faculty consists of a set of PRINCIPLES, which are common to all languages, and a set of PARAMETERS, which determine the variability among languages (Crain, 2008; Crain & Khlentzos, 2008; 2010; Crain & Pietroski, 2001). One parameter that has been proposed is the Disjunction Parameter (Crain, 2008; 2012; Goro, 2004; 2007; cf. Szabolcsi, 2002). This parameter establishes a binary choice in the way that languages analyze disjunction words. This parameter will be discussed in more detail shortly.

Universal Grammar also is home to learnability principles that ensure that children can achieve the target grammar using the input that is available to them. One of these learnability principles is the Semantic Subset Principle (Crain, Ni & Conway, 1994). We will introduce and discuss this principle shortly as well. The Semantic Subset Principle plays an important role in determining the initial interpretations that children assign to sentences with disjunction. According to Crain (Crain, 2008; 2012; Crain & Khlentzos, 2008; 2010), Universal Grammar harnesses principles of classical logic, including innate knowledge that disjunction words like English *or* are inclusive-*or*.

An important difference between these two approaches to language acquisition is in the role that the adult input plays in grammar formation. The two approaches differ in their claims about the input children receive and in the explanations they offer when children and adults differ in how they comprehend sentences. On any usage-based approach, input is paramount. Children attempt to match the input, the best they can, and they do not hypothesize structures or meanings for structures that are not attested in the input. On the Universal Grammar approach, on the other hand, input plays a less critical role. Of course, experience is necessary for acquisition. Children do not all learn the same language, after all. In the present study, the input is used by children to settle on the parameter setting that is

adopted by adult speakers of the local language. But, before children have settled on the parameter value attested by adult language-users, they may flout the value of the local language. In this case, children acquiring a particular language can manifest qualitative differences from the parental input. In this sense, children may be observed to be speaking a 'foreign' language for a brief period of time, until positive evidence guides them to converge to adult grammar. We will see an instance of this in this thesis.

In sum, the two approaches differ in the predictions they make about the role of the input and the type of non-adult utterances that are produced by children or their non-adult comprehension of linguistic structures. This dissertation aims to test the predictions of the UG approach and the usage-based approach by examining the interpretations that monolingual and bilingual children give to sentences containing logical expressions. Monolingual English-, German- and Turkish-speaking children and Turkish-English bilingual children were tested in a series of experimental studies. The main research question was whether young monolingual and bilingual children acquire such interpretations by tracking the adult input and attempting to match it, or whether they draw on the resources of Universal Grammar to guide their initial hypothesis; that is, whether children are found to set parameters in adherence with principles of learnability (i.e., the Semantic Subset Principle). This investigation is conducted through three studies, which I outline next.

The first investigation focuses on the interpretation of the logical word for conjunction assigned by Turkish-speaking children and adults. The experiment tests their interpretation of conjunction in negative sentences such as *This animal did not eat both the carrot and the pepper* (see Chapter 2). The next study compared how Turkish-and German speaking children interpret disjunction in negative sentences as in *This animal did not eat the carrot or the pepper* (see Chapter 3). Finally, our investigation turned to how Turkish-English bilingual children and their mothers interpret disjunction in sentences with the temporal conjunction

before, as in sentences like *A reached the finish line before B or C* in Turkish and in English (see Chapter 4).

Broadly speaking, the findings showed that regardless of the language and the sentence type under investigation, all the child groups tested in Australia, Turkey and Germany exhibited a similar pattern of interpretation to disjunction either in scope of negation or the temporal term *before* and conjunction in negative sentences. This set of findings poses a challenge for usage-based approach to language acquisition, since certain child groups do not reflect the adult input. Instead, they demonstrate qualitative differences from the adult language in the interpretations they assign to disjunction and conjunction in the scope of another logical connector.

Having given a broad outline of this thesis, the rest of this chapter is dedicated, first, to lay the background for how disjunction and conjunction are interpreted in classical logic and in human languages, along with the notions of downward entailment and scope ambiguity. Following this, we introduce the linguistic contexts that are examined in this dissertation. Finally, we introduce a possible learnability scenario along with the specific research questions and the predictions addressed in the thesis.

Disjunction in logic and in human languages

Across human languages, and in classical logic, disjunction carries the truth conditions associated with inclusive-*or*. When we consider a statement of the form *A or B*, the statement is true in three circumstances: (i) if A is true, but B is false, (ii) if B is true, but A is false, and (iii) if both A and B are true. However, in human languages, it is not always clear whether disjunction words carry an inclusive-*or*, or an exclusive-*or* interpretation, where a statement of the form A *or B* is <u>false</u> if both A and B are true. Suppose you have decided to go on a vacation and you are considering your options for paying the holiday package. When you come across a statement on a web site, *You can make a payment online or over the phone*,

what you infer is that you either do the transaction online or over the phone, but not both. The use of disjunction in this specific context is compatible with the truth conditions that are associated with *exclusive-or*. This interpretation eliminates the truth condition where both *A and B* are true. However, in other circumstances, the disjunction word carries the *inclusive-or* meaning. For instance, consider how one would interpret the following statement about a holiday package: *You can enjoy whale-watching or hiking*. This interpretation carries the possibility that one can enjoy both whale-watching and hiking. The use of disjunction in this context is compatible with the truth conditions that are associated with *inclusive-or* in classical logic.

The reason why an exclusive-*or* meaning emerges is that, in every day conversation, some speech acts result in certain pragmatic inferences. In certain pragmatic contexts, disjunction phrases receive a different interpretation from their logical meanings. One principle that can affect the interpretation of a logical operator, such as disjunction, is the Principle of Cooperation (Grice, 1975). According to this principle, speakers are expected to be as informative as possible in their contribution to the conversation without being more informative than required. For instance, in certain conversational contexts, speakers of a language infer that the speaker intends to exclude the possibility that both disjuncts are true. Imagine that you are at a café and on the menu it says: *With your dinner, you may have a free cup of tea or coffee.* Customers would infer that they are not being offered both free tea and free coffee. Otherwise, the coffee shop owner would have used a sentence with conjunction—*With your dinner, you may have a free cup of tea and a free cup of coffee*, rather than the one with disjunction. Because *or* is used instead of *and* on the menu, the customers draw an inference, called an *implicature of exclusivity*. This inference is derived by the assumption that the coffee shop owner was being cooperative, and was producing the strongest statement s/he was in a position to make. The strongest statement was one with disjunction, *or*, rather than one with conjunction, *and*. As a result, the customers eliminate the outcome that they are

being offered both a cup of tea and a cup of coffee from the interpretation that is associated with the disjunctive statement on the menu. To summarize, although inclusive-*or* is the basic meaning of disjunction, speakers often compute a pragmatic inference (implicature of exclusivity) that eliminates the truth condition in which both of the disjuncts are true. This is why it appears that disjunctive statements only have the truth conditions of exclusive disjunction when, as a matter of fact, they have the truth conditions of inclusive disjunction. Now, we are ready to introduce the notion of downward entailment, which is another important logical ingredient in the experimental studies reported in the present thesis.

Downward Entailment

In certain linguistic contexts, a statement with disjunction results in a stronger interpretation than a statement with conjunction. Downward Entailing contexts are those in which disjunction appears in the scope of some member of another class of logical expressions, called Downward Entailing operators. The negative quantifier *Nobody* is an example of a Downward Entailing operator. Consider the following English statement in (1):

(1) **Nobody** ate an apple ***or*** a pear.

The negative disjunction statement in (1) is equivalent to a conjunction of two negative statements and can be paraphrased as *Nobody ate an apple and nobody ate a pear*. The statement is true only in one circumstance, where nobody ate either fruit. This interpretation is referred to as the *conjunctive interpretation* of disjunction in the scope of a downward entailing operator. Here is why. In general, any downward entailing operator, symbolised as Δ, licences an entailment from a disjunctive statement Δ (A or B), to a conjunctive statement in which the downward entailing operator takes scope over each of the disjuncts: Δ(A) and Δ(B). German, like English, also licenses the conjunctive interpretation of disjunction in similar sentences, as illustrated in (2).

(2) **Niemand** aβ einen Apfel ***oder*** eine Birne.

Nobody ate an apple or a pear

'Nobody ate an apple or a pear'.

In Turkish, similar sentences can have two potential forms; the noun phrases in the disjunctive phrase can either have no case marking, as in (3a) or the noun phrases can bear accusative case, as in (3b). Either way, Turkish adult speakers give a conjunctive interpretation to (3a) and (3b). That is, Turkish speakers, like their English and German counterparts, interpret the sentences to mean *Nobody ate an apple and nobody ate a pear*.

(3) a. **Hiçkimse** elma ***ya da*** armut ye**me**di.

Nobody apple or pear eat-NOT-PAST

'Nobody ate an apple or a pear'.

b. **Hiçkimse** elma-*yı* **ya da** armut-*u* ye**me**di.

Nobody apple-ACC or pear-ACC eat-NOT-PAST

'Nobody ate the apple or the pear'.

To summarize, disjunction phrases in the scope of a downward entailing operator such as *Nobody* receive a conjunctive interpretation in English, German and Turkish. The English temporal term *before* also belongs to this group of expressions called the Downward Entailing operators. However, things get more complicated. As we will see, disjunction is interpreted differently across languages with respect to its scope.

Scope ambiguities

When two (or more) logical expressions are used in a statement, the sentence often carries in an ambiguity in interpretation. The different interpretations that a sentence containing two (or more) logical expressions is known as a scope ambiguity. Resolving the ambiguity depends on which logical expression takes prominence over the other. Consider the sentence *Every kangaroo did not jump over the fence*. In English, this sentence is ambiguous. On one

meaning, the inferred interpretation is *None of the kangaroos jumped over the fence*. On this meaning, the universal quantifier *every* has prominence, or takes scope over negation *not*. This scope assignment can be symbolically represented as (*every* > *not*). However, the same sentence can be assigned another meaning, on which it can be paraphrased as *Not every kangaroo jumped over the fence*. In this case, negation *not* takes scope over the universal quantifier *every*. This scope assignment can be symbolically represented as (*not* > *every*).

Scope ambiguities may not necessarily be observed in particular languages, depending on how strongly one scope assignment is favoured over its competitors. However, the different scope assignments of linguistic structures are often clear when one looks across languages. In this dissertation, several sentence types with two logical operators are investigated. They are: (i) conjunction in the scope of negation (in Turkish), (ii) disjunction in scope of negation (in German and Turkish), and (iii) disjunction in scope of the temporal term (before) (in Turkish and English). In order to explain these cross-linguistic differences in the interpretation of disjunction and conjunction in negative sentences, we need to review two lexical parameters that have been proposed in the literature (Crain, 2008; 2012; cf. Szabolcsi, 2002; Goro, 2004; 2007). We turn to introduce these parameters next.

The Disjunction Parameter

The different interpretations that disjunction receives in the scope of a logical expression has been attributed to a lexical parameter called the Disjunction Parameter (Crain, 2008; 2012). We introduce the Disjunction Parameter in two contexts, with negation and with *before*.

Negated disjunction phrases

Negation belongs to the set of logical expressions called Downward Entailing operators. Consider the English and the German negative sentences as in (4) and (5). Both (4) and (5) generate a strong *neither* reading, which can be paraphrased as the conjunction of two

negative statements— *The pig did not eat the carrot and the pig did not eat the pepper*. This interpretation eventuates in both languages because disjunction receives a conjunctive interpretation under negation as in one of de Morgan's laws of propositional logic (de Morgan, 1966). In both of these sentences the speakers favour the surface scope interpretation, where negation takes scope over disjunction (*not* > *or*).

(4) The pig did **not** eat the carrot **or** the pepper.

(5) Das Schwein hat **nicht** die Karotte **oder** die Paprika gegessen.
The pig did not the carrot or the pepper eat-PAST
'The pig didn't eat the carrot or the pepper'.

In languages like English, German and Korean, negation takes scope over disjunction. By contrast, in languages like Mandarin, Japanese and Russian, disjunction takes scope over negation. When (4) and (5) are translated into Japanese, for example, disjunction takes scope over negation both in the surface syntax and at the level of semantic interpretation (*or* > *not*). The corresponding Japanese sentence in (6) is true in a broader set of circumstances, as compared to the sentences in (4) and (5).

(6) Butasan-wa ninjin **ka** piiman-wo tabe-**nakat**-ta
Pig-TOP carrot or pepper-ACC eat-NEG-PAST (Goro, 2007, p. 226)
'The pig didn't eat the carrot or the pepper'.

The sentence in (6) is true (at least in principle) in the same circumstance as the corresponding sentences of German and English, including in the circumstance in (i), where the pig did not eat any of the vegetables. In Japanese, however, this interpretation is more likely to be explicitly ruled out, because Japanese speakers usually follow up the sentence with an explicit disclaimer … '*demo dochira ka wakara-nai'* but I don't know which.' More importantly, however, the Japanese sentence in (6) is true in two other circumstances that make the English and German examples true, namely when (ii) The pig ate the carrot, but did not eat the pepper, and (iii) The pig ate the pepper, but did not eat the carrot. The

interpretation where the pig ate just one of the vegetables – but we don't know which, results in what we will call the 'disjunctive' truth conditions, according to which the statement is true if and only if just one of the disjuncts is true, as on the exclusive meaning of disjunction.

This cross-linguistic difference is explained by proposing that Disjunction is a Positive Polarity Item (PPI) in certain languages where disjunction takes scope over negation regardless of the surface scope order (Goro, 2004; 2007; cf. Szabolcsi, 2002). Thus, disjunction words in these languages receive the 'positive' value, i.e., the [+PPI] value of the Disjunction Parameter. In languages where negation takes scope over disjunction, the disjunction words receive the 'negative' value, i.e., the [–PPI] value of the Disjunction Parameter.

Let us show this step-by-step. First, as we mentioned, disjunction in classical logic is inclusive-*or*. Consider the formula (A ∨ B), where '∨' is the symbol for disjunction. The formula (A ∨ B) is true in three cases: if A is true but not B, if B is true but not A, and if both A and B are true. A statement of the form (A ∨ B) is false, therefore, only if both A and B are false. In symbols, the formula ¬ (A ∨ B) excludes the possibility of A and it excludes the possibility of B, where '¬' is the symbol for negation; ¬ (A ∨ B) is true just in case both A and B are false. It follows from these observations that ¬ (A ∨ B) logically entails (¬A ∧ ¬B), where '∧' is the symbol for conjunction and '⇒' indicates logical entailment. This logical equivalence is captured in one of the laws of propositional logic: ¬ (A ∨ B) ⇒ (¬A ∧ ¬B).

Negated disjunctions in English and German conform to this law of propositional logic. The sentence *The pig did not eat the carrot or the pepper* can be symbolically represented as ¬ (A ∨ B), and the English sentence and its German equivalent generate a *conjunctive* entailment that the pig did not eat the carrot and that the pig did not eat the pepper, which can be symbolically given as (¬A ∧ ¬B). This one of de Morgan's law of proposition logic works in the same way in interpreting the sentences with *Nobody* as

illustrated in (1), (2) and (3a, b). This leads us to conclude that the value of the Disjunction Parameter in English and in German is [–PPI], whereas in Japanese, the value is set to [+PPI].

It must be noted that German marks accusative case both on definite and indefinite nouns. Turkish does not have a definite article and it has an indefinite article, which is also treated as a numeral when stressed. The accusative case marker in Turkish is also the specificity marker. That is why the accusative case marker has a different status in each language and this might result in interpretive differences between the two languages.

Let us now examine Turkish. Turkish uses a number of words such as *ya…ya da* (either…or), *ya da* (or) and *veya* (or) as the morphological realization of the disjunction operator (Göksel & Kerslake, 2005).Turkish disjunction words are not Positive Polarity Items. Consider the negated disjunction phrase in Turkish in (7). Notice that the noun phrases in the disjunction phrase do not bear any case marking:

(7) Domuz-cuk havuç ***veya*** biber ye**me**di.

Pig-DIM carrot or pepper eat-NEG-PAST

'The pig didn't eat a carrot or a pepper'.

When the nouns in the disjunction phrase are not inflected with accusative case as in (7), the sentence generates a conjunctive interpretation. In such sentences, Turkish conforms to the law under discussion: $\neg (A \vee B) \Rightarrow (\neg A \wedge \neg B)$ and (7) can be paraphrased as *The pig did not eat the carrot* and *The pig did not eat the pepper*. The striking fact is that when the nouns in disjunction phrase are marked with accusative case, the disjunction phrase is interpreted as taking scope over negation. This is illustrated in (8):

(8) Domuz-cuk havuç-u ***veya*** biber-i ye**me**di[2].

Pig-DIM carrot-ACC or pepper-ACC eat-NEG-PAST

'The pig didn't eat the carrot or the pepper'.

[2] In the disjunct phrase in (8) the allomorphs for the accusative case marker − *(y)ı* impose a phonological constraint on the nouns and the affixes cannot be suspended since biber and havuç receive different allomorphs.

Sentence (8) is true if just one of the disjuncts is false, or if both are. The interpretation generated by this scope assignment (*or* > *not*) corresponds to the logical formula (¬A ∨ ¬B), which only excludes the possibility of both A and B being true. Because the disjunction phrase takes scope over negation in the semantic representation of these sentences, this one of de Morgan's law of propositional logic under discussion does not apply. This is because the Turkish accusative case marker–*(y)ı* (i.e., the specificity marker) is a Positive Polarity Item.

What we have seen is that in Turkish, the disjunction words themselves carry the [–PPI] value of the Disjunction Parameter, just like in English, and in German. Negation takes scope over disjunction at the level of semantic interpretation unless the nouns in the disjunction phrase are marked with accusative case. When nouns in the disjunction phrase carry the accusative case, they take the [+PPI] value of the Disjunction Parameter. In this case, Turkish matches with the Japanese interpretation by assigning a *disjunctive interpretation* to disjunction in the scope of negation. Negated disjunction phrases in which the noun phrases do not bear any case yield a *conjunctive interpretation* in Turkish just like in English and German.

Two possible concerns might be raised at this point. One might be intrigued to know the relative frequency of disjunction sentences with and without accusative case marking as well as the relative frequency of case marked vs. non-case marked direct objects in the Turkish input. To address the first question is no easy task since there is no corpus of children interacting with their parents or caretakers available to test this question. However, when we take a look at the larger picture, based on a text sample taken from a collection of short stories, it has been reported that the ratio of accusative marked indefinite direct objects to non-marked ones is about 1:8 (Nilson, 1985:55). Erguvanlı and Zimmer (1994) argue that certain contexts, namely some subclass of transitive verbs would have a high probability of case selecting for case-marked indefinite direct objects as exemplified in (9) and a high probability of case selecting for non-case marked direct objects as exemplified in (10). One

such verb that favours case-marked direct object over its non-case marked counterpart is *bin-* (to get on a horse, a bus, etc.) as introduced in (9):

(9) Fil-e bir çocuğ-u bin-dir-ecek.

Fil-Dat a child-Acc ride-Cau-Fut.3Sg.

'He's going to have a child ride on the elephant.' (Erguvanli & Zimmer, 1994:549)

One verb that native speakers favour the non-marked direct object over its marked counterpart is kır- (to break) as given in (10):

(10) Temizlik yaparken bir vazo kır-dı-m.

cleaning while doing a vase break-Past-1Sg.

'I broke a vase while I was cleaning up.' (Erguvanli & Zimmer, 1994:549)

Erguvanli and Zimmer (1994) adheres the difference preference for case selection between (9) and (10) to a parameter of individuation. The verb –to break scores higher on the individuation scale than the verb –to ride. Thus, one also needs to take into account the semantic properties of verbs in Turkish while figuring out the relative frequency of case marked vs. non-marked direct objects.

A second legitimate concern is related to the input frequency of case marked-marked and non-marked disjunct phrases that an average Turkish-speaking child hears in the input. There is no large publicly available corpus that we can report from; however, an analysis of the Frog stories in the Aksu-Koç corpus(CHILDES database; MacWhinney 2000) reveals that the 10 Turkish-speaking adults whose speech was transcribed used the disjunction operator *(ya) … ya da/ veya* a total of 7 times. The disjunctive operator *ya da* was used 6 times and *veya* was used once. All 7 utterances with disjunction words were affirmative sentences. In the spontaneous production data from the 30 files of child Turkish-speakers, children (aged 3; 06-10; 01) did not produce a single utterance with disjunction (*(ya)…ya da / veya*) either in affirmative or in negative sentences. We searched for the

distribution of the conjunction words h*em… hem (de)* in the same corpus. There was not one single utterance with this conjunction word. In short, there is little available evidence in the spontaneous production data about the interpretation of disjunction words, either for child speakers of Turkish.

Disjunction in the scope of the temporal term before

The English temporal term *before* also belongs to the set of logical operators designated as Downward Entailing operators. Consider the English sentence in (11):

(11) The hedgehog finished the race **before** the zebra ***or*** the kangaroo.

Recall that any Downward Entailing operator licences a *conjunctive entailment* as in BEFORE (A or B), in which the downward entailing operator takes scope over each of the disjuncts: BEFORE A and BEFORE B. In English, the temporal conjunction *before* takes scope over disjunction at the level of semantic interpretation. Sentence (11) is true in one case only, when *The hedgehog finished **before** the zebra* <u>and</u> ***before*** *the kangaroo*. However, the Turkish equivalent of the same sentence offers a wider set of interpretations. The Turkish temporal conjunction corresponding to English *before* is *önce*, and one of the ways to express disjunction is to use *ya da*. Consider sentence (12):

(12) Kirpi bitiş çizgisi-(n)e zebra ***ya da*** kanguru-**dan** **önce** ulaştı[3].

Hedgehog finish line-DAT zebra or kangaroo-ABL before reach-PAST

'The hedgehog reached the finish line before the zebra or the kangaroo'.

In the Turkish sentence in (12), disjunction takes scope over the temporal term *before*. The sentence is true in three circumstances: (i) if the hedgehog reaches the finish line before the kangaroo but not the zebra, (ii) if the hedgehog reaches the finish line before the zebra but not the kangaroo, and (iii) if the hedgehog reaches the finish line before both the kangaroo and

[3] In (12) since both nouns in the noun phrase receive the same allomorph for the ablative case ─*dan*, affix suspension is observed without violating the grammaticality of the sentence.

the zebra, which is the interpretation that validates the English sentence (11). This interpretation is known as the *disjunctive interpretation*. In this sense, English assigns the [–PPI] value of the Disjunction Parameter to sentences with a downward entailing operator such as the temporal term *before*, whereas (adult) Turkish-speakers assign the [+PPI] value of the Disjunction Parameter to the same construction. Turkish disjunction words are not necessarily Positive Polarity Items, as we will see. However, the presence of ablative case marking–*den* turns disjunction phrases into Positive Polarity Items.

In this dissertation, we examine how monolingual Turkish-speaking children interpret uninflected vs accusatively marked negated disjunction phrases as in (7) and (8), and we compare the interpretations that Turkish-and German speaking children assign to negated disjunction phrases as in (5) and (8). This is of interest because the languages do not all share the same value of the Disjunction Parameter. To summarize, negated disjunction phrases in German as in (5) and uninflected negated disjunction phrases in Turkish as in (7) yield a conjunctive interpretation, whereas the accusatively marked negated disjunction phrases in Turkish as in (8) result in a disjunctive interpretation. Disjunction generates a conjunctive entailment in sentences containing the temporal conjunction *before* in English as in (11), but the same construction also generates a disjunctive interpretation in Turkish as in (12). Now we move onto the Conjunction Parameter.

The Conjunction Parameter

The lexical parameter that is proposed to govern the interpretation conjunction receives across languages is called the Conjunction Parameter. Consider the English sentence in (13):

(13) The pig did **not** eat (both) the carrot ***and*** the pepper.

In languages like English, negation takes scope over conjunction in negative sentences with conjunction (*not* >*and*). The English sentence above entails that the pig did not eat the carrot or the pepper (or possibly neither). This sentence can be rendered symbolically as ¬ (A ∧ B).

In negative sentences with conjunction, another law of propositional logic is relevant, ¬ (A ∧ B) ⇒ (¬A ∨ ¬B). Therefore, the negation of the formula (A ∧ B) is true in circumstances in which one of the conjuncts is true, either A or B, but not when both are true.

In Turkish, by contrast, conjunction phrases always takes scope over negation with the conjunction operator *ve* (and) as in (14) and *hem… hem (de)* (both…both (also)) as in (15) at the level of semantic interpretation (*and* >*not*) even if negation is positioned 'higher' than the conjunction phrase in the surface syntax. Negative sentences with conjunction phrases have the same semantic interpretation regardless of case marking. Therefore, the conjunction word itself is [+PPI] in Turkish. Case marking does not determine scope relations for sentences with conjunction.

(14) Domuz-cuk havuç-u ***ve*** biber-i ye**me**di.
Pig-DIM carrot-ACC and pepper-ACC eat-NEG-PAST
'The pig didn't eat a certain carrot and a certain pepper'.

(15) Domuz-cuk ***hem*** havuç-u ***hem (de)*** biber-i ye**me**di.
Pig-DIM both carrot-ACC both also pepper-ACC eat-NEG-PAST
'The pig didn't eat both a certain carrot and (also) a certain pepper'.

In Turkish, the interpretation of negated conjunctions can be represented symbolically as (¬A ∧ ¬B). Because the conjunction phrase takes scope over negation in the semantic representation, the law of propositional logic under discussion does not apply.

In languages where conjunction takes scope over negation at the level of semantic interpretation, the designated value of the conjunction phrases is [+PPI], whereas in languages where negation takes scope over the conjunction phrase, the values is set to the [–PPI] of the Conjunction Parameter. Thus, Turkish conjunction words bear the [+PPI] setting of the Conjunction Parameter, whereas the English conjunction word *and* carries the [–PPI] value of the Conjunction Parameter. We investigated how Turkish-speaking children interpret negated conjunction phrases as in (14).

In the next section, we turn to discuss a semantic learnability principle that is proposed to guide children's initial semantic scope assignments, the Semantic Subset Principle.

The Semantic Subset Principle (SSP)

Potential learning problems arise when children are acquiring a construction that is true in one language in a broader range of circumstances than the circumstances that verify the same construction in another language. The languages that makes sentences true is a broader range of circumstances can be designated the 'superset' languages, and the languages that makes sentences true in a narrower range of circumstances can be designated the 'subset' languages. In this case, what we may refer to as 'subset problems' arise if children initially guess that the local language is a member of the superset languages when, as a matter of fact, the local language is one of the subset languages. In the absence of negative evidence (e.g., negative feedback from adults), it is difficult to imagine how children can retract, because all of the input from adults will be consistent with their hypothesis. Children would have to notice the absence of evidence confirming some of the truth conditions that they tolerate, but it is not clear how anyone can notice that certain meanings are not instantiated.

To overcome these potential learning problems, it has been proposed that children initially adopt parameter settings that correspond to the subset languages, so that there will be positive evidence if the local language is one of the superset languages. If children begin with the subset setting of the relevant parameter, then this will ensure that children will encounter positive evidence if adult speakers of the local language adopt the alternative superset value. They simply need to hear an adult speaker produce the relevant structure in a circumstance that is false on the setting of the parameter they initially hypothesize. The principle that constrains children so that they initially set any parameter that is problematic from a learnability perspective to the value that makes the sentence true in the narrowest range of circumstances is called the Semantic Subset Principle (Crain, Ni & Conway, 1994; Crain

2012). If children are guided by the Semantic Subset Principle in their initial semantic interpretations, then they are expected to adopt the [–PPI] value of the Disjunction Parameter and the [+PPI] value of the Conjunction Parameter. This causes them to assign a conjunctive interpretation to all the constructions under investigation within the scope of this dissertation. This means that in certain cases children's interpretations do not match those of adults.

Criticism has been raised regarding the applicability of the Semantic Subset Principle (SSP) on purely semantic phenomenon. One concern is that semantic subset problems do not exist and SSP is not the correct solution to those problems even if they exist (Musolino, 2006). A second concern against the applicability of the SSP is the insufficient input that the children receive as negative evidence. It has been claimed that children do not receive the appropriate amount and kind of input at the right time to promote grammar formation (Gualmini & Schwarz, 2009). As we will see, however, the Semantic Subset Principle explains the data presented in this dissertation without difficulty.

Research questions and Predictions

Here are the main research questions:

(i) Do monolingual children's initial semantic interpretations of disjunction and conjunction in negative sentences match the adult input or are they in line with the predictions of the Semantic Subset Principle?

(ii) Do bilingual children's initial semantic interpretations of disjunction in the scope of the temporal term *before* match the adult input or the Semantic Subset Principle?

If children's hypotheses about the interpretations of sentences containing logical operators are guided by the primary linguistic data, then child speakers of different languages will assign interpretations that are consistent with the local language. It would not be expected that children acquiring a range of different languages all come up with the same interpretation

of the sentences under investigation. Next, we present the predictions of the Semantic Subset Principle for each of the structures that we tested.

When parameter values stand in a subset/superset relation, then explicit predictions can be made about how the language of children will differ from that of adults. As shown in Figure 1, the set of circumstances that makes sentences true when negation takes scope over the conjunction phrase, as represented as (*not* > *and*) are a superset of the circumstances that make sentences true on the alternative scope assignment (*and* > *not*).[4] Therefore, with respect to this construction, Turkish is a subset language and English is the superset language. Turkish assigns a conjunctive interpretation to negated conjunction phrases, but English assigns a disjunctive interpretation to negated conjunction phrases. Turkish adopts the [+PPI] value of the Conjunction Parameter and adult speakers of English adopt the [–PPI] value of the Conjunction Parameter.

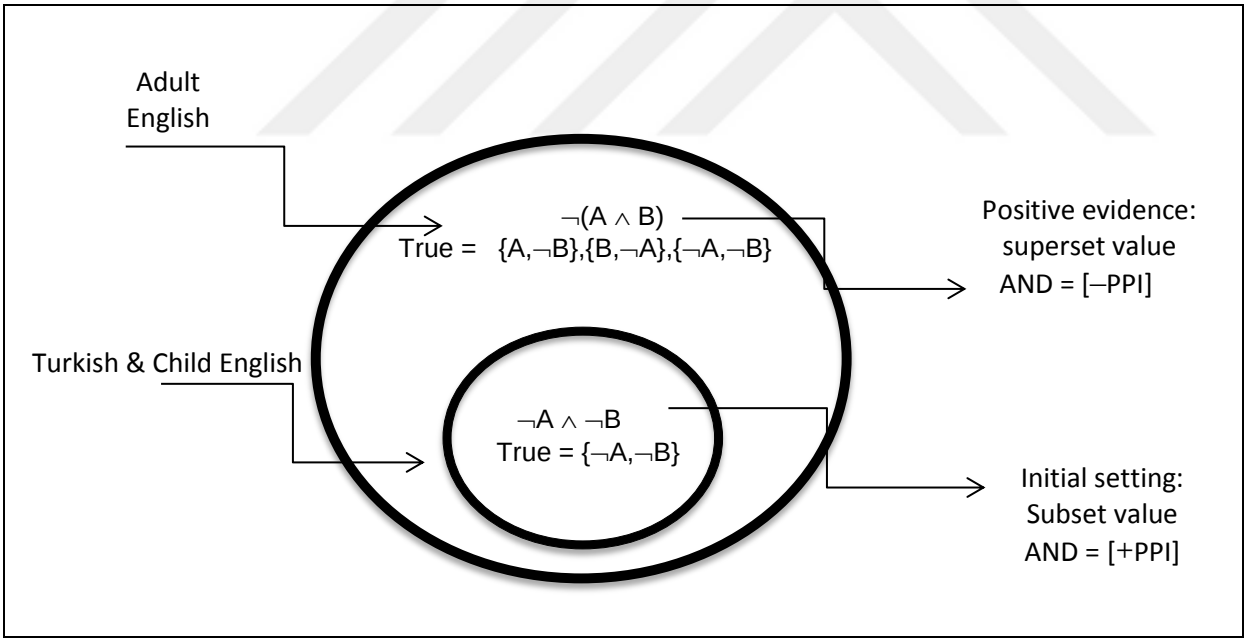

Figure 1: The subset/superset relations associated with the Conjunction Parameter

Prediction 1: The SSP predicts that Turkish children and adults would not differ in their interpretations to negated conjunction phrases as in example (13). The usage-based approach makes the same prediction, too, however due to the frequency effects (see Chapter 2).

[4] Figures 1, 2 and 3 are adapted from Crain (2012).

The next three predictions can be based on the subset/superset relations associated with the Disjunction Parameter. As given in Figure 2, the set of circumstances that makes sentences true when the disjunction phrase takes scope over negation (*or* > *not*) are a superset of the circumstances that make sentences true on the alternative scope assignment (*not* > *or*). In this case, both German negated disjunction phrases and negated disjunction phrases in Turkish with no case marking result in the conjunctive interpretation and both languages carry the [–PPI] value of the Disjunction Parameter.

Prediction 2: The SSP predicts that Turkish children and adults will not differ in their interpretations to uninflected negated disjunction phrases as in example (7). The same prediction holds for the usage-based approach, too, since in this case children's interpretations would match those of adults (see Chapter 2).

However, recall that when the negated disjunction phrase is marked with accusative case, Turkish becomes a superset language giving rise to the disjunctive interpretation of disjunction in negative sentences. This is because the accusative case marker–(*y)ı* is a Positive Polarity Item and accusatively marked negated disjunction phrases in Turkish carry the [+PPI] value of the Disjunction Parameter. German is the subset language and assigns a conjunctive interpretation to negated disjunction phrases since negation takes scope over disjunction in German (*not*>*or*). Turkish is the superset language and assigns a disjunctive interpretation to accusatively marked negated disjunction phrases since the accusative case marker takes scope over both negation and disjunction (*or*>*not*).

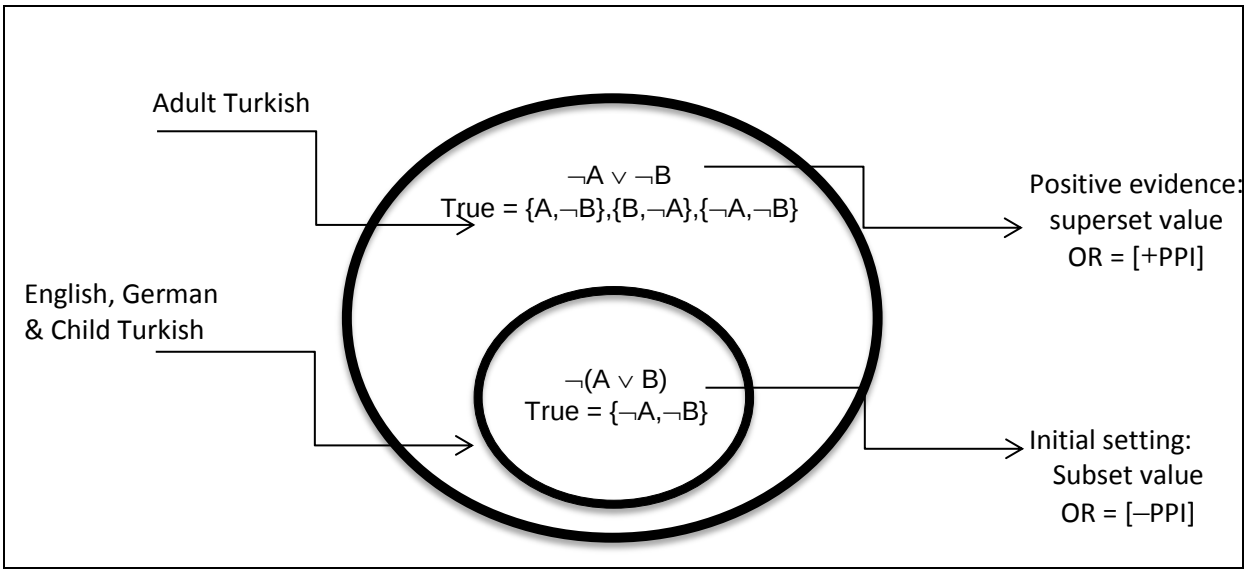

Figure 2: The subset/superset relations associated with the Disjunction Parameter

Prediction 3: The SSP predicts that Turkish children and adults will differ in the interpretations they assign to negated disjunction phrases that are case marked, as in (8). Turkish children are expected to assign the [–PPI] value of the Disjunction Parameter, whereas Turkish adults are expected to assign the [+PPI] value of the Disjunction Parameter. The usage-based approach predicts no such difference (see Chapter 2).

Prediction 4: German-and Turkish-speaking children will not differ from German-speaking adults, whereas Turkish children would differ from Turkish adults in their assignments to sentences as in (5) and (8). Such a difference is not predicted by the usage-based account (see Chapter 3).

Recall that sentences containing disjunction and the temporal conjunction *before*, receive a conjunctive interpretation in English and a disjunctive interpretation in Turkish. In this sense, English is the subset language where the downward entailing operator takes scope over both of the disjuncts (*before>or*) and Turkish is the superset language where disjunction takes scope over the temporal term *önce* (*or>before*). Thus, as given in Figure 3, English carries the [–PPI] value and Turkish carries the [+PPI] value of the Disjunction Parameter.

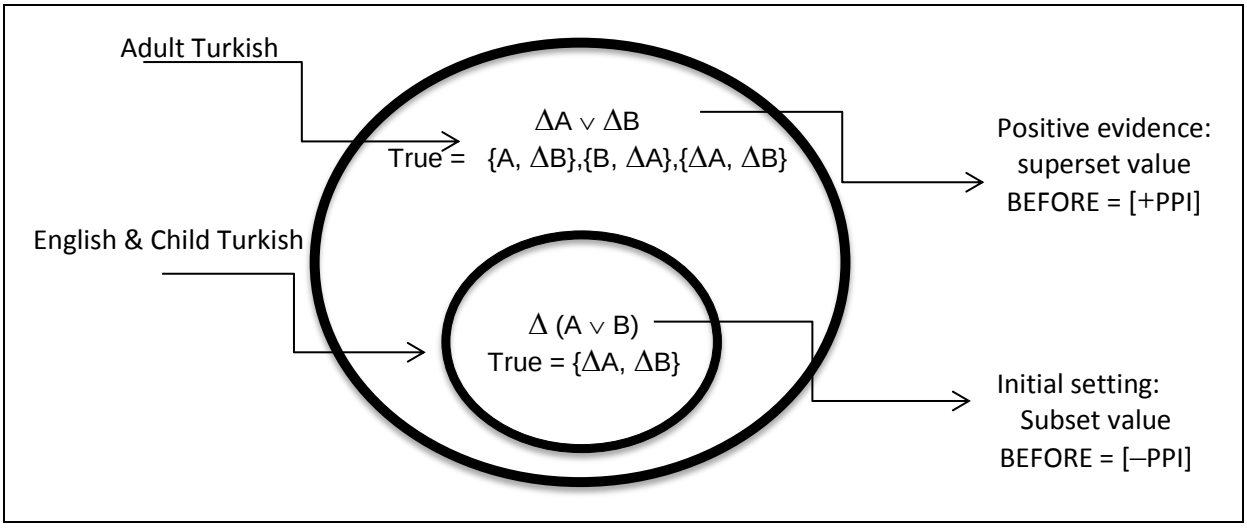

Figure 3: The subset/superset relations associated with the Disjunction Parameter in scope of BEFORE

Prediction 5: Bilingual children are not expected to differ in the interpretations they assign to the Turkish and the English test sentences (as in 12, and 13), but they are expected to differ from their mothers in the interpretations they assign to the Turkish sentences. The usage based account would predict that bilingual children will match with their mothers in the interpretations they assign to both the Turkish and the English sentences (see Chapter 4).The critical predictions for this thesis are the last three predictions which expect a difference between the two approaches. We will discuss which account fulfils which one of these predictions in Chapter 5, which is dedicated to a discussion of our results.

Organization of the thesis

The thesis consists of five chapters, including the present chapter. In this chapter, we have outlined the main goal of the thesis and introduced the relevant linguistic constructions in Turkish, German and English. We have also laid out the main research questions and the predictions to be tested in this dissertation. Chapter 2 discusses how negated conjunction and disjunction phrases are interpreted in child and adult Turkish. Chapter 3 compares the interpretations that Turkish-and-German speaking children assign to negated disjunction

phrases. Chapter 4 compares the interpretations that bilingual Turkish-English children and their mothers assign to sentences containing disjunction and the temporal term *before* in Turkish and in English. In Chapter 5, we conclude the thesis by presenting the results of the experiments we conducted and report whether or not the predictions presented in the first chapter are borne out. We conclude with directions for future research and the implications of the studies conducted within the scope of this dissertation.

References

Ambridge, B. & Lieven, E.V.M. (2011). *Child Language Acquisition: Contrasting theoretical approaches*. Cambridge, UK: Cambridge University Press.

Braine, M. D. S. & Rumain, B. (1981). Development of comprehension of 'or': Evidence for a sequence of competencies. *Journal of Experimental Child Psychology*, 31, 46–70.

Clark, E. V. (1971). On the acquisition of the meaning of before and after. *Journal of Verbal Learning and Verbal Behavior*, 10, 266–75.

Crain, S. (2008). The interpretation of disjunction in Universal Grammar. *Language and Speech*, 5, 151–169.

Crain, S. (2012). *Emergence of meaning*. Cambridge: Cambridge University Press.

Crain, S. & Khlentzos, D. (2008). Is logic innate? *Biolinguistics*, 2 (1), 24–56.

Crain, S. & Khlentzos, D. (2010).The logic instinct. *Mind and Language*, 25, 30–65.

Crain, S. & Pietroski, P. (2001). Nature, nurture and Universal Grammar. *Linguistics and Philosophy*, 24, 139–185.

Crain, S., Ni, W. & Conway, L. (1994). Learning, parsing and modularity. In C. Clifton, L. Frazer, & K. Rayner (Eds.), *Perspectives on sentence processing* (pp. 443–467). Hillside, NJ: Lawrence Erlbaum.

Erguvanlı, E. & Zimmer, K. (1994). *Case marking in Turkish indefinite object constructions*. In Proceedings of the 20th Annual Meeting of Berkeley Linguistics Society: A general session dedicated to the contributions of Charles J. Filnmore, 547-552.

Goldberg, A. E. (2003). Constructions: a new theoretical approach to language. *Trends in Cognitive Science*, 7 (5), 219–224.

Goro, T. (2004). *The emergence of Universal Grammar in the emergence of language: the acquisition of Japanese logical connectives and positive polarity* (Unpublished master's thesis). University of Maryland.

Goro, T. (2007). *Language-specific constraints on scope interpretation in first language acquisition*. (Unpublished doctoral dissertation). University of Maryland.

Göksel, A. & Kerslake, C. (2005). *Turkish, A comprehensive grammar*. London: Routledge.

Grice, H. P. (1975). Logic and conversation. P. Cole & J. Morgan (Eds.), *Syntax and Semantics, vol. 3: Speech Acts* (pp. 41–58). London: Academic Press.

Gualmini, A. & Schwarz, B. (2009). Solving learnability problems in the acquisition of semantics. *Journal of Semantics*, 26, 185-215.

Lieven, E. V. M. & Tomasello, M. (2008). Children's first language acquisition from a usage-based perspective. In, P. Robinson & N. Ellis (Eds.), *Handbook of Cognitive Linguistics and Second Language Acquisition* (pp.168–196). New York: Routledge.

de Morgan, A. (1966). On the syllogism and other logical writings. In P. Heath (ed.), London: Routledge and Kegan Paul.

MacWhinney, Brian. 2000. *The CHILDES Project: Tools for Analyzing Talk*. Mahwah, NJ,Lawrence Erlbaum Associates. Third Edition. Vol 2: The Database.

Morris, B. (2008). Logically speaking: evidence for item-based acquisition of the connectives AND and OR. *Journal of Cognition and Development*, 9 (1), 67–88.

Musolino, J. (2006). On the semantics of the subset principle. *Language Learning and Development*, 2, 195-218.

Neimark, E. D. (1970). Development of comprehension of logical connectives: understanding of "or." *Psychonomic Science*, 21, 217–219.

Nilson, B. (1985). *Case marking semantics in Turkish.* (Unpublished doctoral dissertation). University of Stockholm.

Paterson, K. B., Liversedge, S. P., Rowland, C. & Filik, R. (2003). Children's comprehension of sentences with focus particles. *Cognition*, 89, 263–294.

Piaget, J. (1969). *The mechanisms of perception*. London: Rutledge & Kegan Paul.

Szabolcsi, A. (2002). Hungarian disjunctions and positive polarity. In I. Kenesei & P. Siptar (Eds.), *Approaches to Hungarian 8* (pp. 217–241). Budapest: Akademiai Kiado.

Tomasello, M. (2000). First steps toward a usage-based theory of language acquisition. *Cognitive Linguistics,* 11 (1), 61–82.

Tomasello, M. (2003).*Constructing a Language: A Usage based Theory of Language Acquisition*. Cambridge: Harvard University Press.

Chapter 3

The interpretation of logical connectives in Turkish

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[5] The final version of the paper is included.

Abstract

This study investigated how Turkish-speaking children and adults interpret negative sentences with disjunction (English *or*) and ones with conjunction (English *and*). The goal was to see whether Turkish-speaking children and adults assigned the same interpretation to both kinds of sentences and, if not, to determine the source of the differences. Turkish-speaking children and adults were found to assign different interpretations to negative sentences with disjunction just in case the nouns in the disjunction phrase were marked with accusative case. For children, negation took scope over disjunction regardless of case marking whereas, for adults, disjunction took scope over negation if the disjunctive phrases were case marked. Both groups assigned the same interpretation to negative sentences with conjunction; both case marked and non-case marked conjunction phrases took scope over negation. The findings are taken as evidence for a 'subset' principle of language learnability that dictates children's initial scope assignments.

Key words: conjunction, disjunction, Turkish

INTRODUCTION

Languages vary in the way in which words for disjunction and for conjunction are interpreted in negative sentences. These interpretive differences can be attributed to variation in the scope relations between negation and logical connectives (Crain, 2012; Goro, 2004; 2007). Consider the English sentence *The pig did* ***not*** *eat the carrot* ***or*** *the pepper*. Here the negative marker *not* takes scope over the disjunction word *or*. For English-speaking children and adults the sentence entails that the pig did not eat the carrot and it entails that the pig did not eat the pepper. However, if the English sentence *The pig did not eat the carrot or the pepper* is translated into many other languages, including Mandarin Chinese, the corresponding sentences do not generate these entailments (Crain, 2012; Jing, Crain & Hsu, 2005). In Mandarin Chinese, the corresponding sentence can be paraphrased as *It was either the carrot or the pepper that the pig did not eat.* We can understand these cross-linguistic differences in terms of scope. In English, negation takes scope over disjunction, whereas disjunction takes scope over negation in Mandarin. Turkish turns out to be more complex. Turkish patterns like Mandarin, when a disjunctive phrase is marked with accusative case, but it patterns like English when a disjunctive phrase is not case marked. One of the goals of the present study was to see how children acquire a language like Turkish, i.e., one with 'mixed' scope assignments.

Turning to negative sentences with conjunction, another pattern is revealed across languages. The English sentence *The pig did* ***not*** *eat (both) the carrot* ***and*** *the pepper* is true in circumstances in which the pig did not eat both the carrot and the pepper, and in circumstances in which the pig ate neither one. This range of truth conditions is generated in English because negation takes scope over conjunction, both in the surface syntax and at the level of semantic interpretation, just as in classical logic. However, if the English sentence *The pig did not eat (both) the carrot and the pepper* is translated into Mandarin Chinese, Japanese, Russian or Turkish, the corresponding sentences generate different scope relations,

according to which conjunction takes scope over negation. This yields an interpretation that can be paraphrased as *It was (both) the carrot and the pepper that the pig did not eat*. In summary, English negation takes scope over both logical connectives, disjunction and conjunction, in negative sentences, whereas the pattern is reversed in many other languages, and Turkish adds an unexpected wrinkle involving case marking in negative sentences with disjunction phrases.

The focus of the present study is on the acquisition of scope relations by Turkish-speaking children. For adult Turkish-speakers, scope relations are determined in part by case marking. Based on a recent proposal about language learnability and parametric variation, we anticipated that there would be both similarities and differences in scope assignments made by Turkish-speaking children, as compared to Turkish-speaking adults. Differences in the interpretations that are assigned by child and adult language-users are important data for theories of language acquisition.

The present study investigated a theoretically motivated account of the different interpretations of negative sentences with logical connectives by child and adult Turkish-speakers. Adopting a theory of scope assignment, and a principle of language learnability, we investigated the possibility that Turkish-speaking children and adults would differ in the interpretations they assign to negative sentences with disjunction phrases, but that these differences would not appear in negative sentences with conjunction phrases. If these predictions are upheld, this would provide evidence that is difficult to accommodate by an experience-based approach to language learning. Moreover, confirming differences between child and adult language that are predicted by linguistic theory would augment the growing body of evidence that children's linguistic competence receives assistance from Universal Grammar (Chomsky, 1965; 1981; 1995). Before we turn to the experimental predictions, we briefly review some basic facts about the scope assignments that are generated by Turkish-speaking adults.

Conjunction in negative sentences

Turkish is a head-final language, with extensive case marking. Reminiscent of the Japanese *mo-…mo-* construction, Turkish nouns in conjunction phrases are often preceded by the particle *hem… hem (de),* as illustrated in (1) and (2). In addition, these conjoined noun phrases can either be accusatively case marked, as in (1), or they can contain bare nouns, as in (2). Sentences (1) and (2) exhibit the same scope relations, with conjunction taking scope over negation at the level of semantic interpretation. It follows from this observation that accusative case marking is not a necessary ingredient for scope assignment of conjunction phrases in Turkish.

(1) Domuz-cuk ***hem*** havuc-u ***hem (de)*** biber-i ye-***me***-di.
Pig-DIM both carrot-ACC both also pepper-ACC eat-NEG-PAST
'The pig didn't eat a certain carrot and the pig didn't eat a certain pepper'

(2) Domuz-cuk ***hem*** havuç ***hem (de)*** biber ye-***me***-di.
Pig-DIM both carrot both (also) pepper eat-NEG-PAST
'The pig didn't eat carrots and the pig didn't eat peppers'

The markers *hem…hem (de)* are not a necessary ingredient for determining scope relations in Turkish. Although *de* is optional in sentences such as (1) and (2), when it is omitted it may be possible for adult speakers of Turkish to access the 'not both' reading of the conjunctive phrase.

In sentences (3) and (4), the *hem…hem (de)* particles have been replaced by the Turkish word for conjunction *ve*. As in (1) and (2), the nouns in the conjunction phrase are marked with accusative case in (3), but not in (4). Despite these changes in syntactic structure, sentences (3) and (4) retain the same scope relations that are exhibited by (1) and (2), with the conjunction phrase taking scope over negation at the level of semantic interpretation, though not in the surface syntax (where negation c-commands the conjunction phrases).

(3) Domuz-cuk havuc-u ***ve*** biber-i ye-***me***-di.
Pig-DIM carrot-ACC and pepper-ACC eat-NEG-PAST
'The pig didn't eat a certain carrot and the pig didn't eat a certain pepper'

(4) Domuz-cuk havuç ***ve*** biber ye-***me***-di.
Pig-DIM carrot and pepper eat-NEG-PAST
'The pig didn't eat carrots and the pig didn't eat peppers'

Alternatively, the particle construction with *hem… hem (de)* or the conjunction word *ve* can be replaced by the clitic *dA*. The nouns that are conjoined can be marked with accusative case, as in (5) or without case marking, as in (6). The clitic *dA* is a conjunction and connective with several discourse functions, being additive and adversative, and having continuative/topic-shifting and enumerating functions. It occurs after stressed constituents, except when it functions as a continuative/topic-shifting element (Göksel & Kerslake, 2005:101). Again, there is no change in interpretation. The *da…da* phrase takes scope over negation at the level of semantic interpretation.

(5) Domuz-cuk havuc-u ***da*** biber-i ***de*** ye-***me***-di.
Pig-DIM carrot-ACC both pepper-ACC both eat-NEG-PAST

‘It was both a certain carrot and a certain pepper that the pig didn’t eat’

(6) Domuz-cuk havuç ***da*** biber ***de*** ye-***me***-di.

Pig-DIM carrot both pepper both eat-NEG-PAST

‘It was both carrots and peppers that the pig didn’t eat’

These facts lead us to conclude that, in adult Turkish, conjunction phrases always take scope over negation.

Disjunction in negative sentences

The interpretation of disjunction in negative sentences in Turkish is more complex. As with conjunction, there are three lexical items in Turkish for expressing disjunction, *ya… ya da* ‘either or’, *veya* ‘or’ and *ya da* ‘or’ (Göksel & Kerslake, 2005). The complication is that regardless of the lexical expression that is used, disjunction phrases sometimes take scope over negation, and sometimes do not. The critical feature is accusative case marking. Consider example (7), where the disjunction phrase contains the expression *ya… ya da* ‘*either or’* and is accusatively case marked. The interpretation of (7) can be paraphrased using an English cleft structure in which the disjunction phrase (*havucu* ***ya da*** *biberi*) is positioned higher than negation in the surface syntax: *It was either a certain carrot or a certain pepper that the pig did not eat*.

(7) Domuz-cuk ***ya*** havuc-u ***ya da*** biber-i ye-***me***-di.

Pig-DIM either carrot-ACC or pepper-ACC eat-NEG-PAST

‘It was either a certain carrot or a certain pepper that the pig didn't eat’

In Turkish, however, the disjunction phrase precedes negation in (7), and is positioned in the scope of negation in the surface syntax. Nevertheless, the disjunction phrase takes scope over negation at the level of semantic interpretation, just as it does in the cleft structure we have used in the English gloss for example (7). These observations suggest that, in Turkish, an accusatively marked disjunction phrase is 'raised' to take scope over negation at the level of semantic interpretation. In any event, surface syntax in Turkish does not dictate the semantic interpretation, either for accusative case marked disjunction phrases or for conjunction phrases (whether or not they are case marked). In these kinds of negative sentences, Turkish enforces 'inverse' scope relations between both logical connectives (conjunction or disjunction) and negation.

There is an exception to the rule that Turkish enforces 'inverse' scope assignments. The exception is illustrated in (8). Although (8) exhibits the same word order and surface syntactic structure as sentence (7), negation takes scope over the disjunction phrase (*havuç **ya da** biber*) in (8), just as it does in the corresponding English sentence *The pig did **not** eat the carrot **or** the pepper*. The only difference between (7) and (8) is the absence of case marking in (8). Without case marking, a Turkish disjunction phrase is interpreted in its surface syntactic position (*in situ*). Consequently, sentence (8) generates the same kind of conjunctive entailment as the English sentence *The pig did **not** eat the carrot **or** the pepper*. That is, sentence (8) entails that the pig didn't eat carrot(s) and that the pig didn't eat pepper(s). In short, accusative case marking is a prerequisite for the inverse scope relations between disjunction and negation in Turkish. Without accusative case marking, the surface syntax dictates scope relations in Turkish, as in English.

(8) Domuz-cuk	havuç	***ya da***	biber	ye-***me***-di.
Pig-DIM	carrot	or	pepper	eat-NEG-PAST

'The pig didn't eat carrots and the pig didn't eat peppers'

In the next section, we show that the surface scope relations in (8) mirror the laws of propositional logic.

LOGIC AND LANGUAGE

First we discuss disjunction. In classical logic, a negative formula with disjunction entails the negation of each of the disjuncts. Let us show why, step-by-step. First, disjunction in classical logic is inclusive-*or*. Consider the formula (A ∨ B), where '∨' is the symbol for disjunction. The formula (A ∨ B) is true in three cases: if A is true but not B, if B is true but not A, and if both A and B are true. A statement of the form (A ∨ B) is false, therefore, only if both A and B are false. In symbols, the formula ¬ (A ∨ B) excludes the possibility of A and it excludes the possibility of B. Therefore, the negation of the formula (A ∨ B), in symbols ¬ (A ∨ B) is <u>true</u> just in case both A and B are false. It follows from these observations that ¬ (A ∨ B) logically entails (¬A ∧ ¬B), where '∧' is the symbol for conjunction and '⇒' indicates logical entailment. This logical equivalence is captured in one of the laws of propositional logic: ¬ (A ∨ B) ⇒ (¬A ∧ ¬B).

Negated disjunctions in English conform to this law of propositional logic. The sentence *The pig did not eat the carrot or the pepper* can be (very roughly) rendered symbolically as ¬ (A ∨ B), and this English sentence generates a 'conjunctive' entailment that the pig did not eat the carrot and that the pig did not eat the pepper, which can be rendered symbolically as (¬A ∧ ¬B). Sometimes Turkish disjunction phrases generate a conjunctive interpretation in negative sentences, namely when the nouns in a disjunction phrase are not marked with accusative case. In such sentences, Turkish conforms to the law under discussion: ¬ (A ∨ B) ⇒ (¬A ∧ ¬B). However, when the disjunction phrase is accusatively case marked in Turkish, the disjunction phrase is interpreted as taking scope over negation.

These sentences are true if just one of the disjuncts is false (or if both are). The interpretation generated by this scope assignment (OR > NOT) corresponds to the logical formula ($\neg A \vee \neg B$), which only excludes the possibility of both A and B being true. Because the disjunction phrase takes scope over negation in the semantic representation of these sentences, the law of propositional logic under discussion does not apply.

In negative sentences with conjunction, another law of propositional logic is relevant, $\neg (A \wedge B) \Rightarrow (\neg A \vee \neg B)$. English negative sentences with conjunction conform to this law. Consider, for example, the English sentence *The pig did not eat (both) the carrot and the pepper*. This sentence can be rendered symbolically as $\neg (A \wedge B)$, with negation taking scope over the conjunction phrase (NOT > AND). The English sentence entails that the pig did not eat the carrot or did eat the pepper ('not both'), as in the formula ($\neg A \vee \neg B$). This shows that English adheres to the law under consideration: $\neg (A \wedge B) \Rightarrow (\neg A \vee \neg B)$. In Turkish, by contrast, conjunction phrases always take scope over negation at the level of semantic interpretation (AND > NOT), even if negation is positioned 'higher' than the conjunction phrase in the surface syntax. In Turkish, therefore, the interpretation of negated conjunctions can be represented symbolically as ($\neg A \wedge \neg B$). Because the conjunction phrase takes scope over negation in the semantic representation, the law of propositional logic under discussion does not apply.

LEXICAL PARAMETERS

Following a suggestion by Szabolcsi (2002), Goro (2004; 2007) and Crain (2012) attribute the cross-linguistic variation in scope assignments to two lexical parameters, one governing the interpretation of conjunction in negative sentences, and one governing the interpretation of disjunction in negative sentences. According to each of the lexical parameters, there are two classes of languages. In one class, the logical expressions corresponding to disjunction or

conjunction are analyzed as Positive Polarity Items, but the corresponding logical expressions are not Positive Polarity Items in the other class of languages.

By definition, a Positive Polarity Item (PPI) must take scope over negation. English *some* meets this definition when it is stressed, as (9) illustrates.

(9) Ted did**n't** eat **some** kangaroo.

'There is some kangaroo that Ted didn't eat'

If *some* were to be interpreted within the scope of negation, the sentence would mean that Ted didn't eat <u>any</u> kangaroo. Instead, it means that there is <u>some</u> kangaroo that Ted did <u>not</u> eat, where the logical expression *some* takes scope over *not*. We can represent this symbolically using the existential quantifier, ∃, to encode the semantics of English *some*, i.e., (∃ > NOT). We can cast the different scope relations using a lexical parameter. Let us call this parameter P. One value of parameter P enforces a polarity restriction, forcing the English PPI *some* to take scope over negation. Let us indicate this value of parameter P with the 'positive' feature [+PPI]. The other value, [–PPI], allows the expression under consideration to be interpreted where it sits in the surface syntax (*in situ*). Interestingly, Moscati and Crain (2014) propose that English-speaking children initially analyze *some* as [–PPI], to avoid potential learnability problems that would otherwise arise. We discuss this in the next section.

The parametric account of scope assignments was extended to the logical connectives, disjunction and conjunction, by Goro (2004; 2007) and by Crain (2012), respectively. They propose two lexical parameters, which we will refer to as the Disjunction parameter and the Conjunction parameter. The Disjunction parameter has a [+PPI] value in one class of languages, and a [–PPI] value in another class of languages. For instance, the Japanese disjunction operator, *ka*, takes scope over negation at the level of semantic interpretation (although not in the surface syntax). Therefore, Japanese adopts the [+PPI] setting of the

Disjunction parameter. However, English *or* is not a Positive Polarity Item, since negation takes scope over disjunction in English. Therefore, the English value of the Disjunction parameter is [–PPI].

As in Japanese, Turkish disjunction phrases sometimes take scope over disjunction. This happens when the nouns contained in the disjunction phrase bear accusative case. Otherwise, negation takes scope over the disjunction phrase. It follows from this that disjunction words in Turkish are neither [+PPI] nor [–PPI]. Rather, the accusative case marker determines whether or not a disjunction phrase is 'raised' at the level of semantic interpretation. We propose, therefore, that Turkish disjunction words (*ya da/veya*) are [–PPI]; however, the Turkish accusative case marker, *–(y)ı,* is [+PPI]. This explains why bare disjunction phrases generate a conjunctive entailment in negative sentences in Turkish, just as they do in English. When disjunction phrases are marked with accusative case, however, they take scope over negation.

Another lexical parameter is the Conjunction parameter. This parameter determines the scope assignment of conjunction phrases in negative sentences across languages. In languages where the conjunction marker is [+PPI], conjunction takes scope over negation at the level of semantic interpretation. If the value for conjunction is [–PPI], then negation takes scope over the conjunction phrase. As in Mandarin-Chinese and in Japanese, Turkish conjunction phrases always take scope over negation, so Turkish conjunction words are [+PPI], in contrast to English.

THE LEARNABILITY PROBLEM

The question of language learnability is to explain how children figure out when disjunction does and does not take scope over negation in Turkish. As we have seen, word order does not always provide the relevant cue. Children must become (implicitly) aware that case marking

is critical for semantic interpretation in deriving the adult scope assignments for negative sentences with disjunction.

For the sake of argument, suppose that Turkish-speaking children interpret negative sentences with disjunction phrases that are not accusatively case marked on analogy with ones that are accusatively case marked. If so, Turkish-speaking children would assign a non-adult interpretation to negative sentences with disjunction phrases lacking accusative case marking. Children would use the scope assignment (OR > NOT), whereas adults would use the scope assignment (NOT > OR). This raises a problem of language learnability; namely, how children come to jettison their non-adult interpretations from their grammars.

To appreciate the dilemma children face, the critical observation is that the circumstances that make sentences true when the disjunction phrase takes scope over negation (OR > NOT) constitute a superset of the circumstances that make these same sentences true on the alternative scope assignment (NOT > OR). Putting it differently, the [+PPI] value of the (accusative case marking) parameter in Turkish makes sentences true in a superset of the circumstances that correspond to the [–PPI] value of the parameter that applies to sentences without accusative case marking on the noun phrases in the disjunction. We can verify this subset/superset relation in scope assignments by comparing the truth conditions of the Turkish examples (7) and (8). In sentence (7) *Domuzcuk ya havucu ya da biberi yemedi*, the disjunction phrase takes scope over negation (OR > NOT), because the nouns in the disjunction phrase are marked with accusative case. Consequently, (7) can be paraphrased using an English cleft structure – *it was either a certain carrot or a certain the pepper that the pig did not eat*. This sentence is true in three sets of circumstances: ones in which (i) the pig only ate a certain pepper, (ii) the pig only ate a certain carrot, and (ii) the pig did not eat either one. Now consider the truth conditions associated with sentence (8) *Domuzcuk havuç ya da biber yemedi*. Here the nouns in the disjunction phrase lack accusative case, so the disjunction phrase is [–PPI]. The meaning of this sentence can be paraphrased in English using a

combination of two negative statements –*The pig didn't eat carrot* and *the pig didn't eat pepper*. That is, sentence (8) generates a conjunctive entailment, such that it is only true in one of the circumstances corresponding to sentence (7), namely in circumstances in which the pig did not eat carrots and did not eat peppers (NOT > OR). Therefore, (8) is true in a subset of the circumstances corresponding to (7). In sum, if children uniformly treat disjunction phrases as [+PPI], then they will overgenerate, always allowing sentences with disjunction to be true in three sets of circumstances, while adults only allow the [+PPI] value of the parameter for disjunction phrases that are accusatively case marked.

THE SEMANTIC SUBSET PRINCIPLE

A potential problem of language learnability arises in cases like this, when the truth conditions corresponding to one scope assignment (OR > NOT) constitute a superset of the truth conditions that correspond to the alternative scope assignment (NOT > OR). Whenever scope relations are in this kind of subset/superset relationship, children potentially confront what is called a 'subset problem' (Berwick, 1985). In a nutshell, a subset problem arises if children initially adopt the scope assignment that generates the superset truth conditions. Whenever adults produce a relevant negative sentence, it is true in one of the circumstances that children associate with the sentence. In the absence of negative evidence (or some substitute for it), children who initially adopt the superset scope assignment would therefore be hard-pressed to retreat to the alternative subset interpretation based on input from adults. If one concedes that there is insufficient negative evidence of the appropriate kind and at the appropriate time to promote grammar formation (Brown & Hanlon, 1970; Morgan & Travis, 1989; Marcus, 1993), then it seems reasonable to conclude that children do not initially adopt the scope assignment that generates the superset interpretation. This guarantees that children will encounter relevant input if adult speakers of the local language adopt the superset value

of the lexical parameter. To ensure that children do not confront such learnability problems, it has been proposed that they adhere to a principle of language learnability called the Semantic Subset Principle (SSP) (Crain, Ni & Conway, 1994; Crain, 2012).

The Semantic Subset Principle (SSP) assigns a learnability ordering to the value of certain lexical parameters, namely ones where one value makes sentences true in a subset of circumstances that correspond to the other value. To avoid learnability problems, the SSP instructs children to initially adopt the subset value of the lexical parameter. For this reason, the SSP dictates that negation must initially take scope over disjunction phrases for child language learners, across languages. According to the SSP, therefore, Turkish-speaking children are predicted to initially analyse negation as taking scope over disjunction phrases regardless of whether or not the nouns in the disjunction phrase are case marked. It follows that Turkish-speaking children will differ from adults in the scope relations they assign to negative sentences with accusative case marked disjunction phrases.

As we have seen, Turkish-speaking adults interpret disjunction phrases as taking scope over negation in such sentences. So, adults adopt the [+PPI] value for such disjunction phrases. The Semantic Subset Principle predicts that, in contrast to adults, Turkish-speaking children start off with the default value [–PPI]. That is, children are expected to initially generate conjunctive entailments to all negated disjunctions, regardless of case marking. This ensures that children will have access to positive evidence informing them that adult speakers of Turkish adopt the alternative [+PPI] value of the parameter. We tested this prediction with both children and adults. In contrast to negated disjunction, both Turkish-speaking children and adults were predicted to make the same scope assignments in interpreting negative sentences with conjunction phrases. As we have seen, Turkish-speaking adults are expected to adopt the ‘subset’ value of the Conjunction Parameter, such that they generate conjunctive entailments for negative sentences with conjunction phrases, regardless of case marking. Supposing that children initially assign the subset value of the Conjunction parameter,

children are predicted to generate the same scope assignments as adults do to negative sentences with conjunction phrases. Before turning to our empirical investigations of Turkish-speaking children and adults, we will briefly review the findings from previous studies of the acquisition of disjunction and conjunction in negative sentences.

LOGICAL CONNECTIVES IN CHILD LANGUAGE

Children's interpretation of disjunction in English negative sentences was investigated in a number of studies (e.g., Chierchia, Crain, Guasti, Gualmini, & Meroni, 2001, Gualmini & Crain 2002; 2004; 2005). One representative study, by Crain, Gardner, Gualmini and Rabbin (2002), used a Truth Value Judgment task to investigate the interpretation that 4- to-5-year-old children assigned to disjunction in negative sentences with different syntactic structures. In one condition, the negative marker did not take scope over disjunction in the surface syntax, as in *The girl who did**n't** go to sleep will get a dime **or** a jewel*. In the other condition, the negative marker took scope over disjunction in the surface syntax, as in *The girl who stayed up late will **not** get a dime **or** a jewel*. The difference in the structural configuration resulted in different semantic interpretations for children. When negation took scope over disjunction in the surface syntax, children assigned a conjunctive entailment to the disjunction phrase. So, children interpreted *The girl who stayed up late will **not** get a dime **or** a jewel* to entail that the girl would not get a dime <u>and</u> would not get a jewel. This explains the fact that children rejected this sentence in a circumstance in which the girl received a dime, but not the jewel. No such entailment was generated in the other sentence *The girl who did**n't** go to sleep will get a dime **or** a jewel* where negation failed to take scope over disjunction in the surface syntax; children accepted this sentence in a circumstance in which the girl received a dime, but not a jewel.

A number of previous studies used a similar methodology to investigate how children interpret disjunction in simple negative sentences in a number of languages. The initial study was by Goro and Akiba (2004a,b; Goro, 2004; 2007), who investigated the interpretation that thirty 3-to-6-year-old Japanese-speaking children assigned to the disjunction word, *ka*, in simple negative sentences. The experiment was in the form of a game about different animals and what they chose to eat. The child watched the game alongside a puppet, Kermit the Frog. Each of the animals featured in a colorful story book was asked, in turn, to choose among three food items: a cake, a pepper and a carrot. Of course, all of the animals chose to eat the cake, but some animals ate vegetables and some did not. If an animal chose both vegetables, the child was invited to reward it with a gold medal. If an animal ate only one of the vegetables, the child rewarded it with a silver medal. If it refused to eat either vegetable (and chose just the cake) it received a black cross. After the animals had all been rewarded, the food items were removed. This experimental manoeuvre made it appropriate to use disjunction, even to describe past events, because it was no longer obvious which of the vegetables the animal had eaten. The puppet guessed what each animal had eaten, based on the reward it had received. The child's task was to judge the puppet's statements. The silver medal condition contained the critical test sentences, including four items with negated disjunctions such *as Butasanwa ninjin* ***ka*** *piimanwo tabe****nakat****ta* ('The pig didn't eat the carrot or the pepper'). If children assigned a conjunctive interpretation to the disjunction word, as predicted by the Semantic Subset Principle, they were expected to reject the test sentences on the silver medal condition.

The main finding was that Japanese-speaking children rejected the test sentences when the animal had received a silver medal 75% of the time, whereas adult Japanese-speakers consistently accepted the same test sentences in such circumstances. This finding suggests that, in contrast to adults, Japanese-speaking children initially analyse the disjunction word *ka* as [–PPI], which is the 'subset' value of the Disjunction Parameter. Similar findings resulted

from studies using the same methodology in Mandarin Chinese, Korean, Russian, and German (Jing, Crain & Hsu, 2005; Lee, 2010; Verbuk, 2007; Geçkin, Thornton & Crain, in prep.) The evidence therefore suggests that children acquiring all of these languages initially adopted the same 'subset' scope assignments, with negation taking scope over disjunction phrases, regardless of the scope assignments favoured by adult speakers (Crain, 2012).

English-speaking children's interpretation of conjunction in negative sentences was also investigated using the Goro and Akiba methodology. In a study by Crain, Goro, Notley and Zhou (2013), 21 3-to-5-year-old English-speaking children and a control group of adults were asked to judge negative sentences with the conjunction operator *both…and* as in *The pig did not eat both the carrot and the pepper*. In the silver-medal condition, where the animal had eaten only one of the vegetables, adults accepted the test sentences 88% of the time, whereas children rejected them 98% of the time. This finding was interpreted as evidence that English-speaking children, in contrast to adults, initially assign the 'subset' [+PPI] value of the Conjunction parameter.

This previous literature has demonstrated striking cross-linguistic similarities in children's initial interpretations of negated disjunction phrases and negated conjunction phrases, regardless of the interpretation that is favoured by adult speakers of the local language. The findings are evidence that children initially assign the default values of the Disjunction Parameter, [–PPI], and the Conjunction Parameter, [+PPI], as predicted by the Semantic Subset Principle. An experiment was designed to evaluate the same predictions in Turkish.

EXPERIMENT

Experiment and predictions

The experiment investigated whether or not Turkish-speaking children assign the same scope relations as adults when they interpret negative sentences with conjunction phrases and ones with disjunction phrases. If children acquiring Turkish are guided by the adult input, then children and adults are not expected to differ in their interpretations of the test sentences. On the other hand, if Turkish-speaking children are constrained by the Semantic Subset Principle, then they are expected to assign a conjunctive interpretation to the test sentences regardless of whether or not these phrases generate a conjunctive interpretation for adult speakers of the local language.

Participants

Fifty-seven child and adult participants took part in the experiments. There were 31 child participants, all monolingual speakers of Turkish. Five of these children were excluded from the analysis, however, because they failed to complete both sessions of the study. The remaining 26 children took part in Conditions 2 and 3 (mean age = 4; 7, SD = .50, 4; 1-5; 11 years) and 22 of these children also took part in Conditions 1 and 4 (mean age = 4; 7, SD = .48, 4; 1-5; 11 years). We also interviewed 26 adults in all four conditions (mean age = 20; 1, SD = 2.40, 18-27 years). All participants were from middle-class families, and had no known record of speech, hearing or language impairment. Each participant was tested individually in two experimental sessions lasting roughly 15-20 minutes; the two sessions were administered on different days.

Procedures

The experiment used the version of the Truth Value Judgment task originally designed by Goro and Akiba (2004a,b) (cf. Crain & Thornton, 1998). There were two experimenters. One

experimenter manipulated a puppet who looked at a story book alongside the child participant. The story book was described by the other experimenter. A different animal appeared on each page of the story book. All of the animals were introduced in turn, and each was invited to participate in an eating-game. The game was to see which animals would eat their vegetables, a carrot and a green pepper. As the child was taken through the pages of the story book, the child participants were instructed to award medals to each of the animals, depending on how many vegetables it had eaten. The child was instructed to give the animal a gold medal sticker if it managed to eat both the carrot and the pepper. We will call these Gold-Medal contexts. If the animal only managed to eat one of the vegetables, but not both of them, then the child was instructed to reward it with a silver medal sticker. These will be called Silver-Medal contexts. Finally, the child gave an animal a sad face sticker if it did not manage to eat either of the vegetables. These are called Sad-Face contexts.

To ensure that each child participant understood the reward system, there was a training session with three items. In the training section the children were asked to reward the animal with one of the 3 medals, depending on what it ate. Following the training session, the child proceeded to the main session. In the main session, 12 animals participated in the eating-game. Four animals were rewarded with a gold medal, 4 others were rewarded with a silver medal and 4 others were rewarded with a sad face. The items of each kind were randomized in each of the four Conditions. Following the first run-through of the story book, where the animals selected vegetables and received awards, the vegetables were removed. Then, the experimenter went through the story book again. This time, the experimenter asked the puppet to tell the child what each of the 12 animals had eaten. On each trial, the puppet indicated that he couldn't remember what the animal had eaten, so he would have to guess, based on the reward that the animal had received. The child’s task was to judge whether these sentences produced by the puppet were true or false. Whenever children rejected the puppet’s

statement, they were asked to “tell the puppet why it was wrong”. The test sentences produced by the puppet were pre-recorded by a female native speaker of Turkish.

The child participants were tested in a quiet room in their kindergarten. Adult participants were tested on the university campus. The testing was conducted by the first author, who is a native speaker of Turkish. Children’s responses and justifications for their rejections were audio-recorded. They were later transcribed to document children’s justifications for their rejections of the puppet’s statements. A reliability check was made by another native speaker of Turkish. There were no conflicts between the two coders.

Materials

The test sentences in Condition 1 contained disjunction phrases without accusative case marking. In Condition 2, the test sentences contained conjunction phrases marked with accusative case. In Conditions 3 and 4, the target sentences contained disjunction phrases that were marked with accusative case. The difference between the target sentences was that the sentences in Condition 3 contained the disjunction word *ya…ya da* ‘either or’ whereas the sentences in Condition 4 contained the disjunction word *veya* ‘or.’ In the main session, each condition had 12 randomized sentences. 4 of these sentences were true in the Gold-Medal contexts, the other 4 were true in the Silver-Medal contexts and the final 4 sentences were true in the Sad-Face contexts. Here are the examples of test sentences from all four conditions.

Condition 1: Sentences with uninflected disjunction phrases (*veya* ‘or’)

Bu	hayvan-cık	havuç	***veya***	biber	ye-***me***-di.
This	animal-DIM	carrot	or	pepper	eat-NEG-PAST

‘This animal did not eat carrots or peppers’

Condition 2: Sentences with inflected conjunction phrases (*hem…hem de* ‘both…both also’)

Bu hayvan-cık ***hem*** havuc-*u* ***hem de*** biber-*i* ye-***me***-di.

This animal-DIM both carrot-ACC both also pepper-ACC eat-NEG-PAST

‘This animal did not eat both (a certain) carrot and also (a certain) pepper’

Condition 3: Sentences with inflected disjunction phrases (*ya…ya da* ‘either or’)

Bu hayvan-cık ***ya*** havuc-*u* ***ya da*** biber-*i* ye-***me***-di.

This animal-DIM either carrot-ACC or pepper-ACC eat-NEG-PAST

‘This animal did not eat a certain carrot or a certain pepper’

Condition 4: Sentences with inflected disjunction phrases (*veya* ‘or’)

Bu hayvan-cık havuc-*u* ***veya*** biber-*i* ye-***me***-di.

This animal-DIM carrot-ACC or pepper-ACC eat-NEG-PAST

‘This animal did not eat a certain carrot or a certain pepper’

Summary of predictions

The target sentences in Conditions 1 and 2 were both expected to yield a conjunctive interpretation. The meanings of the test sentences in both conditions can be paraphrased as *This animal did not eat the carrot and did not eat the pepper*. In Condition 1, this meaning is expected to be derived because negation takes scope over the disjunction phrase (havuç ***veya*** biber ‘carrot or pepper’). We have indicated this scope assignment as (NOT > OR). In Condition 2, the same meaning is derived by a different route. In sentence (2), the conjunction phrase (***hem*** havuc*u* ***hem de*** biber*i* ‘carrot and pepper’) takes scope over negation. We have indicated this scope assignment as (AND > NOT). It is pertinent to note that the (NOT > OR)

meaning corresponds to the subset value of the Disjunction Parameter, and the (AND > NOT) meaning corresponds to the subset value of the Conjunction Parameter. Therefore, the Semantic Subset Principle predicts that children will initially make the same scope assignments that are characteristic of adult Turkish speakers. If these predictions are upheld, then both groups of participants should reject the target sentences in the Silver-Medal contexts, where the reward indicates that the animal has eaten just one of the vegetables. The circumstances in which the animal eats just one of the vegetables are ruled out by the conjunctive interpretation. The conjunctive interpretation associated with (NOT > OR) in Condition 1 and with (AND > NOT) in Condition 2 are both true if and only if the animal eats neither of the vegetables. It follows that both children and adults were expected to reject the test sentences in Conditions 1 and 2 in the Gold-Medal and Silver-Medal contexts, and to accept them in the Sad-Face contexts.

If children acquiring Turkish are guided by the Semantic Subset Principle, then they are expected to manifest the same pattern of responses in Conditions 3 and 4, as in Conditions 1 and 2. Children are expected to assign the subset meaning (NOT > OR) to both sentence types. Children are expected to accept the test sentences in the Sad-Face contexts, but to reject them in the Gold-Medal and Silver-Medal contexts. This follows from the prediction that, for children, Turkish disjunction is [–PPI] and conjunction is [+PPI]; these are the subset values of the Disjunction Parameter and the Conjunction Parameter, respectively.

In contrast to children, we have seen that the accusative case marker is associated with the [+PPI] value of the lexical parameter for Turkish-speaking adults. Therefore, adults are expected to assign the meaning according to which disjunction phrases are forced to ‘raise’ at the level of semantic interpretation to take scope over negation (OR > NOT). Therefore, adult Turkish-speakers are expected to accept the target sentences in the Silver-Medal contexts in Conditions 3 and 4, since the scope assignment for these sentences only requires that the animal under consideration did not eat one of the vegetables. As in Conditions 1 and 2, both

children and adults are expected to reject the test sentences in Conditions 3 and 4 in the Gold-Medal contexts.

Table 1 provides a summary of the predicted patterns of responses by both children and adults in the critical Silver-Medal contexts. At this point, it is unclear how the adult participants should be expected to respond in the Sad-Face contexts in Conditions 3 and 4. For now, we will defer our discussion of the responses by the adult participants in the Sad-Face contexts. We will provide an analysis of the adult pattern of responses in the Sad-Face contexts after we report the findings, i.e., in the General Discussion.

Silver Medal Contexts			
Conditions	*Participants*	*Analysis*	*Predictions*
Condition 1	children & adults	Disjunction *veya* is [–PPI]	Reject
Condition 2	children & adults	Conjunction:*hem hem de* is [+PPI]	Reject
Condition 3	children	Disjunction *ya da* is [–PPI]	Reject
	Adults	ACC case marker –*(y)*ı is [+PPI]	Accept
Condition 4	children	Disjunction *veya* is [–PPI]	Reject
	Adults	ACC case marker –*(y)*ı is [+PPI]	Accept

Table 1: Predicted responses by children and adults in the Silver-Medal contexts

For both the child and the adult participants, Conditions 1 and 4 were administered in the first session, and Conditions 2 and 3 were administered in the second session, about a week later. This ordering was chosen to ensure that all participants encountered the two conditions with case-marked disjunction phrases in different sessions. This also ensured that

participants encountered the test sentences with different words for disjunction in different sessions.

RESULTS

The findings for the Gold-Medal context were the same for both the child and the adult participants. Both groups rejected the sentences 100% of the time in the Gold-Medal contexts, in all four conditions. We therefore limit our report of the findings to the Silver-Medal contexts and the Sad-Face contexts. Because the test sentences in Condition1 contained a disjunction phrase, whereas those in Condition 2 contained a conjunction phrase, we will report the findings separately for the two conditions.

Condition 1

In Condition 1, both Turkish-speaking children and adults were expected to assign a conjunctive interpretation to disjunction phrases without accusative case marking in negative Turkish sentences. For adults, this prediction was based on the observation that disjunction words are [–PPI] in the adult grammar. For children this prediction was based on the fact that [–PPI] is the subset value and, therefore, the default value of the Disjunction Parameter. Thus, both children and adults were expected to interpret disjunction phrases without accusative case marking in their surface syntactic position (i.e., *in situ*) in negative Turkish sentences, resulting in the (NOT > OR) reading. For these reasons, both child and adult participants were expected to reject the test sentences in the Silver-Medal contexts, and accept them in the Sad-Face contexts.

In keeping with these predictions, the child participants rejected the test sentences 95.4% of the time (84/88) in the Silver-Medal contexts, and adults rejected them 76.9% of the time (80/104) in these contexts. Although both groups showed the same pattern of rejection, a

Mann-Whitney U test showed that children assigned a conjunctive interpretation significantly more often than adults did ($z = 3.06$, $p = .002$) with a medium to large effect size ($r = 0.44$). We can only speculate on why the adult participants accepted the test sentences to a greater extent than the child participants did. Perhaps the adult participants were influenced by the fact that the majority of disjunction phrases in adult Turkish do not generate a conjunctive entailment, including disjunction phrases marked with accusative case, as in Conditions 3 and 4.

Condition 2

In Condition 2, the test sentences contained conjunction phrases marked with accusative case. As we have seen, accusative case marking is analyzed as [+PPI] in Turkish (for adults). Therefore, the conjunction phrases in Condition 2 were expected to take scope over negation at the level of semantic interpretation for adult Turkish speakers, yielding the (AND > NOT) reading. The same prediction holds for children, but for a different reason. Children were expected to analyze expressions for conjunction as [+PPI] because this is the subset value and, therefore, the default value of the Conjunction Parameter. It is interesting to note that the subset value of the Conjunction Parameter (AND > NOT) is not the same as the meaning assigned to conjunction in classical logic (NOT > AND). For conjunction, the superset value of the Conjunction Parameter yields the truth conditions for conjunction in classical logic.

Regardless of the derivation of the (AND > NOT) scope assignment, both child and adult Turkish-speakers were expected to reject the test sentences in the Silver-Medal contexts, and to accept them in the Sad-Face contexts. As predicted, both children and adults rejected the test sentences 100% of the time (104/104) in the Silver-Medal contexts. When children were asked to justify their rejections, their responses can be paraphrased in English in the same way as in Condition 1: *Because the animal got a silver medal* or *Because the animal ate one of the vegetables*. In the Sad-Face condition, neither children nor adults rejected a single

one of the test sentences (children = 0/104; adults = 0/104). The findings for Conditions 1 and 2 are summarized in Figure 1.

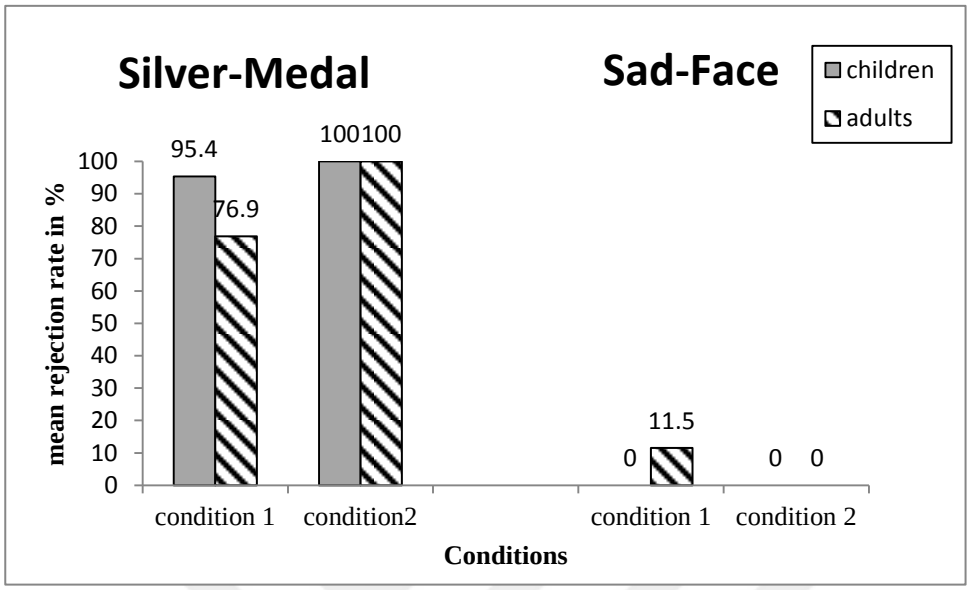

Figure 1: Mean proportions of rejections in Conditions 1 and 2

Conditions 3 and 4

The only difference between the test sentences in Conditions 3 and 4 was the particular term that was used to express disjunction. The target sentences in Condition 3 contained the disjunction word *ya…ya da* 'either or,' whereas the target sentences in Condition 4 contained the disjunction word *veya* 'or'. In both conditions, the disjunction phrases in the target sentences were marked with accusative case. We introduced this change to assess the possibility that different disjunction words would result in different scope assignments, either for children or for adults.

Before we report the findings, we will briefly review the predictions we made about the pattern of responses by children and adults in the Silver-Medal contexts in Conditions 3 and 4. For adult speakers of Turkish, accusative case marked noun phrases are [+PPI]. Disjunction phrases with case-marked nouns are therefore 'raised' to take scope over negation, yielding the (OR > NOT) reading. On this reading, adult Turkish-speakers were

expected to accept the test sentences in the Silver-Medal contexts. On the (OR > NOT) reading, sentences are true if one of the vegetables was not eaten by the animal.

Turkish-speaking children were expected to assign the [–PPI] value of the Disjunction Parameter in Conditions 3 and 4, leading children to adopt the (NOT > OR) scope assignment, in contrast to adults. The expectation was that children would adopt the [–PPI] value of the Disjunction Parameter, as dictated by the Semantic Subset Principle. On this scope assignment, the test sentences are false in the Silver-Medal contexts, so Turkish-speaking children were expected to reject the test sentences in these contexts in Conditions 3 and 4.

The Semantic Subset Principle also explains the pattern of responses by Turkish-speaking children in the Sad-Face contexts in Conditions 3 and 4. Because disjunction is [–PPI] for children, disjunction is interpreted within the scope of negation (NEG > OR). It follows that disjunction phrases generate conjunctive entailments, making the test sentences true in the Sad-Face contexts. We postpone discussion of the responses by Turkish-speaking adults in the Sad-Face contexts in Conditions 3 and 4, because the interpretation of the findings requires further theoretical background. It must suffice for now to observe that adult Turkish-speakers exhibited the completely opposite pattern of responses than children did in the Sad-Face contexts; whereas children accepted the test sentences in these contexts. In Condition 3, children accepted the test sentences 96.2% of the time, whereas adults rejected them 88.4% of the time. This difference proved to be highly significant (Mann-Whitney U test, $z = -12.21$, $p < .001$), with a large effect size ($r = 1.69$). In Condition 4, children accepted the test sentences 100% of the time, whereas adults rejected them 100% of the time. Again, the different patterns of responses by children and adults proved to be highly significant (Mann-Whitney U test, $z = -10.29$, $p < .001$), with a large effect size ($r = 1.48$).

As expected, children and adults produced different patterns of responses in the Silver-Medal contexts. In Condition 3, the child participants rejected the test sentences 87%

of the time (90/104), whereas the adult participants rejected them only 3% of the time (3/104). A Mann-Whitney U test revealed a significant difference in the response patterns of the two groups ($z = 12.10$, $p < .001$) with a large effect size ($r = 1.67$). When children were asked to explain why they rejected the test sentences, they offered the same kinds of justifications as in Conditions 1 and 2. Children's responses can be paraphrased in English as follows: *Because the animal got a silver medal* or *Because the animal ate one of the vegetables*. Both of these responses indicated that children had generated a conjunctive entailment.

In Condition 4, children and adults also produced opposite patterns of responses in the Silver-Medal contexts. Children rejected the target sentences 98.8% of the time (87/88), whereas adults rejected them only 23% of the time (24/104). A Mann-Whitney U test revealed a highly significant difference between these rates of rejection ($z = 10.56$, $p < .001$), and a large effect size ($r = 1.52$). As in Condition 3, when children were asked to explain why they rejected the test sentences in Condition 4 ("Why was the puppet wrong?") they offered two kinds of responses. Their responses can be paraphrased in English as follows: *Because the animal got a silver medal* or *Because the animal ate one of the vegetables*. Both of these kinds of responses indicated that children had generated a conjunctive entailment for the Turkish negative sentences with case-marked disjunction phrases, so the expressions that were used for disjunction had little effect on children's responses.

Figure 2 provides a summary of the findings for Condition 3 and Condition 4. As the figure indicates, the Turkish-speaking child participants consistently accepted the test sentences in the Sad-Face contexts, and rejected them in the Silver-Medal contexts. The pattern of responses by Turkish-speaking adult participants was exactly the reverse. Turkish-speaking adults accepted the test sentences in the Silver-Medal condition, and rejected them in the Sad-Face condition.

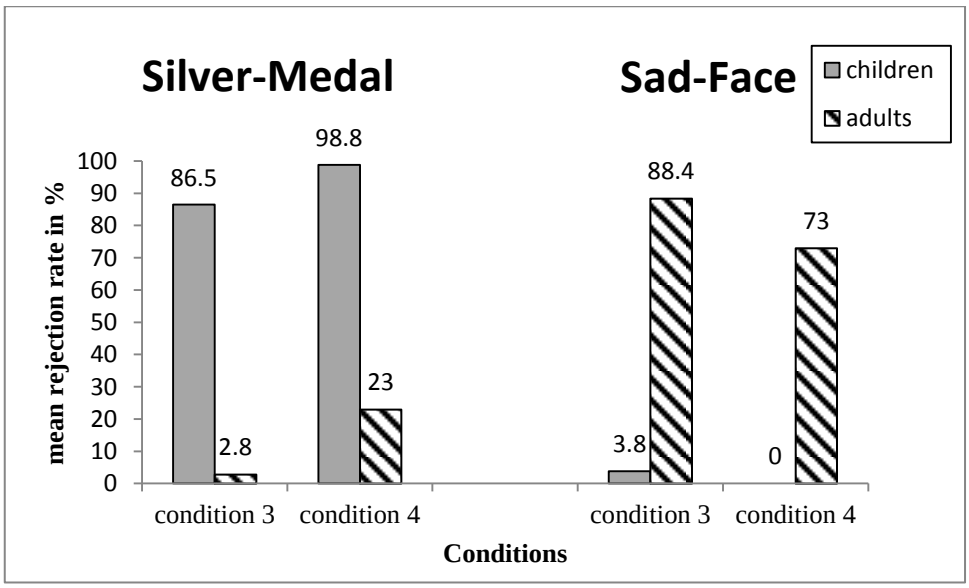

Figure 2: Mean proportions of rejections in Conditions 3 and 4

GENERAL DISCUSSION

The responses by the child Turkish-speakers in the Silver-Medal contexts in all four conditions were as predicted by the Semantic Subset Principle. This principle of language learnability dictates that children initially analyze disjunction as [–PPI], and will analyze conjunction as [+PPI], as these are the default, subset values of the Disjunction Parameter and the Conjunction Parameter. These values translate into (NOT > OR) and (AND > NOT) scope assignments, which explains why Turkish-speaking children rejected the test sentences in the Silver-Medal contexts.

The fact that adult Turkish-speakers rejected the test sentences in the Silver-Medal contexts in Condition 1, but accepted the test sentences in these contexts in Conditions 3 and 4 was also expected on the parametric account. Turkish disjunction phrases without case marking are [–PPI] for adults. This explains why negative sentences with unmarked disjunction phrases were accepted by adults in the Sad-Face contexts in Condition 1. In Conditions 3 and 4, the disjunction phrases were marked with accusative case, so these phrases were analyzed by adult Turkish-speakers as Positive Polarity Items. For adults,

therefore, these disjunction phrases take scope over negation at the level of semantic interpretation, so Turkish-speaking adults accepted negative sentences with disjunction in the Silver-Medal contexts, where one of the vegetables was eaten.

One finding remains to be explained, namely why adult Turkish-speakers consistently rejected the test sentences in the Sad-Face contexts in Conditions 3 and 4. This finding does not follow from anything we have discussed up to this point. Notice that, according to the adult value of the Disjunction Parameter in Turkish, accusatively case-marked disjunction phrases are [+PPI]. These disjunction phrases take scope over negation, (OR > NOT). From a logical point of view, therefore, the test sentences were verified for adult Turkish-speakers in the Sad-Face condition. To see this, let us paraphrase the meaning of the Turkish test sentences using an English cleft structure – *It's the carrot or the pepper that the animal didn't eat*. Clearly, this sentence is true if just the carrot, or just the pepper, wasn't eaten. But it is important to observe that, if disjunction is analyzed as inclusive-*or*, as in classical logic, then this sentence is also true if neither the carrot nor the pepper was eaten, which is the circumstance depicted in the Sad-Face contexts.

Why then did Turkish-speaking adults reject the test sentences in the Sad-Face contexts in Conditions 3 and 4? First, we wish to point out that this is not just a fact about Turkish. Adult English-speakers have the same intuition about the cleft structure in which disjunction takes scope over negation in the surface syntax – *It's the carrot or the pepper that the animal didn't eat*. English-speakers tend to reject this sentence in circumstances where neither vegetable was eaten, e.g., in the Sad-Face condition. To explain why language users reject sentences with disjunction in these circumstances, researchers have invoked pragmatic principles, in addition to principles of logic.

In ordinary conversational contexts, sentences that are logically true may nevertheless be pragmatically odd. For example, sentences can be pragmatically odd, despite being literally true, if they violate one of the basic pragmatic principles. One of the most basic

pragmatic principles is the Principle of Cooperation (Grice, 1975). The Principle of Cooperation is further articulated into a number of maxims, including the Maxim of Quantity. The Maxim of Quantity guides speakers to use sentences that convey their intended meaning using the most economical sentence at the speaker's disposal, as compared to alternative sentences that the speaker might have produced.

This pragmatic account can be invoked to explain why Turkish-speaking adults rejected the test sentences in the Sad-Face condition. Essentially, rejections by adults are due to a pragmatic implicature of 'exclusivity,' which follows from the Maxim of Quantity. The implicature results from comparing what the puppet actually said with alternative sentences that the puppet might have used. The implicature of exclusivity applies to sentences with disjunction. What the puppet actually said in the present study were negative sentences with disjunction. We have been paraphrasing the test sentences using the English cleft structure, as in – *It's the carrot <u>or</u> the pepper that the animal didn't eat*. The critical observation is that, in the Sad-Face condition, the puppet might have used a sentence with conjunction instead – *It's the carrot <u>and</u> the pepper that the animal didn't eat*.

The fact that the puppet used a sentence with disjunction rather than one with conjunction invites the inference that the puppet did not think that the sentence with conjunction was true. If the puppet thought that the animal did not eat either vegetable, then it would have used the sentence with conjunction – *It's the carrot <u>and</u> the pepper that the animal didn't eat*. In short, we are entitled to infer from the puppet's disjunctive statement that it believes the following: the animal did not eat the carrot or did not eat the pepper, but the animal did eat one of them.

This pattern of inference does not follow from logic. Rather, it follows from a consideration of what the puppet actually said (a sentence with disjunction), as contrasted with what the puppet might have said (a sentence with conjunction). Based on this contrast, the Turkish-speaking adults judged the puppet's sentences with disjunction to be

pragmatically infelicitous in the Sad-Face condition. Given that the task was to judge whether the puppet's statements were true or false, Turkish-speaking adults judged them to be false.

Why is it pragmatically odd to use a sentence with disjunction when the corresponding sentence with conjunction is also true? The intuition is that the sentences with conjunction (e.g. *It's the carrot* <u>*and*</u> *the pepper that the animal didn't eat*) are more informative than the corresponding ones with disjunction. Following a proposal by Grice (1975), words for disjunction and conjunction can be positioned on a scale according to the relative strength of the information they convey, from 'weaker' to 'stronger.' By definition, sentences with a stronger term on the scale are true in a subset of the circumstances that verify sentences with a weaker term (more formally, stronger statements asymmetrically entail weaker ones). One scale contains the words for disjunction and conjunction, yielding <*or, and*>. The word for disjunction *or* is the weaker term on the scale, because both sentences with *or* and ones with *and* are true in circumstances that verify both of the disjuncts/conjuncts, but sentences with *or* are also true in other circumstances as well, namely when just one of the disjuncts is true. The fact that the puppet used the weaker term *or* in the Sad-Face condition, rather than the stronger term *and*, led the Turkish-speaking adult participants to infer that the puppet did not believe that the sentence with the stronger term (*and*) was true. The adult participants therefore inferred the negation of the sentence with the stronger term. At the end of this line of reasoning, adult Turkish-speakers concluded that the puppet believed that the stronger statement was false –*It's the carrot* <u>*and*</u> *the pepper that the animal didn't eat*, contrary to fact. If the puppet believed that the sentence with conjunction was true, the puppet would have produced it, instead of the sentence with disjunction. Consequently, adults rejected the puppet's sentences with disjunction in the Sad-Face condition.

The findings from Condition 1 raise another question. Recall that the pattern of responses by the adult participants adopted the scope assignment that is associated with the [+PPI] accusative case-marker (OR > NOT), rather than the (NOT > OR) scope assignment

that corresponds to the [–PPI] disjunction words themselves. The question is why the [+PPI] value wins out over the [–PPI] value. One possibility is that principles of computational efficiency favor isomorphic mappings between surface word order and semantic interpretation, but that these principles are overridden whenever there is explicit evidence that an isomorphic mapping does not yield the intended interpretation.

CONCLUSION

As predicted, Conditions 1 and 2 evoked the same patterns of responses by child and adult Turkish-speakers, whereas Conditions 3 and 4 evoked different patterns of responses. We attributed these different patterns of responses to different scope assignments. The scope assignment by children was dictated by the Semantic Subset Principle, as applied to a lexical parameter that determines the scope relations between disjunction phrases and negation. The Semantic Subset Principle compels children to adopt the [–PPI] value of the Disjunction Parameter, whereas Turkish-speaking adults adopt the [+PPI] value.

The different values of the Disjunction Parameter generate different scope assignments. The [–PPI] value yields the (NOT > OR) scope assignment, and the [+PPI] value yields the (OR > NOT) scope assignment. The fact that Turkish-speaking children and adults generate different scope relations between disjunction and negation is important, because it rules out the possibility that Turkish-speaking children ‘learned’ the (NOT > OR) scope assignment based on input from adults, who favor the (OR > NOT) scope assignment. The finding that children and adults differ in this way is consistent with the analysis we proposed, but difficult to reconcile with experience-based accounts of language development. Clearly, Turkish-speaking children do not formulate their initial scope assignment based on the adult input. A more likely source is the Semantic Subset Principle, which dictates that

disjunction words are initially [−PPI] for children across languages, and conjunction words are initially [+PPI] for children across languages (Crain, 2012).

The final question is how children converge on the adult grammar, when the initial value of the Disjunction Parameter differs from the value adopted by adult speakers of the local language. Here is the learnability scenario we propose, based on 'positive' evidence, the Semantic Subset Principle, and another sub-Maxim of the Principle of Cooperation: Be Truthful. First, children always assume that adults speak truthfully. Second, adults only produce sentences in circumstances in which they judge them to be true. Together with the Semantic Subset Principle, these two premises guarantee that children will encounter 'positive' evidence if the value of the Disjunction Parameter differs from that of adult speakers of the local language. According to the Semantic Subset Principle, there is only permissible difference between the parameter values of children and adults. This is the possibility that is substantiated in Turkish, where children initially adopt the [−PPI] value, but adults adopt the [+PPI] value.

It follows from these considerations that when disjunction phrases are assigned the value [+PPI] in a language, adult speakers will produce sentences with disjunction phrases in circumstances that validate one, but not both of the disjuncts. For example, adult speakers of these languages will use negative sentences with disjunction – e.g. *The animal didn't eat the carrot or the pepper* – in circumstances in which the animal did not eat the pepper, but did eat the carrot. These sentences are false for children on the [−PPI] value of the Disjunction Parameter. Because children assume that adults speak truthfully, these sentences inform children that their grammars are in need of repair. In short, sentence/meaning pairs like this represent detectable mismatches between the grammars of children and those of adults. Once a child has encountered a sufficient number of these detectable mismatches, children have no option but to abandon their current value of the Disjunction Parameter, [−PPI], in favor of the value that is attested in the primary linguistic data, [+PPI].

We conclude with two general observations, followed by one observation about Turkish in particular. We would note, first, that our findings are compatible with the Continuity Hypothesis (Pinker, 1984; Crain, 1991; 2002; Crain & Pietroski, 2001). According to the Continuity Hypothesis, child language can differ from that of adult speakers of the local language only in ways that adult languages can differ from each other. In the present study, we witnessed Turkish-speaking children behaving like child and adult speakers of English, German, and Korean. We attributed this to the Semantic Subset Principle, which compels children to initially make scope assignments that make sentences true in the narrowest range of circumstances. On the account we proposed, the interpretive options are encoded in lexical parameters. This guarantees that children will always be speaking a possible human language, as required by the Continuity Hypothesis. The second observation is that children acquiring all human languages are expected to initially start out along the same path. Since children are predicted to initially assign values of lexical parameters that make sentences true in the narrowest range of circumstances, children will begin with the same initial values, regardless of the values adopted by adult speakers. The final point is about Turkish. Turkish differs in one respect from the other languages whose scope assignments have been investigated within the current framework. Turkish is the first language we have seen in which accusative case marking, rather than the logical connective is the bearer of the status of a Positive Polarity Item. We assume that this will turn out to be a property of other human languages, but only time will tell.

REFERENCES

Berwick, R. (1985). *The Acquisition of Syntactic Knowledge*. Cambridge, Mass: MIT Press.

Brown, R. & Hanlon, C. (1970). Derivational complexity and the order of acquisition of child speech. In J. R. Hayes (ed.), *Cognition and the Development of Language*, 11–53. New York: Wiley.

Chierchia, G., Crain, S., Guasti, M.T., Gualmini, A. & Meroni, L. (2001). The acquisition of disjunction: Evidence for a grammatical view of scalar implicatures. In A-H.-J., Do, L. Dóminguez, & A. Johansen, (eds.), *Proceedings of the 25th Boston University Conference on Language Development*, 157–168. Somerville: MA: Cascadilla Press.

Chomsky, N. (1965). *Aspects of the Theory of Syntax*. Cambridge, MA: MIT Press.

Chomsky, N. (1981). *Lectures on Government and Binding*. Dordrecht: Foris.

Chomsky, N. (1995). *The Minimalist Program*. Cambridge, Mass: MIT Press.

Crain, S. (1991). Language acquisition in the absence of experience. *Behavioral and Brain Science*s **14**, 597–650.

Crain, S. (2002). The continuity assumption. In I. Lasser (ed.), *The Process of Language Acquisition*, 3–24. New York: Peter Lang.

Crain, S. (2012). *Emergence of meaning*. Cambridge: Cambridge University Press.

Crain, S., Gardner, A., Gualmini, A. & Rabbin, B. (2002). Children's command of Negation. In Y. Otsu (ed.), *Proceedings of the Third Tokyo Conference on Psycholinguistics*, 71–95. Tokyo: Hituzi Publishing Company.

Crain, S., Goro, T., Notley, N. & Zhou, P. (2013). A parametric account of scope in child language. In . S. Stavrakaki, M. Lalioti & P. Konstantinopoulou (eds.), *Advances in language acquisition*, 63–71. Cambridge: Cambridge Scholar Publishing.

Crain, S., Ni, W. & Conway, L. (1994). Learning, parsing and modularity. In C. Clifton, L. Frazer, & K. Rayner (eds.), *Perspectives on sentence processing*, 443–467. Hillside, NJ: Lawrence Erlbaum.

Crain, S. & Pietroski, P.M. (2001). Nature, nurture and Universal Grammar. *Linguistics and Philosophy* **24**, 139–185.

Crain, S. & Thornton, R. (1998). *Investigations in Universal Grammar: A guide to experiments on the acquisition of syntax and semantics*. Boston: Massachusetts Institute of Technology.

Geçkin, V., Thornton, R. & Crain, S. (in prep.) Children's interpretation of disjunction in negative sentences: A comparison of Turkish and German.

Goro, T. (2004). The emergence of Universal Grammar in the emergence of language: the acquisition of Japanese logical connectives and positive polarity. Unpublished master's thesis, University of Maryland.

Goro, T. (2007). Language-specific constraints on scope interpretation in first language acquisition. Unpublished doctoral dissertation, University of Maryland.

Goro, T. & Akiba, S. (2004a). The acquisition of disjunction and positive polarity in Japanese. In V. Chand, A. Kelleher, A. J. Rodriguez & B. Schmeiser (eds.), *WCCFL 23 Proceedings*, 251–264. Somerville, MA: Cascadilla Press.

Goro, T. & Akiba, S. (2004b). Japanese disjunction and the acquisition of positive polarity. In Y. Otsu (ed.), *Proceedings of the Fifth Tokyo Conference on Psycholinguistics*, 137–162. Tokyo: Hituzi Shobo Publishing Company.

Göksel, A. & Kerslake, C. (2005). *Turkish, A comprehensive grammar*. London: Routledge.

Grice, H. P. (1975). Logic and conversation. P. Cole & J. Morgan (Eds.), *Syntax and Semantics, vol. 3: Speech Acts* (pp. 41–58). London: Academic Press.

Gualmini, A. & Crain, S. (2002). Why no child or adult must learn De Morgan's Laws. In B. Skarabela, S. Fish & A. H-J. Do (eds.), *Proceedings of the 27th Boston University Conference on Language Development*, 243–254. Somerville, MA: Cascadilla Press.

Gualmini, A. & Crain, S. (2004). Operator conditioning. In A. Brugos, L. Micciulla & C. E. Smith (eds.), *Proceedings of the 28th Boston University Conference on Language Development*, 232–243. Somerville, MA: Cascadilla Press.

Gualmini, A. & Crain, S. (2005). The structure of children's linguistic knowledge. *Linguistic Inquiry* **36**, 463–473.

Gualmini, A., Crain, S., Meroni, L., Chierchia, G. & Guasti, M. T. (2001). At the semantics interface in child language. In R. Hastings, B. Jackson & Z. Zvolenszky (eds.), *SALT XI*, 231–47. Ithaca, NY: Cornell University.

Jing, C., Crain, S. & Hsu, C. (2005). The interpretation of focus in Chinese: Child vs. adult language. In Y. Otsu (ed.), *Proceedings of the 6th Tokyo Conference on Psycholinguistics*, 165–190. Tokyo: Hituzi Publishing Company.

Lee, O. (2010). Acquisition of Korean disjunction under negation. *Working Papers in Linguistic*s **41(7),** 1–12. University of Hawaii.

Marcus, G. F. (1993). Negative evidence in language acquisition. *Cognition* **46**, 53–85.

Morgan J., L. & Travis, L. (1989). Limits on negative information on language input. *Journal of child language* **16**, 531–552.

Moscati, V. & Crain, S. (2014). When Negation and Epistemic Modality Combine: The Role of Information Strength in Child Language. *Language Learning and Development*, 1–36.

Pinker, S. (1984). *Language Learnability and Language Development*. Cambridge MA: Harvard University Press.

Szabolcsi, A. (2002). Hungarian disjunctions and positive polarity. In I. Kenesei & P. Siptar (eds.), *Approaches to Hungarian 8*, 217–241. Budapest: Akademiai Kiado.

Verbuk, A. (2007). The acquisition of the Russian Or. In E. Bainbridge & B. Agbayani (eds.), *Proceedings of the thirty-fourth Western Conference on Linguistics (WECOL 2006)*, 443–455. Fresno: California State University Fresno, Department of Linguistics.

Chapter 4

Children's interpretation of disjunction in negative sentences: A comparison of Turkish and German

This chapter is based on a paper which has been revised and submitted for publication[6]:

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[6] The final version of the paper is included.

Abstract

This study investigates the interpretation of disjunction words (English *or*) in negative sentences by Turkish- and German-speaking children. Both children and adults were asked to judge Turkish/German sentences corresponding to the English sentence *This animal did not eat the carrot or the pepper*. Children acquiring both languages consistently assigned the same interpretation, which can be paraphrased as *This animal did not eat either the carrot or the pepper.* German-speaking adults also consistently assigned this interpretation, whereas Turkish-speaking adults assigned a different interpretation, which can be paraphrased as *It is the carrot or the pepper that this animal did not eat.* The finding that children initially assign the same interpretation across languages, despite difference in the interpretations assigned by adults, is credited to a 'subset' principle of language learnability.

Key words: semantics, German, Turkish, child language, disjunction, negation.

Children's interpretation of disjunction in negative sentences:

A comparison of Turkish and German

This chapter reports data from two groups of monolingual children coming from two distinct languages, Turkish and German. The interpretation of disjunction with a specific focus on these two languages has not been studied before, so this is one of the first studies comparing the interpretation of a purely semantic phenomenon by two groups of children coming from typologically two different languages.

1. Introduction

The logical connectives *and*, *or*, and *not* are used to express principles of reasoning, and children's command of these logical connectives has received considerable attention in the literature for over fifty years, beginning with the seminal work of Piaget (e.g. Inhelder & Piaget 1964; Piaget 1969; Braine & Rumain 1981). The results of experimental studies of children's mastery of logical operators, however, have led to mixed results. For example, English-speaking children appear to comprehend the logical meaning of conjunction (English *and*) at an early age (Suppes & Feldman 1971), but it has been concluded that English-speaking children do not assign the logical meaning of disjunction words (English *or*). In classical logic, disjunction words are assigned the truth conditions of inclusive disjunction. However, it is widely held that children initially interpret disjunction as exclusive-*or* (e.g. Morris 2008) and that adults do too, except in special circumstances (Neimark 1970; Morris 2008; Quine 1992). In the reasoning literature, too, it has been suggested that exclusive disjunction is the dominant meaning of disjunction words in human languages (e.g., Kegley & Kegley 1978; Richards 1978; Braine & Rumain 1981). The general conclusion seems to be that children acquire the truth conditions associated with logical expressions in sequential steps, achieving the formal meanings of logical operators relatively late in the course of

language development (Paris 1973; Piaget 1969; Taplin, Staudenmayer & Taddonio 1974; Johnson-Laird 2001; Johnson-Laird & Byrne 2002; Morris 2008).

According to one account of language acquisition, children's knowledge of the meanings of linguistic expressions is based on observations of the linguistic behavior of others. This is true especially for the acquisition of the meanings of logical expressions. We call this the usage-based account of language acquisition. On this account, meaning must be manifested in use, because all there is to the meaning of a logical expression is the use that speakers make of it. Modern philosophy of language yields many endorsements of this approach. To cite just one example, Dummett (1978: 216-217) remarks:

> *The meaning of a mathematical statement determines and is exhaustively determined by its use. The meaning of a mathematical statement cannot be, or contain as an ingredient, anything which is not manifested in the use made of it, lying solely in the mind of the individual who apprehends that meaning: if two individuals agree completely about the use to be made of the statement, then they agree about its meaning. The reason is that the meaning of a statement consists solely in its role as an instrument of communication between individuals, just as the powers of a chess-piece consist solely in its role in the game according to the rules.*

Advocates of the usage-based approach are well represented in the literature on child language. For example, one usage-based theorist, Morris (2008: 68), contends that "children acquire word uses closely related to those used in natural language input, only later using a word to convey a broader range of meanings" (cf. Lieven, Pine & Baldwin 1997; Tomasello 2003; MacWhinney 2002). To substantiate this conclusion, Morris (2008) cites the findings of a review of 240 transcriptions of audiotaped exchanges between 2- to 5-year-old English-speaking children and their parents (CHILDES database; MacWhinney 2000). There were 465 uses of 'or' out of a total of 100,626 conversational turns. For children, utterances in which disjunction meant inclusive-*or* were produced less than 10% of the time, and such utterances were produced only

slightly more often than this by adults.[7] Citing the findings of this review, Morris (2008: 70) identifies an advantage to children in initially assigning the exclusive interpretation to disjunction, and he concludes that the meaning of 'or' associated with classical logic is acquired later in life:

Interference with other possible meanings could increase the difficulty of acquiring the term; thus initial meanings should occupy a unique area in conceptual space. … For example, while inclusive OR (A, B, A & B) overlaps with AND (A & B) in that the presence of both options is allowable, exclusive OR (A, B, but not both) has no overlap with AND, and thus should create less interference during acquisition.

Lacking relevant input, children learn the 'formal logic' uses of disjunction words much later in life, according to Morris (2008: 82-84):

> *Through experience, children acquire additional non-core uses (e.g., assigning explicit truth-values) the conditions under which use is appropriate (i.e., pragmatics), and forms a more abstract connective representation (Gentner & Namy 2006).*
>
> *The data demonstrate that initial language use of a connective is not identical to the logical use. … Because the data demonstrate that children's initial uses are restricted to non-logical functions, logical functions must be acquired.*
>
> *If connectives are a part of a syntax of thought, then what must be learned are conditions for use. … If, however, logical functions are learned, then learning likely occurs in reasoning situations in which the goals of connective use matches a logical use. … Importantly, there were nearly no examples of these contexts in the present data.*

[7] Logically speaking, the sentences with disjunction that were categorized by Morris as instances of exclusive-*or* are consistent with both exclusive-*or* and inclusive-*or*. Both exclusive-*or* and inclusive-*or* make sentences true if only one of the disjuncts is true. These sentences were (incorrectly) counted by Morris as evidence in support of the conclusion that the input from adults is largely exclusive-*or*.

As the last quote from Morris makes clear, another account of the acquisition of logical words is on offer. In contrast to the usage-based approach, some researchers have reached the opposite conclusion - that words for disjunction are interpreted as inclusive-*or* by both children and adults, across languages (Crain 2012; Crain, Goro &Thornton 2006; Crain, Gualmini & Pietroski 2005; Crain & Khlentzos, 2008, 2010; Crain & Thornton 2006). According to this account, children are endowed with a logical faculty that is based on several logical concepts from classical logic, including the logical operators corresponding to the English expressions *and*, *or* and *not*. This account is known as 'logical nativism' (Crain & Khlentzos 2008; 2010). Logical nativism claims that all human languages access the same semantic representations of logical expressions, as part of the theory of Universal Grammar (e.g. Crain, Gualmini & Meroni 2000; Notley, Zhou, Jensen & Crain 2012; Crain, Goro, Notley & Zhou 2013). Language learners are therefore expected to know the truth conditions associated with logical words as soon as they learn to map linguistic expressions of the local language onto the corresponding logical operators in classical logic.

These two accounts of the acquisition of the meanings of logical expressions are evaluated in the present study. The study consists of an experiment that compares the interpretations that Turkish-speaking and German-speaking four-year-olds assign to negative sentences with the disjunction operator. German and Turkish represent an ideal testing ground for adjudicating between the usage-based approach and logical nativism, because adult speakers of these languages assign different interpretations to negative sentences with disjunction. If children base their initial meanings on parental input, then children acquiring both languages are not expected to differ qualitatively from those of adult speakers of the local language. By contrast, the logical nativist approach anticipates that, across languages, children will initially assign the same (logical) interpretation to negative sentences with disjunction, despite cross-linguistic differences exhibited by adult speakers.

2. Disjunction in logic and in human languages

Inclusive-*or* is the meaning of disjunction in classical logic, where the symbol for disjunction is '$\vee$'. In classical logic a formula of the form (A $\vee$ B) is true in three circumstances: (i) when only A is true, (ii) when only B is true, and (iii) when both A and B are true. It is this last circumstance that distinguishes inclusive-*or* from exclusive-*or*. Exclusive-*or* is false when both A and B are true. Assuming that disjunction is inclusive-*or*, the formula (A $\vee$ B) is only false when A and B are both false. In symbols, this is written (~A & ~B).

The topic of the present paper is the acquisition of the interpretation of disjunction words in negative statements in German and in Turkish. First, consider the German negative statement in (1). We just saw that, in classical logic, the formula (A $\vee$ B) is false just in case A and B are both false. Negation reverses truth-values. Therefore, the negated formula ~(A $\vee$ B) is <u>true</u> just in case both A and B are false. This yields one of de Morgan's laws of propositional logic. According to this law, negated disjunctions make a 'conjunctive' entailment. Negative statements with disjunction, ~(A $\vee$ B), entail a conjunction of two negative statements, (~A & ~B). From the German statement (1), it is valid to infer the two following statements: *This animal did not eat the pepper* and *this animal did not eat the carrot*. If (1) is true, then both of these statements must also be true. It would seem, then, that German 'oder' is inclusive-*or*, just as in classical logic.

(1) *Dieses Tier hat* ***nicht*** *die Karotte* ***oder*** *die Paprika gegessen.*

This animal did not the carrot or the pepper eat-PAST

'This animal didn't eat the carrot or the pepper.'

Despite this evidence that German 'oder' is inclusive-*or*, the literature on human reasoning has consistently rejected the conclusion that disjunction in human languages is inclusive-*or*. Reasoning experts have concluded that the meaning of 'or' in English is exclusive-*or*: A or B, but not both A and B.

The idea that disjunction is exclusive-*or* in human languages has intuitive appeal. There is supporting evidence from English-speakers' comprehension of simple sentences with

disjunction. For example, when adult English-speakers are tested on the meaning of statements such as (2), they tend to judge them to be true just in case exactly one of the disjuncts is true, i.e., if the animal ate the carrot but not the pepper, or if it ate the pepper but not the carrot. English-speakers judge (2) to be false if the animal ate both the carrot and the pepper. This finding would appear problematic for the logical nativist account.

(2) This animal ate the carrot or the pepper.

To maintain the view that disjunction words are inclusive-*or* across human languages, logical nativists invoke a distinction originally discussed by Grice (1975). According to Grice, disjunction has a basic meaning and a derived meaning. The basic meaning is inclusive-*or* (A or B, and possibly both A and B). The derived meaning comprises the truth conditions associated with exclusive-*or* (A or B, but not both A and B). This derived meaning is manifested in certain linguistic contexts, but not in others. According to the Gricean account, disjunction words and conjunction words in human languages form a scale < OR, AND >. The scale is ordered by information strength, from weakest to strongest, where a term α is 'weaker' than another term β if β asymmetrically entails α (Horn 1996). Since the truth conditions assigned to statements with conjunction are a subset of those that verify the corresponding statements with disjunction, statements with conjunction asymmetrically entail the corresponding statements with disjunction. So, disjunction words are weaker than conjunction words, at least in simple affirmative sentences.

When a speaker uses the weaker term such as English 'or', a scalar implicature of 'exclusivity' is engaged. The trigger to the implicature is usually attributed to the Gricean conversational maxim of quantity, which entreats speakers to make their contributions as informative as possible. In adherence with this maxim, hearers generally assume that a speaker who uses 'or' in describing a situation is not in a position to use the corresponding statement with the stronger term 'and' (Grice 1975). Upon hearing a statement with 'or', therefore, hearers

remove the truth conditions associated with ‘and’ from the basic inclusive-*or* meaning of disjunction, yielding the derived meaning - exclusive-*or* (A or B, but not both A and B).

To see that sentences with English ‘and’ are true in a subset of the circumstances associated with ‘or’, consider the sentence in (3). On the basic meaning of disjunction (inclusive-*or*), (3) is true in circumstances C1-C3. Notice that the corresponding statement with conjunction is true in just one of these circumstances, C3.

(3) The animal ate the carrot or the pepper.

C1: The animal ate the carrot, but not the pepper.

C2: The animal ate the pepper, but not the carrot.

C3: The animal ate both the pepper and the carrot.

Now we can address the question of why the implicature of ‘exclusivity’ is removed in negative sentences, such as in the German example in (1). The reason is that negation reverses entailment relations. When negation has scope over disjunction, the relative strength of the scalar terms *or* versus *and* is the reverse of what it would be in affirmative sentences. To see this, consider the English example in (4). As in German, when disjunction appears in a negative sentence, it generates a conjunctive entailment. There is no implicature of ‘exclusivity’ in (4). The reason is that the corresponding statement with conjunction (4) *The animal did not eat the carrot or the pepper*, is true in a broader range of circumstances than the statement with disjunction. When disjunction is interpreted in the scope of negation, as in (4), it makes a stronger statement than the corresponding statement with conjunction (5). That is, (4) asymmetrical entails (5).

(4) The animal did not eat the carrot or the pepper.

C1: The animal did not eat the carrot and did not eat the pepper.

(5) The animal did not eat the carrot and the pepper.

C1: The animal did not eat the carrot, but did eat the pepper.

C2: The animal did not eat the pepper, but did eat the carrot.

C3: The animal did not eat the pepper, and did not eat the carrot.

The same logical relationship is not maintained when English or German sentences are translated into Turkish, or into Japanese or many other languages. In these languages, negative statements with disjunction do not generate conjunctive entailments, at least not for adult speakers.

Earlier, we saw that the German statement in (6), repeated from example (1), generated a conjunctive entailment. One of the Turkish statements corresponding to the German example is given in (7).[8]

(6) Dieses Tier hat nicht die Karotte *oder* die Paprika gegessen[9].

This animal did not the carrot or the pepper eat-PAST

'This animal didn't eat the carrot or the pepper.'

(7) Bu hayvan-cık *ya* havuc-u *ya da* biber-i ye-me-di.

This animal-DIM either carrot-ACC or pepper-ACC eat-NEG-PAST

'It's a certain carrot or a certain pepper that the animal did not eat.'

The Turkish sentence (7) is true in three circumstances. It is true when the animal in question ate the carrot but did not eat the pepper, or when the animal ate the pepper but did not eat the carrot. It is also (logically) true in the one circumstance that validates the German sentence (6), namely when the animal did not eat either of the vegetables.[10] It follows that negative sentences with disjunction in German are true in a subset of the circumstances that validate negative sentences with disjunction in Turkish. Turkish and German are therefore in a subset-superset relation with respect to the interpretation of disjunction in negative sentences. There is one linguistic construction in which German and Turkish assign the same inclusive-*or* interpretation to

[8]Turkish uses a number of words such as *(ya)…ya da, veya* as the morphological realization for the disjunction operator *or* (Göksel & Kerslake 2005). See Geçkin, Crain & Thornton (ms.) for evidence of Turkish-speaking children's interpretation of negated disjunction phrases both with and without accusative case.

[9] Instead of the German construction given in 6, we might have used the sentences ' Dieses Tier hat die Karotte oder die Paprika nicht gegessen', where the disjunction word *oder* takes scope over negation on the surface order. The test sentence was given to 20 native speakers of German who judged the sentence to be grammatical. Whether the disjunction word takes scope over negation or vice versa on the surface order, negation takes scope over the disjunction word at the level of semantic interpretation, and that is what matters for the purpose of this study.

[10] The reading on which both disjuncts are false is not readily accessed by adult Turkish speakers, due to a scalar implicature of 'exclusivity'. A speaker of (7) who was in a position to know that both disjuncts were false would have used the corresponding sentence with conjunction.

disjunction in negative sentences. This is when the nouns in the disjunction phrase are not accusatively case marked, as in (8). Turkish-speaking adults interpret (8) as generating a conjunctive entailment, so they judge (8) to be true in the same circumstances as the German example (6).

(8) Bu hayvan-cık *ya* havuç *ya da* biber ye-me-di.

This animal-DIM either carrot or pepper eat-NEG-PAST

'This animal didn't eat carrot or pepper.'

3. The Semantic Subset Principle

Before we proceed further, let us first put to rest the possibility that the Turkish disjunction word, *ya…ya da*, is exclusive-*or*. If this were the case, adult speakers of Turkish would not interpret sentences like (2) in the way that they do. To see this, consider the logical formula (A ⊕ B), where the symbol '⊕' represents exclusive-*or*. This formula is true if exactly one of {A, B} is true. It follows that the negated disjunction, ~(A ⊕ B), is <u>false</u> if exactly one of {A, B} is true. But as we saw, adult speakers of Turkish accept the negated disjunction in (7) when exactly one of the disjuncts is false, i.e., when the animal ate a certain carrot but not a certain pepper, or when it ate a certain pepper but not a certain carrot. These are circumstances in which negated disjunctions would be false if *ya…ya da* were exclusive-*or*.

An account of the observed cross-linguistic variation was initially suggested by Szabolcsi (2002), and proposed more formally in work by Goro (2004, 2007) (For subsequent research adopting this proposal, see Crain 2008; Crain, Goro & Minai 2007; Crain, Goro & Thornton 2006; Crain & Khlentzos 2008). On this account, the cross-linguistic variation is due to a parameter, called the Disjunction Parameter. The Disjunction Parameter partitions languages into two classes. In one class of languages, disjunction is a positive polarity item. By definition, a positive polarity item (PPI) takes scope over (local) negation. In the other class of languages, according to the Disjunction Parameter, disjunction is not a positive polarity item, so the logical form mirrors the surface syntax in negated disjunctions, with

negation taking scope over disjunction.

Turkish is slightly more complicated. Disjunction is not a Positive Polarity Item in Turkish. However, disjunction phrases that are marked with accusative case are interpreted as taking scope over negation, at least by adult speakers of Turkish. On the other hand, disjunction phrases that are not marked with accusative case do not take scope over negation. It follows that the Turkish accusative case marker *-(y)ı* is a Positive Polarity Item, but not Turkish disjunction words per se. In Japanese, by contrast, disjunction phrases consistently take scope over negation, at least for adult speakers, whether or not they are case marked.

Setting complexities aside, the two values of the disjunction parameter distinguish languages according to the possible scope relations between negation and disjunction. On one value of the parameter, disjunction and negation are related by 'inverse scope', because disjunction is a PPI. On the other value of the parameter, disjunction is not a PPI, so the scope relations are dictated by the surface syntax.

Let us indicate the parameter value on which disjunction takes scope over negation as OR = +PPI, and let us use OR = –PPI to indicate the other parameter value, where negation takes scope over disjunction. English takes the OR = –PPI value of the parameter. This is why the German statement in (6) *Dieses Tier hat nicht die Karotte oder die Paprika gegessen* 'This animal did not eat the carrot or the pepper' generates a conjunctive entailment, as in classical logic. Notice that the symbol for negation takes scope over the disjunction operator '$\vee$' in the logical formula $\sim (A \vee B)$. Following de Morgan's laws, a negated disjunction generates a conjunctive entailment: $(\sim A \wedge \sim B)$. Languages in which negation takes scope over disjunction include English, German, French, Greek, Romanian, Bulgarian, and Korean (Szabolcsi 2002). In Turkish, disjunction has the other parameter value, OR = +PPI. Therefore, disjunction fails to generate a conjunctive entailment in negative sentences in Turkish, such as example (9) (repeated from example (7)). The logical formula corresponding to (9) is $(\sim A \vee \sim B)$. Languages in which

disjunction takes scope over negation include Mandarin, Japanese, Hungarian, Russian, Serbo-Croatian, Slovak, and Polish (Szabolcsi 2002; Goro & Akiba 2004a; Goro & Akiba 2004b).

(9) Bu hayvan-cık *ya* havuc-u *ya da* biber-i ye-me-di.

This animal-DIM either carrot-ACC or pepper-ACC eat-NEG-PAST

'It's a certain carrot or a certain pepper that the animal did not eat.'

It is important to note that the implicature of exclusivity that is observed in sentences without negation, such as the English sentence *The animal ate the carrot or the pepper*, is also expected to be operative in languages that adopt the OR = +PPI value of the Disjunction Parameter. When disjunction takes scope over negation, it will be subject to a scalar implicature. Therefore, speakers are expected to reject negative sentences with disjunction if both disjuncts are false. They are expected, therefore, to generate a derived meaning that can be represented symbolically as $(\sim A \vee \sim B)$, but not both $\sim A \wedge \sim B$.

Tests of polarity sensitivity have been used to assess the viability of the Disjunction Parameter. More specifically, disjunction fails to 'scope out' over negation in linguistic contexts that cancel the polarity sensitivity of PPIs. One such context is using the English PPI *some*. The PPI *some* and the NPI *any* are both existential expressions, in current parlance they are ∃-items. However, the PPI *some* and the NPI *any* are in complementary distribution in simple negative sentences. So, *some* takes scope over negation in the sentence *Malcolm didn't chase some of the kangaroos* (∃ > NOT), whereas negation takes scope over the NPI *any* in the sentence *Malcolm didn't chase any of the kangaroos* (NOT > ∃). As Baker (1971) observed, the polarity sensitivity of English *some* is cancelled in sentences in which negation resides in a higher clause than the clause that contains *some*. Examples are given in (10) and (11). The existential *some* in (10) has the same meaning as the NPI *any* in (11). Both sentences are true if the speaker is **not** convinced that there **exist** kangaroos that Malcolm chased. That is, both examples receive the NOT > ∃ interpretation in which negation takes scope over the existential.

(10) You did**n't** convince me that Malcolm chased **some** of the kangaroos. NOT > ∃

(11) You did**n't** convince me that Malcolm chased **any** of the kangaroos. NOT > ∃

So, the English PPI *some* is interpreted inside the scope of negation in sentences where negation and *some* reside in different clauses.

We can apply the same test to disjunction words. If disjunction words are PPIs in some languages as we have suggested, then negation will take scope over disjunction in sentences in which negation and disjunction are situated in different clauses, in these languages. Of course, in languages where disjunction is not a PPI, negation takes scope over disjunction regardless of whether these expressions are situated in the same clause, or in a different clause. We used this diagnostic test to determine whether Turkish disjunction phrases with and without accusative case (with the disjunction word *ya…ya da*) are assigned an inclusive-*or* interpretation when negation resides in a higher clause than the disjunction phrase.

We presented sentences with each kind of disjunction phrase to a different group of Turkish-speaking adults. One group (26 adults) was presented with disjunction phrases that were marked with accusative case, as illustrated in (12). These disjunction phrases were embedded in sentences in which negation resided in a higher clause than the clause that contained the disjunction phrase. These 26 adults assigned a 'neither' interpretation to sentences such as (12) 70% of the time.

(12) İrem'in *ya* elma-(y)ı *ya da* armud-u ye-diğ-in-e ben-i

İrem-GEN either apple-ACC or pear-ACC eat-VN-3SG.POSS-DAT me-ACC

ikna ed-emez-sin.

convince make-NEG-2SG

'You can't convince me that it was either a certain apple or a certain pear that İrem ate.'

A second group (45 adults) was asked to interpret the same sentences without accusative case marking on the disjunction phrases, as in (13). These adults assigned a ‘neither’ interpretation to sentences like (13) 80% of the time.

(13) İrem’in *ya* elma *ya da* armut ye-diğ-in-e ben-i
İrem-GEN either apple or pear eat-VN-3SG.POSS-DAT me-ACC
ikna ed-emez-sin.
convince make-NEG-2SG
‘You can’t convince me that it was either apple or pear that İrem ate.’

Taken together, these findings of this study suggest that Turkish disjunction phrases generate a conjunctive entailment in negative sentences in which negation resides in a higher clause than the disjunction phrase, regardless of whether the noun clauses in the disjunction phrase are inflected with accusative case or not. In both (12) and (13), negation takes scope over disjunction, resulting in a conjunctive entailment for the majority of Turkish speakers. We infer from this that disjunction phrases take scope over negation in simple (one clause) negative Turkish sentences, such as example (9) above.

To summarize, adult speakers of Turkish are expected to accept negative sentences with case-marked disjunction phrases in a broader range of circumstances than adult speakers of German. Despite these differences in interpretation for adults, logical nativism predicts that children acquiring either language should initially generate the same scope ‘subset’ assignment in response to negative sentences with disjunction phrases. The prediction is that Turkish-speaking children will initially interpret negative sentences with disjunction in the same way as German-speaking children and adults, regardless of case marking. This prediction follows from the Semantic Subset Principle, which is the next topic.

4. Avoiding Subset Problems in Language Acquisition

Introducing the Disjunction Parameter raises new questions. One question is whether children are expected to adopt an initial, default setting of the Disjunction Parameter. Alternatively, children could be free to select either value. Following the line of reasoning first advanced by Robert Berwick (1985), children are expected to initially adopt the same value for a certain class of parameters. The learning mechanism that determines the initial, default value for this class is called The Subset Principle. The Subset Principle orders parameter values according to the number of sentences and their corresponding meanings that can be assigned to linguistic expressions.

The Subset Principle is operative when the class of languages that adopts one setting of a parameter, P (call these P1 languages), generates fewer sentence/meaning pairs for a given type of expression than the class of languages that adopts the alternative setting of P (call these P2 languages). In such cases, the Subset Principle compels children learning P1 languages and children learning P2 languages to initially hypothesize that the local language is a P1 language, rather than a P2 language. Children learning P2 languages are therefore expected to speak a fragment of a 'foreign' language for a while.

The Subset Principle should be operative in the case of the Disjunction Parameter. It can easily be verified that the circumstances in which sentences are true on the OR = +PPI value comprise a superset of those circumstances that make sentences true on the OR = –PPI value. In other words, the binary values are in a subset/superset relation. To see this, note that the OR = –PPI value yields a *neither* reading, whereas the OR = +PPI value yields a *not both* reading. A statement to the effect that *neither A nor B* is true in a subset of the circumstances that corresponds to the statement endorsing *not both A and B.*

Based on these learnability considerations, Goro (2004, 2007) predicted that children acquiring all human languages should initially adopt the OR = –PPI value of the Disjunction Parameter. If so, they would be expected to interpret sentences with negation and disjunction in the same way as German-speakers or English-speakers, OR = –PPI, but not in the same way as

adult speakers of Turkish, Mandarin or Japanese. In these languages adult speakers adopt the OR = –PPI value of the Disjunction Parameter. So, children and adults are expected to assign different interpretations to negative sentences with disjunction in these languages.

The Semantic Subset Principle is motivated by learnability considerations. In the absence of readily available negative evidence, children are expected to initially favour the 'subset' value of parameters whose alternative values are in a subset/superset relation. This includes the Disjunction Parameter. If children start with the subset language, OR = –PPI, this guarantees that there will be positive evidence to compel children to override their initial preferences for the scope relations between negation and disjunction, if these preferences are not exhibited by adult speakers of the local language. For disjunction, the positive evidence for Mandarin-speaking children will be sentence/meaning pairs exhibiting the preference by Mandarin-speaking adults for disjunction to take scope over negation. Because disjunction takes scope over negation, these sentences will typically engage a scalar implicature. This guarantees that negated disjunctions will be used by Turkish-speakers in circumstances in which only one disjunct is false, not both. In Turkish, then, the sentence corresponding to *The animal didn't eat the carrot or the pepper* means that it is either the carrot or the pepper (but not both) that the animal didn't eat. In contrast to adults, the same sentence is expected to be true for Turkish-speaking children only if both disjuncts are false, NOT > OR. So, the truth conditions assigned to negated disjunctions by adults are inconsistent with the truth conditions that correspond to children's initial interpretation. Assuming that scope preferences take time to reverse, a number of negated disjunctions must be encountered by children before they jettison their initial preference in favor of the adult parameter setting.

To recap, the critical prediction concerns negative sentences with disjunction phrases that are accusatively marked. According to the SSP, Turkish-speaking children are expected to assign the (NOT > OR) interpretation to such sentences, whereas Turkish-speaking adults are expected to assign the (OR > NOT) interpretation. German-speaking children and adults will serve as controls, since both groups are expected to assign the same (NOT> OR)

interpretation to the corresponding German sentences.

5. Experiment

An experiment was designed to investigate Turkish-speaking children's interpretations of negative sentences with disjunction phrases marked with accusative case. The most critical comparison is the interpretation of negated disjunctions assigned by Turkish-speaking children and by German-speaking children. The SSP predicts that children acquiring all languages will initially assign the same (NOT > OR) interpretation. Another critical comparison is between Turkish- and German-speaking adults. We expect adult speakers of these two languages to assign different interpretations. Based on these comparisons, we anticipate that Turkish-speaking children and adults will differ in how they interpret negative sentences with disjunction phrases; children are predicted to assign the (NOT > OR) interpretation, whereas adults are expected to assign the (OR > NOT) interpretation. If the findings are as expected, then this would pose a challenge for the usage-based account of language acquisition. Such an account supposes that children base their scope assignments on evidence that is provided in the primary linguistic data. This account can explain the fact that German-speaking children and adults assign the same (NOT > OR) interpretation to negative sentences with disjunction phrases, but it would not be able to explain why Turkish-speaking children and adults have different scope relations in negated disjunction phrases.

5.1 *Materials*

The study adapted the Goro & Akiba (2004a, b) methodology. The task consisted of an eating game, which was presented using a colourful booklet. First, there was a training session to familiarize the participants with the task. In the main session, 12 animals were each asked if they were happy to eat two vegetables: a carrot and a green pepper. Four of the animals agreed to eat both the carrot and the green pepper; another 4 animals only agreed to eat one of

the vegetables, and another 4 of the animals refused to eat any vegetables. Each animal received a different prize depending on what they ate: the animals who ate both vegetables were rewarded with a gold medal; the animals who ate only one of the vegetables were rewarded with a silver medal; and the animals who ate neither vegetable received a sad face (the reward was a black cross in the Goro and Akiba study).

To make sure that each child participant understood the rules, there was a short training session preceding the main test session. In the training session, children were asked to reward each animal with the appropriate medal, according to the reward system. If a child made a mistake, they were corrected. None of the German children was corrected only two of the Turkish children were corrected. After the training phase, the main session introduced 12 animals in turn. The child participants rewarded all 12 animals with a medal, according to the vegetables they had eaten. Then, the remaining vegetables were removed, and the participants listened to the test sentences that were uttered by a puppet, beginning with the first animal. The Turkish test sentences were pre-recorded by a female native speaker of Turkish and the German test sentences were pre-recorded by a female native speaker of German in a stress-neutral manner. 5 native adult speakers from each language listened to the test sentences and also judged them to be stress neutral. The Turkish children listened to the test sentence *Bu hayvancık ya havucu ya da biberi yemedi* and the German children listened to the sentence D*ieses Tier hat nicht die Karotte oder die Paprika gegessen*. Each group of children listened to the same sentence 12 times. On each trial, the puppet indicated that he couldn't recall what each animal had eaten, so he would have to guess what the animal had eaten based on the reward that the animal had received. The task of the participants was to judge whether the test sentence uttered by the puppet was right or wrong. Whenever participants judged the puppet to be wrong, they were asked to explain why.

5.2 *Procedures*

German-speaking children were tested at the lab on university campus and Turkish-speaking children were tested at a quiet room at school. Adult participants were tested in a quiet room on the university campus. Testing in Turkey was conducted by a native speaker of Turkish and testing in Germany was conducted by a native speaker of German. The responses of the participants were audio recorded using an audio-recorder for later coding of responses, and for transcribing participants' justifications for their rejections of the puppet's statements. Reliability checks were made by another native speaker of Turkish and one other native speaker of German. There were no conflicts between the coders. The procedures were exactly the same for both groups of monolingual children.

5.3 *Participants*

There was a total of seventy-seven Turkish-speaking participants. Twenty-six Turkish-speaking children participated. They ranged in age from 4; 01 to 5; 11, with a mean age of 4; 07 (SD: .50). These children are the same ones that were reported on Chapter 3.There were 51 Turkish-speaking adults, who ranged in age from 18; 6 to 27; 11, with a mean age of 21; 04 (SD: 2.40). There was a total of forty-six German-speaking participants. The children (n=24) ranged in age from 4; 01 to 5; 08, with a mean age of 4; 05 (SD: 2.03), and the adults (n=22) ranged in age from 19 to 31, with a mean age of 24; 06 (SD: 2.65).

6. Results

We will use the pattern of responses in the 'silver medal' condition in order to evaluate the experimental hypotheses. Recall that rejections in the silver medal condition can be taken to be indicative of a conjunctive (NOT > OR) interpretation of disjunction in negative sentences. The rejection rates in the silver medal condition are summarized in Figure 1, for the four groups of participants.

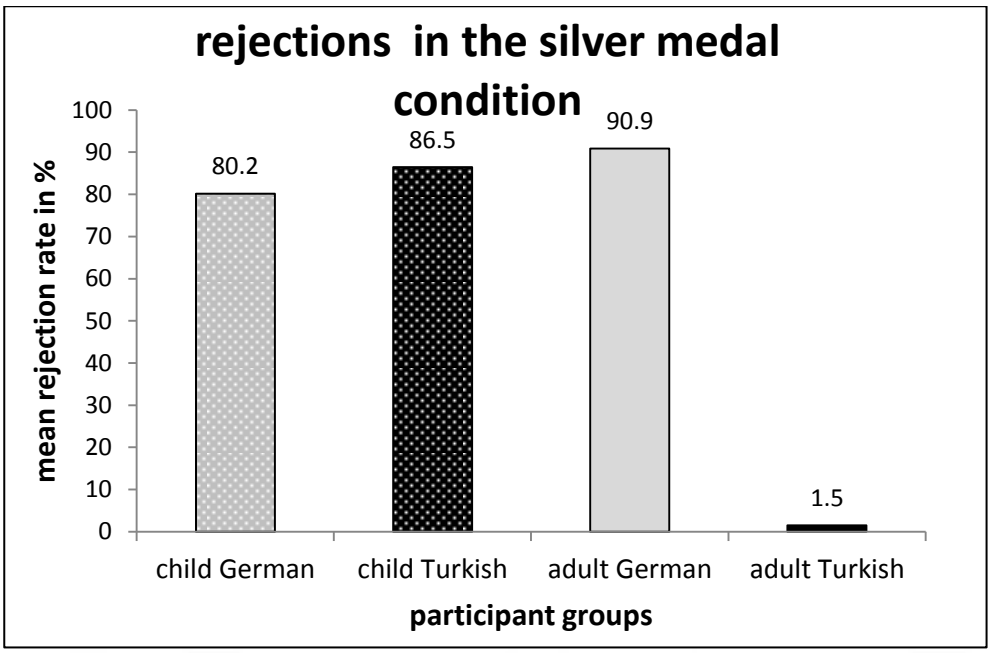

Figure 1: Mean proportions of rejection rates in the silver medal condition across participant groups.

As shown in Figure 1, German-speaking children rejected the test sentences in the silver medal condition 80.2% of the time (77/96), and Turkish-speaking children rejected them 86.5% (90/104) of the time. 14 of the sentences that were rejected in this condition; these rejections came from 7 different children. This is one indication that children consistently assigned a conjunctive (NOT > OR) interpretation in both Turkish and in German. Another indication of children's interpretation can be witnessed by looking at the reasons they give for judging the puppet to have produced a sentence that was incorrect. In short, the justifications offered by almost all children can be paraphrased in two ways in English. Children either said that *because the animal got a silver medal* or *because he ate one of the vegetables*. This brings us to the responses by adults. German-speaking adults rejected the test sentence in this condition 90.9% of the time (80/88). However, the rejection rate of the Turkish adults in the silver medal condition was only by 1.5% (3/204).

Statistical analyses were conducted with the lme4 package (Bates & Maechler 2008) for the statistical language R (R Core Development Team 2008). The data were analysed with general linear mixed effect regressions. We computed general linear mixed effects models for

the sad face and the silver medal conditions separately by using the lme4 library, version 2.13.1 (2011-07-08) (Bates & Maechler, 2008) in R (Baayen, 2008). We took *response* (accepted vs rejected) as the binary dependent variable. Fixed effects included *language* (German vs Turkish) and *age* (children vs adults). *Subjects* and *items* were taken as random effects. We tested for main effects of *language* and *age* on *response* in both conditions by using the formula *glmer (response~language+age+(1|subjects)+(1|items), family=binomial)* (See Jaeger, 2008 and Field et al., 2012 for a discussion of binomial logistic regression analysis). *Language* (z=-3.183, p=.001) and *age* (z=4.72, p<.001) had a significant main effect on responses in the sad face condition and on responses in the silver medal condition (*language*: z=5.475, p<.001, *age*: z=-5.314, p<.001).

We computed two other models to do group comparisons. First, we examined whether *language* had a significant effect on responses between the child groups by using the formula *glmer (response~language+(1|subjects)+(1|items), family=binomial)***.** Turkish-speaking children did not significantly differ from German-speaking children in their responses in the sad face (z=.488, p=.625) or in the silver medal condition (z=-.148, p=.882). Next, we examined whether *age* was a statistically significant contributor to response patterns, this time by using the formula *glmer (response~age+(1|subjects)+(1|items), family=binomial)***.** German speaking children did not differ from German-speaking adults in their responses (z=-.242, p=.808) in the silver medal condition. No statistical difference existed in the response patterns of Turkish-speaking children and German-speaking adults in the silver medal condition, (z=.099, p=.921). However, Turkish speaking children were significantly different in their responses when compared to Turkish speaking adults in the sad face (z=4.087, p<.001) as well as in the silver medal condition (z=-.110, p=.912).

7. Discussion

The present study investigated the predictions of two accounts to language acquisition. On one account, Turkish-speaking children and German-speaking children were expected to

initially adopt the ’subset’ interpretation of negative sentences with disjunction phrases. On the opposing, usage-based account, children were expected to adopt the same interpretations as adults do, because children are guided in their interpretations by the primary linguistic data. More specifically, if children acquiring both German and Turkish are guided by the SSP, then we expected Turkish-speaking children to differ from Turkish adults, but to initially assign the same interpretations as German-speaking children and German adults. These predictions were borne out. First, the response patterns of the two groups of child participants did not differ significantly. Second, the response pattern of Turkish-speaking children differed significantly from that of Turkish-speaking adults, but this pattern did not differ from that of child and adult German speakers. Our findings provide support for the SSP, and for logical nativism. Children acquiring different languages appeared to access the same semantic representations of logical expressions, and the truth conditions associated with these expressions correspond to classical logic.

If both groups of children had been guided by the adult input, then Turkish-speaking children would have been expected to assign the same interpretation to the test sentences as Turkish-speaking adults. However, this did not happen. The fact that the interpretations of Turkish-speaking children differed from Turkish adults poses a challenge for the usage-based account. It appears that the children did not build their semantic interpretations solely on adult input. Finally, the data confirm the predictions of the Continuity Hypothesis (Pinker 1984; Crain 1991, 2002; Crain & Pietroski 2001), which claims that children may differ from the adult speakers of the local language only in ways that human languages can differ from one another. The findings of the present study reveal that, although Turkish-speaking children do not make the same scope assignment as those of adult speakers of the local language, Turkish-speaking children make the same assignments as adult speakers of another language, namely German.

One explanation might be that the Turkish speaking children do not know the *ya… ya da* construction. We conducted a pre-test to examine children's understanding of disjunction. Nineteen monolingual Turkish-speaking children (range: 4;05-6;01, mean: 4;05) took part in a simple experiment in two sessions, administered on different days. In one session, a puppet appeared on the screen and asked the child to pick up *makası veya telefonu* (the scissors or the phone), from a set of 5 objects. In the second session, another puppet appeared on the screen and asked the child to pick up *ya treni ya da elmayı* (either the train or the apple). The children were 90% accurate in responding to *veya* (*or*) in this pre-test and they were 79% accurate with *ya… ya da* (*either or*). This is evidence that the disjunction phrases containing *ya… ya da* are not beyond the comprehension of Turkish-speaking children.[11]

To conclude, the main difference between the usage-based approach and logical nativism concerns the role of experience. According to the usage-based account, regularities in the input to children play a much more important role in language acquisition, as compared to the logical nativist account (Saffran 2003; Samuelson 2002). An examination of the frog stories from the Aksu-Koç corpus (CHILDES database; MacWhinney 2000) revealed that the 10 Turkish-speaking adults whose speech was transcribed used the disjunction operator *(ya) … ya da/ veya* a total of 7 times. The disjunctive operator *ya da* was used 6 times and *veya* was used once. All 7 utterances with disjunction words were affirmative sentences. It was clear from the context that only one of the disjuncts was true. Therefore, these data were not unequivocal evidence for children in favour of either the exclusive-*or* or the inclusive-*or* meaning of disjunction in Turkish, since the utterances produced by adult Turkish-speakers were true on both meanings of disjunction. Unequivocal evidence in favour of inclusive-or would consist of affirmative sentences in which both disjuncts were true, or negative sentences in which both disjuncts were true. In the spontaneous production data from the 30

[11] A reviewer correctly points out that there are alternative ways to account for the data. We agree, but we favor the present account for two reasons. First, the pattern of responses by children was predicted on the present account; the explanation is not *post hoc*. Second, the pattern of responses is consistent with findings from studies of children acquiring other languages.

files of child Turkish-speakers, children (aged 3; 06-10; 01) did not produce a single utterance with disjunction (*(ya)…ya da / veya*) either in affirmative or in negative sentences. In short, there is little available evidence in the spontaneous production data about the interpretation of disjunction words, either for child or adult speakers of Turkish.

References

Baayen, R. Harald. 2008. *Analyzing linguistic data: A practical introduction to statistics using R.* New York, NY: Cambridge University Press.

Baker, John L.1971. Van Wijngaarden grammars from van Wijngaarden property grammars: a construction. *University of Calgary Department of Mathematics, Statistics and Computing Science* 130.

Bates, Douglas. M., Martin Maechler & Bin Dai. 2008. lme4: Linear mixed-effect models using S4 classes. [Computer software manual].Available from http://lme4.r-forge.r-project.org/ (R package version 0.999375-31).

Berwick, Robert. (1985). *The Acquisition of Syntactic Knowledge*. Cambridge, Mass: MIT Press.

Braine, Martin. D. S. & Barbara Rumain. 1981. Development of comprehension of 'or': Evidence for a sequence of competencies. *Journal of Experimental Child Psychology* 31. 46-70.

Crain, Stephen.1991. Language acquisition in the absence of experience. *Behavioural and Brain Sciences* 4. 597-650.

Crain, Stephen. 2002. The continuity assumption. In Ingeborg Lasser (ed.), *The Process of Language Acquisition* 3-24. New York: Peter Lang.

Crain, Stephen. 2008. The interpretation of disjunction in Universal Grammar. *Language and Speech* 51.151-169.

Crain, Stephen. 2012. *Emergence of meaning*. Cambridge: Cambridge University Press.

Crain, Stephen, Andrea Gualmini & Luisa Meroni. 2000. The acquisition of logical words. Logos and Language. *Journal of General Linguistics and Language Theory* 1. 49-59.

Crain, Stephen, Andrea Gualmini & Paul Pietroski. 2005. Brass tracks in linguistic theory: Innate grammatical principle. In Peter Carruthers, Stephen Laurence and Stephen Stich (eds.), *The innate mind: Structure and contents*,1-175. New York: Oxford University Press.

Crain, Stephen, Takuya Goro & Utako Minai. 2007. Hidden units in child language. In Andrea Schalley and Drew Khlentzos (eds.), *Mental States Volume 1: Evolution, Function, Nature*, 274-295. John Benjamins: Amsterdam, Netherlands.

Crain, Stephen, Takuya Goro, Anna Notley & Peng Zhou. 2013. A parametric account of scope in child language. In Stavroula Stavrakaki, Marina Lalioti and Polyxeni Konstantinopoulou (eds.), *Advances in language acquisition*, 63–71. Cambridge: Cambridge Scholar Publishing.

Crain, Stephen, Takuya Goro & Rosalind Thornton. 2006. Language acquisition is language change. *Journal of Psycholinguistic Research* 35 (1). 31-49.

Crain, Stephen & Drew Khlentzos. 2008. Is logic innate? *Biolinguistics* 2 (1). 24-56.

Crain, Stephen & Drew Khlentzos. 2010. The logic instinct. *Mind and Language* 25. 30-65.

Crain, Stephen & Paul Pietroski. 2001. Nature, nurture and Universal Grammar. *Linguistics and Philosophy* 24. 139-185.

Crain, Stephen & Rosalind Thornton. 2006. Acquisition of syntax and semantics. In Michael Trexler and Morton Ann Gernsbacher (eds.), *Handbook of Psycholinguistics*, 1073-1110. St Peters, Australia: Elsevier.

Dummett, Michael. 1978. *Truth and other enigmas*. Cambridge Massachusetts: Harvard University Press.

Field, Andy, Jeremy Miles & Zoe Field. (2012). Discovering statistics using R. London: Sage.

Geçkin, Vasfiye, Stephen Crain & Rosalind Thornton. (submitted.) The interpretation of logical connectives in Turkish.

Gentner, Dedre & Laura Namy. 2006. Analogical process in language learning. *Current Directions in Psychological Science* 15. 297-301.

Goro, Takuya. 2004. *The emergence of Universal Grammar in the emergence of language: the acquisition of Japanese logical connectives and positive polarity*. Ma. University of Maryland.

Goro, Takuya. 2007. *Language-specific constraints on scope interpretation in first language acquisition*. University of Maryland dissertation.

Goro, Takuya & Sachie Akiba. 2004a. The acquisition of disjunction and positive polarity in Japanese. In Vineeta Chand, Ann Kelleher, Angelo J. Rodriguez and Benjamin Schmeiser (eds.), *Proceedings of the 23rd West Coast Conference on Formal Linguistics[WCCFL, 23]*, 251–264. Somerville, MA: Cascadilla Press.

Goro, Takuya & Sachie Akiba.2004b. Japanese disjunction and the acquisition of positive polarity. In Yukio Otsu (ed.), *Proceedings of the Fifth Tokyo Conference on Psycholinguistics*, 137-162. Tokyo: Hituzi Shobo Publishing Company.

Göksel, Aslı & Celia Kerslake. 2005. *Turkish, A comprehensive grammar*. London: Routledge.

Grice, Paul. 1975. Logic and conversation. In Peter Cole and J. Morgan (eds.), *Syntax and Semantics, vol. 3: Speech Acts*, 41–58. London: Academic Press.

Horn, Laurence. 1996. Exclusive company: Only and the dynamics of vertical inference. *Journal of Semantics* 13. 1-40.

Inhelder, Barbel & Jean Piaget.1964. *The early growth of logic in child*. Harper & Row.

Jaeger, T.Florian, 2008. Categorical data analysis: Away from ANOVAS (transformation or not). And towards logit mixed models. *Journal of Memory and Language*, 59 (4), 434-446.

Johnson-Laird, Philip. N. 2001. Mental models and deduction. *Trends in Cognitive Science* 5. 434-442.

Johnson-Laird, Philip. N. &Ruth, M. J. Byrne. 2002. Conditionals: A theory of meaning, pragmatics, and inference. *Psychological Review* 109. 646-678.

Kegley, Charles.W. & Jacquelyn Ann Kegley. 1978. *Introduction to logic*. Lanham, MD: University Press.

Lieven, Elena, Julian Pine & Gillian Baldwin. 1997. Lexically-based learning and early grammatical development. *Journal of Child Language* 24 (1). 187-219.

MacWhinney, Brian. 2000. *The CHILDES Project: Tools for Analyzing Talk*. Mahwah, NJ,Lawrence Erlbaum Associates. Third Edition. Vol 2: The Database.

MacWhinney, Brian. 2002. Language acquisition. In Michael Arbib (ed.), *Handbook of neural networks,* 600-604.Cambridge: MIT Press.

Morris, Bradley J. 2008. Logically speaking: evidence for item-based acquisition of the connectives AND and OR. *Journal of Cognition and Development* 9(1). 67-88.

Neimark, Edith. D. 1970. Development of comprehension of logical connectives: understanding of "or." *Psychonomic Science* 21. 217-219.

Notley, Anna, Peng Zhou, Britta Jensen & Stephen Crain. 2012. Children's interpretation of disjunction in the scope of ‘before’: a comparison of English and Mandarin. *Journal of Child Language* 9(3). 482–522.

Paris, Scott. G. 1973. Comprehension of language connectives and propositional logical relationships. *Journal of Experimental Child Psychology* 16. 278-291.

Piaget, Jean. 1969. *The mechanisms of perception*. London: Rutledge & Kegan Paul.

Pinker, Steven. 1984. *Language Learnability and Language Development*. Cambridge MA: Harvard University Press.

Quine, Willard van Orman. 1992. *Pursuit of Truth*. Cambridge, MA: Harvard University Press.

R Development Core Team. 2008. *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing.

Richards, Thomas. J. 1978. *The language of reason*. Rushcutters Bay, NSW.

Taplin, John. E, Herman Staudenmayer & Judith L. Taddonio. 1974. Developmental changes in conditional reasoning: Linguistic or logical? *Journal of Experimental Child Psychology* 17. 360-373.

Saffran, Jenny. R. 2003. Statistical language learning: mechanisms and constraints. *Current Directions in Psychological Science* 12. 110-114.

Samuelson, Larissa. K. 2002. Statistical regularities in vocabulary guide language acquisition in connectionist models and 15-20-month-olds. *Developmental Psychology* 38(6). 1016–1037.

Suppes, Patrick & Shirley Feldman.1971**.** Young children's comprehension of logical connectives. *Journal of Experimental Child Psychology* 12. 304-317.

Szabolcsi, Anna. 2002. Hungarian disjunctions and positive polarity. In István Kenesei and Péter Siptar (eds.), *Approaches to Hungarian 8*, 217–241. Budapest: Akademiai Kiado.

Tomasello, Michael. 2003. *Constructing a language: a usage-based theory of language acquisition*. Harvard University Press.

Chapter 5

Acquisition of scope relations

by

Turkish-English bilingual children

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Abstract

This is a bidirectional case study in the acquisition of semantics by Turkish–English bilingual children. The research question is whether bilingual children acquiring Turkish and English use parental input, versus a principle of language learnability, as the basis for their initial interpretation of sentences with a temporal connective (English *before*, Turkish *önce*) and disjunction (Turkish *ya da*, English *or*). According to the learnability principle, bilingual children were expected to initially assign the same interpretation to the target sentences in both languages, despite differences in the input from adult speakers. The findings of the study confirmed this prediction, and are taken as evidence in support of the principle of language learnability, called the Semantic Subset Principle.

Key words: bilingualism, Turkish, temporal connectives, disjunction, language learnability.

Acquisition of scope relations by Turkish-English bilingual children

Introduction

One approach to language acquisition maintains that learning a language is not fundamentally different from mastering other cognitive skills, such as learning to read or to play a musical instrument. On this approach, children attend carefully to the input from their parents and other caretakers in acquiring the structures of the local language. Children are seen to form generalizations based on distributional regularities in the input, using domain-general learning procedures. This perspective is known as the experience-based (or usage-based) approach to language development (Ambridge & Lieven 2011; Goldberg 2003; Lieven & Tomasello 2008; Rowland 2014; Tomasello 2000; 2003).

Another perspective maintains that, as part of the human biological endowment for language, children come equipped with domain-specific principles of language learning. These principles guide children in specific directions as they navigate through the primary linguistic data towards convergence on a grammar that is equivalent to that of adult speakers of the local language. The principles of language learning supplement the linguistic knowledge that children bring to the task of language acquisition. On this approach, children have access to two kinds of linguistic knowledge from the earliest stages of language acquisition. First, linguistic knowledge is comprised of 'core' linguistic PRINCIPLES that are common to human languages and, second, knowledge is encoded in a series of decision-points, or PARAMETERS, that enable children to identify those features of the local language that distinguish it from other languages spoken around the globe. We will refer to this as the Principles and Parameters approach to language development (Chomsky 1981; 1995; Thornton & Crain 2013).

These two approaches to language development make different predictions about the course of language development for both monolingual children and for bilingual children. In

contrast to the experience-based approach, advocates of the Principles and Parameters approach anticipate that children will sometimes adopt linguistic hypotheses, i.e., parameter settings, which are not attested in the input. When this happens in monolingual children, they will be seen to speak a fragment of a 'foreign' language for a brief period, before they settle on the linguistic structures that distinguish the local language from other languages (Crain 2012; Crain, Goro & Thornton 2006; Crain, Gualmini & Pietroski 2005). Bilingual children are expected to sometimes assign the same initial analysis to certain structures, in both of the languages they are mastering, despite the absence of evidence for this analysis in the adult input corresponding to one of the languages. The present study is an example of this second situation. In the present study, we found that bilingual children analyse certain sentence structures in the same way in both languages, whereas adult speakers analyse the same sentences differently in one language as compared to the other. This finding is compelling evidence for the Principles and Parameters approach to language development.

For both monolingual and bilingual children, children's early non-adult analyses facilitate language acquisition. By adopting certain parameter settings rather than others, children are able to steer clear of potential pitfalls that they would otherwise encounter. More specifically, potential pitfalls arise for children when the sentence structures generated in different languages stand in a particular logical relationship. The problematic relationship is one in which sentences in one language are true in a greater number of circumstances than the corresponding sentences in the other language. Where such subset/superset relations obtain, a domain-specific learnability principle entreats children to initially assume that the language(s) they are acquiring fall within the class that makes sentences true in the narrowest range of circumstances. If children begin with this setting of the relevant parameters, then they will have evidence from the input informing them if the local language is a 'superset' language such that the sentences in question turn out to be true in circumstances beyond those initially permitted by children. The principle that dictates children's initial preferences for the class of

languages that make sentences true in the narrowest range of circumstances is called the Semantic Subset Principle (Crain 2012; Crain, Ni & Conway 1994).

The predictions of the Semantic Subset Principle will be used in the present paper to adjudicate between the two different approaches to language development. On the experience-based approach, child language is expected to differ from adult language in certain ways, but not in others. Essentially, child language is expected to be less articulated than adult language, but it is not expected to be qualitatively different. On the experience-based approach, differences between child and adult language are expected to reflect the frequency of different constructions in the input to children, with more frequent constructions being acquired earlier than less frequent ones. Simple structures are combined, by general learning algorithms (such as analogical processes), to form more complex structures, so the latter emerge later in the course of acquisition (Lieven & Tomasello 2008).

According to the Principles and Parameters approach, by contrast, the system of parameters determines how child language differs from that of adults. On this approach, child and adult language are expected to differ just in ways that adult languages differ from each other. The system of parameters that distinguish classes of human languages sets the boundary conditions on differences between child and adult language in the same linguistic community. It follows that children are always speaking a possible human language, but one that may differ in certain identifiable features from the language that is being spoken around them. The natural seams of human languages are spelled out by parameters, and these represent potential points of variation between child and adult language, both for monolingual and for bilingual children. When parameter values stand in a subset/superset relation, then explicit predictions can be made about how the language of monolingual and bilingual children will differ from that of adults. The present study follows up one of these predictions, for bilingual children acquiring Turkish and English, which are languages that differ in the

value that is assigned to one such parameter, called the Disjunction Parameter (Crain 2008; 2012).

Studies in the bilingual literature speculated whether simultaneous bilingual children have unitary (Volterra&Taeschner, 1978; Taeschner, 1983) or separate syntactic representations for each of their languages (Meisel, 1989; have separate systems for each language (Paradis & Genesee, 1996; de Houwer, 1990). Today the widely held view is that bilingual children hold two separate systems. Despite the two separate systems, cross-linguistic influence between the two languages has also been reported. Syntax external factors such as language dominance have been given as sources for cross-linguistic influence (Peterson, 1988; Yip & Matthews, 2001; Bernardini &Schlyter, 2004; Grüter & Paradis, 2014). Cross-linguistic influence has also been sourced to factors internal to the languages. Provided that there has to be an overlap at the surface level between the two languages for the property in question (Hulk &Muller, 2000; Muller &Hulk, 2001), a unidirectional cross-linguistic influence has been predicted between the two languages. The language in which the property is more simple (i.e. less restricted) will influence the language in which the property is more complex (i.e. more restricted) will influence the language in which the property is more complex (i.e. more restricted). For example, the use of overt subjects in pro-drop languages is pragmatically regulated and restricted to certain contexts; by comparison, the use of overt subjects in non-pro-drop languages is simpler (they must be used). A pairing of these two types of languages is predicted to result in influence of the non-pro-drop language on the pro-drop language, which manifests as overuse of overt subject pronouns. This directionality of influence has been observed in the bilingual acquisition of overt subject pronouns in pro-drop and non-pro-drop languages (Argyri &Sorace, 2007; Haznedar, 2007; Serratrice, Sorace & Paoli, 2004). The contribution this study makes to the bilingual literature is that it is the first study which tests the acquisition of a purely semantic phenomenon on balanced Turkish-English bilingual children.

Studies of bilingual children provide one means of evaluating the different predictions about the course of language development made by the competing approaches. The findings of the present study demonstrate that, in forming linguistic hypotheses, bilingual children sometimes disregard the input from adult speakers of one of the languages they are acquiring. Consequently, bilingual children assign the same meanings to sentences in both languages, despite the fact that different meanings are assigned by adult speakers of the two languages. The findings are interpreted as empirical support for the Semantic Subset Principle, as well as for the Principles and Parameters approach to language development.

The Disjunction Parameter

Disjunction in logic and in language

In classical logic, disjunction is inclusive-*or*. A statement of the form *A or B* is true in three circumstances: (i) if A is true, but B is false, (ii) if B is true, but A is false, and (iii) if both A and B are true. In human languages, it is not always clear whether the lexical items associated with words for disjunction correspond to inclusive-*or*, or to exclusive-*or*, where a statement of the form *A or B* is <u>false</u> if both A and B are true. Suppose, at a party, the host informs the guests *You may have an apple or a banana.* The guests would infer that the host is offering each of them either an apple or a banana, but not both. The use of disjunction in this circumstance is consistent with the truth conditions that are associated with exclusive-*or*. Nevertheless, English *or* seems to be inclusive-*or* in other circumstances. For example, consider how a job-seeker would interpret the following advertisement: *We are looking for someone with a degree in Economics or three years of accounting experience*. Applicants who respond to the ad will surely not expect to be turned away if they have both a degree in Economics <u>and</u> three years of accounting experience. The use of disjunction in this circumstance is consistent with the truth conditions that are associated with inclusive-*or*, as in classical logic.

From the perspective adopted here, there is just one meaning of disjunction in human languages, and it is the same meaning as in classical logic, namely inclusive-*or*. When language users appear to assign an exclusive-*or* meaning to disjunction words, this is simply the product of conversational principles that eliminate certain truth conditions from consideration. Adherence to these conversational principles leads language users to draw certain inferences about the intentions of speakers in the conversational context. One of these inferences involves statements with a disjunction word (English *or*). In many conversational contexts, language users infer that speaker's assertions that contain disjunction are intended to exclude the possibility that both disjuncts are true (Grice 1975). We will explain the source of this inference of 'exclusivity' in the next section.

The implicature of exclusivity

It is important to distinguish between the literal meaning of a logical expression, such as disjunction, and the pragmatic norms we follow in making inferences about what the speaker intends by using a particular logical expression. One of the most basic norms of conversation is the Principle of Cooperation. According to this principle, speakers are enjoined to make their contributions to conversations as informative as possible. To be optimally informative, speakers need to choose carefully among logical expressions, since some logical expressions are more informative than others even in the same conversational context. This is sometimes the case with the logical expressions for disjunction and for conjunction. In certain circumstances, sentences that contain either disjunction or conjunction may be true. In such circumstances, the Principle of Cooperation weighs in favour of the sentences with conjunction. This is a consequence of the fact that disjunction and conjunction in human languages can be positioned on a scale, according to the relative strength of the information they convey. Typically, sentences that contain expressions for conjunction are informationally

stronger (i.e., true in fewer circumstances) than the corresponding sentences with expressions for disjunction.

Here is an example. Suppose that, at a party, the host uses a disjunctive statement to inform the guests about the dessert options. The host says *You may all have an apple* <u>*or*</u> *a banana*. Because this statement is taken to be the strongest statement the host was in a position to make, the guests infer that they are not being offered both an apple and a banana. The guests reason that, if the host had been in a position to offer them both an apple and a banana, then the host would have used a sentence with conjunction —*You may have an apple* <u>*and*</u> *a banana*, rather than one with disjunction. The fact that the speaker used the weaker term *or* instead of the stronger term *and* leads the guests to draw an implicature of exclusivity. This implicature is based on the assumption that the host was being cooperative, and produced the strongest statement he or she was in a position to make. Consequently, the guests eliminate the possible outcome that they are being offered both an apple and a banana from their interpretation of the host's disjunctive statement. This analysis permits us to maintain inclusive-*or* as the basic meaning of disjunction in human languages, with the understanding that, when speakers use disjunctive statements, hearers will compute an implicature of exclusivity in circumstances in which the basic meaning of disjunction results in a 'weaker' statement than the corresponding statement with conjunction.

Downward entailment

In some linguistic contexts, the use of disjunction results in a stronger statement than the corresponding statement with conjunction. These are contexts in which disjunction appears in the scope of a member of a class of logical expressions called Downward Entailing operators. The negative quantifier phrase *none of the…* is an example of a Downward Entailing operator. Consider the following disjunctive statement —*None of these computers comes with Safari or Firefox.* Next consider the corresponding statement with conjunction —*None of these*

computers comes with Safari and Firefox. The first statement, with disjunction, excludes more possibilities than the second statement does. Consider the statement with conjunction first. If none of the computers comes with Safari and Firefox, then some computers may have Safari but not Firefox, others may have Firefox but not Safari, and still others may have neither. In contrast, the statement with disjunction is only true in one of these circumstances, where none of the computers has either Safari or Firefox. Clearly then, a sentence with disjunction makes a stronger statement than the corresponding sentence with conjunction when these expressions appear within the scope of the downward entailing operator *none of the*…. It follows, as a matter of logic, that the negative disjunctive statement *None of the computers comes with Safari or Firefox* is equivalent to a conjunction of two negative statements: (i) *None of the computers comes with Safari* and (ii) *None of the computers comes with Firefox*.[12] We will refer to this as the 'conjunctive' entailment of disjunction in the scope of a Downward Entailing operator.[13]

Scope ambiguities

We are now in a position to introduce the notion of logical scope. When sentences contain two (or more) logical expressions, they are often ambiguous, depending on which of the logical expressions is interpreted to take prominence. The different interpretations of a sentence with two logical operators is referred to as a scope ambiguity. A simple example should suffice. Consider the sentence –*Every airplane does not carry pets*. On one meaning, this could convey the proposition that none of the airplanes carries pets. On this meaning, the

[12] More generally, a downward entailing operator Δ licences an entailment from a disjunctive statement, Δ(A or B), to a conjunctive statement, Δ(A) and Δ(B), where the downward entailing operator Δ takes scope over each of the disjuncts.

[13] This does not mean that disjunction, *or*, can be replaced by conjunction, *and*. Rather, a statement with a single Downward Entailing (DE) operator, when combined with disjunction, logically entails a conjunction of two statements, where the DE operator applies to each of the disjuncts in the original disjunctive statement.

universal quantifier *every* takes scope over negation *not*, which we represent symbolically as (*every* > *not*). However, presumably the intended meaning is different. It can be paraphrased as *Not every airplane carries pets*, where negation *not* takes scope over the universal quantifier *every*, which we represent as (*not* >*every*). When disjunction is combined with other logical expressions, such as negation, the result is often a scope ambiguity. Scope ambiguities are sometimes difficult to recognize if we restrict our attention to particular languages, but such ambiguities are readily apparent if we look across languages, as we will show momentarily.

To explain the observed cross-linguistic differences in the interpretation of disjunction in negative sentences, a lexical parameter has been proposed. This is called the Disjunction Parameter (Crain 2008; 2012; Goro 2004; 2007; cf. Szabolcsi 2002).

The Disjunction Parameter

The Disjunction Parameter governs the scope relations between disjunction and negation across languages. In languages like English, German and Korean, negation takes scope over disjunction, whereas in languages like Japanese, Mandarin Chinese and Russian, disjunction takes scope over negation. The Disjunction Parameter incorporates the notion of polarity sensitivity. More specifically, the observation that disjunction takes scope over negation in some languages, regardless of its position in surface syntax, can be accounted for by positing that disjunction is a Positive Polarity Item (PPI) in these languages. This is the 'positive' value of the Disjunction Parameter, i.e., [+PPI]. In languages in which negation takes scope over disjunction, the disjunction operator is assigned the 'negative' value of the parameter, [–PPI] (Crain, Goro, Notley & Zhou 2013).

Consider the English negative statement in (1) *The pig did not eat the pepper or the carrot*. In interpreting sentences such as (1), English speakers strongly favour the surface scope interpretation, on which negation takes prominence over disjunction (*not* > *or*). On this

reading (1) generates a strong ‘neither’ reading. This reading eventuates because disjunction generates a conjunctive entailment under negation, as in one of de Morgan’s laws of propositional logic, so example (1) can be paraphrased using a conjunction of two negative statements, *The pig did not eat the pepper and the pig did not eat the carrot*.

(1) The pig did ***not*** eat the pepper ***or*** the carrot.

When the English example in (1) is translated into Japanese, as in (2), a different meaning emerges. The Japanese statement in (2) is true in two circumstances, ones in which the pig didn’t eat the pepper, but did eat the carrot, and ones in which the pig didn’t eat the carrot, but did eat the pepper. In principle, negated disjunctions are expected to be true if both of the disjuncts are true, on the supposition that disjunction is inclusive-*or* in human languages, as it is in classical logic (Crain 2012). However, this third circumstance is ruled out, more often than not, by an explicit disclaimer. That is, adult speakers of Japanese typically follow their productions of sentences such as (2) with the qualification … *demo dochira ka wakara-nai* ‘but I don’t know which.’

(2) Butasan-wa ninjin ***ka*** piiman tabe-***nakat***-ta

Pig-TOP carrot or pepper eat-NEG-PAST

‘The pig didn’t eat the carrot or the pig didn’t eat the pepper.’

Adopting the Disjunction Parameter, we can capture the difference between English and Japanese as follows. In English, the disjunction expression *or* carries the [–PPI] value of the Disjunction Parameter. On this value of the parameter, negation takes scope over disjunction (*not* > *or*), both in the surface syntax and at the level of semantic interpretation. So, negated disjunctions generate a conjunctive interpretation in English, as in one of de Morgan’s laws of propositional logic. In Japanese, by contrast, the disjunction word *ka* is a Positive Polarity Item. So Japanese adopts the [+PPI] setting of the Disjunction Parameter, where disjunction takes scope over negation (*or* > *not*). Consequently, the Japanese example in (2) can be paraphrased using disjunction as the primary logical expression, as in *The pig*

did not eat the pepper or the pig did not eat the carrot. This interpretation is associated with what we will call the 'disjunctive' truth conditions, according to which a disjunctive statement is true if at least one of the disjuncts is true (i.e., the truth conditions associated with inclusive-*or*). In Japanese, by contrast, disjunction takes scope over negation regardless of case marking. This is illustrated in example (3), which is true in precisely the same circumstances as (2), despite the fact that the disjunction phrase bears the accusative case marker –*wo*.

(3) Butasan-wa ninjin ***ka*** piiman-***wo*** tabe-***nakat***-ta

Pig-TOP carrot or pepper-ACC eat-NEG-PAST

'The pig didn't eat the carrot or the pepper.' (Goro 2007: 226)

Turkish is a head final language like Japanese. However, Turkish differs from Japanese, because accusative case marking is an essential ingredient in determining scope relations between disjunction and negation in Turkish.[14] We would note, first, that disjunction words are not Positive Polarity Items in Turkish. That is, Turkish adopts the [–PPI] value of the Disjunction Parameter, just as English does. This is illustrated in example (4), in which disjunction *ya da* generates a conjunctive entailment; so (4) can be paraphrased as *The pig did not eat the pepper and The pig did not eat the carrot*.

(4) Domuz-cuk havuç ***ya da*** biber ye-***me***-di.

Pig-DIM carrot or pepper eat-NEG-PAST

'The pig didn't eat the carrot or the pepper.'

However, when the nouns in a disjunction phrase are marked with accusative case, as in (5), Turkish sentences no longer generate a conjunctive entailment. Instead, (5) is assigned

[14] Turkish has two expressions for disjunction, (*ya)…ya da* ('either')…'or' and *veya* 'or' (cf. Göksel & Kerslake 2005).

disjunctive truth conditions, as in Japanese. The difference in the interpretation of (4) versus (5) indicates that the Turkish accusative case marker–*(y)ı* is a Positive Polarity Item.

(5) Domuz-cuk havuç-u ***ya da*** biber-i ye-***me***-di.

Pig-DIM carrot-ACC or pepper-ACC eat-NEG-PAST

'The pig didn't eat a certain carrot or didn't eat a certain pepper.'

The next section introduces another linguistic phenomenon that is governed by the Disjunction Parameter, namely sentences in which disjunction appears in the scope of a temporal operator (e.g. English *before).*

Temporal Operators

Across human languages, the temporal term *before* is downward entailing. We can use disjunction as a diagnostic test. As we have seen, when disjunction appears in the scope of a downward entailing operator, it generates a conjunctive entailment. Consider the English example in (6) *The hedgehog finished the race* ***before*** *the zebra* ***or*** *the kangaroo.* This sentence is true only if both of the following sentences are true: (a) *The hedgehog finished the race before the zebra* <u>and</u> (b) *The hedgehog finished the race before the kangaroo*. However, when the same sentence is translated into Turkish, a different meaning emerges. The temporal connective corresponding to English *before* in Turkish is *önce,* and one Turkish expression for disjunction is *ya da*. So, the translation of the English example (6) into Turkish is (7), where the temporal term *önce* 'before' requires a disjunctive phrase marked with ablative case (*–den*).

(6) The hedgehog finished the race **before** the zebra **or** the kangaroo. (*before* > *or*)

(7) Kirpi yarış-ı zebra **ya da** kanguru-**dan** **önce** bitir-di. (*or* > *before*)

Hedgehog race-ACC zebra or kangaroo-ABL before finish-PAST

'The hedgehog finished the race before the zebra or the kangaroo.'

In contrast to English, the disjunction phrase takes scope over the temporal term *önce* 'before'

in (7), so this sentence is true in three circumstances: (a) if the hedgehog reaches the finish line before the kangaroo but not before the zebra, (b) if the hedgehog reaches the finish line before the zebra but not before the kangaroo, and (c) if the hedgehog reaches the finish line before both the kangaroo and the zebra. On the other hand, this is the only circumstance that makes the English sentence (6) true. It follows that Turkish sentences like (7) are true in a 'superset' of the circumstances that make English sentences like (6) true.

The Disjunction Parameter governs the interpretations assigned to sentences in which disjunction is in combination with the temporal term *before*. The parameter value with disjunction taking scope over the temporal term is designated [+PPI], and the value with the temporal term taking scope over disjunction is [–PPI]. English assigns the [–PPI] value of the Disjunction Parameter in the English sentence (6). In Turkish, disjunction phrases are marked with ablative case (*–den*) when they appear in the scope of the temporal term *önce* 'before'[15]. The entire constituent (e.g., zebra *ya da* kanguru-*dan önce*) is associated with the value [+PPI]. Therefore, the *before*-phrase with disjunction in (7) fails to generate a conjunctive entailment. Instead, the Turkish sentence (7) is associated with 'disjunctive' truth conditions. It follows that Turkish sentences like (7) are logically true in a superset of the circumstances that verify English sentences like (6). Notice, however, that circumstances in which both disjuncts are true (i.e., situation (c), where the hedgehog reaches the finish line before both the kangaroo and the zebra) would be more perspicuously described using a sentence with conjunction rather than one with disjunction. Therefore Turkish sentences like (7) are pragmatically infelicitous if they are produced in these circumstances.

When the same sentence structure is assigned different meanings across languages,

[15] We saw earlier that disjunctive phrases are interpreted *in situ* when they are not case marked. So the disjunction word itself is not a Positive Polarity Item (PPI), but certain disjunction phrases are PPIs in Turkish, including disjunction phrases marked with accusative case, and ones that appear in the scope of the temporal term *önce* 'before'.

and when these meanings stand in a subset/superset relation, language learners confront a potential learnability problem. If language learners initially hypothesize that the local language is one of the superset languages, then this hypothesis will be confirmed even if the language is actually one of the subset languages. To avoid such learnability dilemmas (called Subset Problems), it has been proposed that children initially assume that the local language is a subset language (Berwick 1985; Crain & Khlentzos 2008; Pinker 1984). If the local language turns out to be a superset language, then 'positive' evidence will be available to disconfirm children's initial hypothesis, so that they can converge on a grammar that is equivalent to adults. The positive evidence consists of adults using the expression in circumstances that would make the sentence false for the learner. Because the learner assumes that adults are being cooperative and, therefore, produce sentences that are true, such adult input indicates to learners that they have to reset the value of the relevant parameter, for the subset value to the superset value.

Given that English and Turkish yield different interpretations of sentences like (6) and (7), bilingual children's acquisition of disjunction in the two languages presents an opportunity to adjudicate between the predictions of the experience-based approach to language development and those of the Principles and Parameters approach. According to the Principles and Parameters approach, the Semantic Subset Principle compels children to initially hypothesize the subset value of scope parameters. The subset value of the Disjunction Parameter is aligned with the English interpretation of (6), so the interpretation that is expected to be assigned by English-speaking children will be the same as that of adults. The interpretation assigned by Turkish-speaking children is also expected to be initially aligned with the subset value of the Disjunction Parameter [–PPI], whereas adults adopt the alternative, superset value of the parameter [+PPI]. Therefore, Turkish-speaking children are predicted to differ from adults in their assignments of scope relations to sentences like (7).

Differences between child and adult language are among the strongest arguments for the Principles and Parameters approach. If the prediction that Turkish-speaking children and adults differ in the interpretations they assign to sentences like (7) is verified, then this would be compelling support for the Principles and Parameters approach. On the other hand, the experience-based approach anticipates that child language should closely approximate the adult input. It is expected, therefore, that children and adults will assign the same scope relations to ambiguous sentences, for each language. To address these predictions, a case study was conducted with four Turkish-English bilingual children and their mothers. Before we present the details of the study, we will review previous studies of the interpretation of temporal terms, and scope ambiguities, by monolingual and bilingual children.

The Interpretation of logical expressions in child language

Monolingual Child Language

Children's comprehension of English sentences with the temporal term *before* has received much attention in the literature on first language acquisition. Early studies found that pre-school children experienced difficulty in acting out and in understanding sentences with both *before* and *after*. In these studies, children were invited to act out sentences with temporal terms using toys and props made available in the experimental workspace. The main finding was that children were successful in acting out the meanings of sentence if the conceptual order of events matched the order in which events were mentioned in the target sentences, but performed poorly if there was a conflict between the conceptual order and the order of mention (Ferreiro & Sinclair 1971; Hatch 1971; Barrie-Blackley 1973). For example, children successfully performed the actions mentioned in sentences like *After the dog pushes the cat, the zebra pushes the walrus*, where the event of the dog pushing the cat is mentioned before the event of the zebra pushing the walrus. However, children performed poorly in acting out sentences like *Before the dog pushes the cat, the zebra pushes the walrus*, where the order in

which the events are mentioned conflicts with the conceptually correct order in which the events take place.

The difficulties experienced by pre-schoolers were attributed to an immature syntax by Amidon and Carey (1972). More specifically, the hypothesis was that children lacked sentential embedding. Another early account of children's difficulties, by Clark (1971), attributed children's non-adult performance to semantic complexity. However, studies by Crain (1982) and by Gorrell, Crain and Fodor (1989) revealed that the performance of pre-school children was nearly equivalent to that of adults if certain presuppositions of the test sentences were satisfied in the experimental context. For example, the presupposition of the temporal term *before* can be satisfied by asking the child to commit to pushing some toy, say a car, and then incorporating the child's intention to push the car into the test sentence, as in *Before you push the car, push the boat*. The finding that, by age 4, children act out these sentences correctly, once the presupposition is satisfied, shows that children know both the syntax and the semantics of temporal terms, though this knowledge may be masked in experimental tasks that do not meet the pragmatic felicity conditions that govern the use of these terms.

Turning to disjunction, it has been noted that the disjunction operator, *or*, is used by both children and adults in contexts that do not distinguish between exclusive versus inclusive disjunction (e.g. Morris 2008). However, there is increasing evidence demonstrating that children interpret disjunction as inclusive-*or*. For example, several studies have found that children younger than 6-years-old accept disjunctive statements in contexts in which both disjuncts are true, despite the observation that adults reject the same sentences in such contexts, presumably due to an implicature of exclusivity (Noveck 2001; Guasti, Chierchia, Crain, Foppolo, Gualmini & Meroni 2005). This growing body of research findings has led many researchers to conclude that children assign inclusive-*or* as the basic meaning of

disjunction, as in classical logic, but lack the same sensitivity as adults to the scalar implicature associated with disjunction.

Recent studies of children's interpretation of disjunction have also confirmed that children interpret disjunction as generating a conjunctive entailment when it appears in the scope of negation, or in the scope of other Downward Entailing operators. This is further evidence that children initially interpret disjunction as inclusive-*or*. Several studies have contrasted the interpretation of disjunction by monolingual children in Downward Entailing versus non-Downward Entailing linguistic contexts. We will review just one representative study, by Su and Crain (2013). These researchers investigated Mandarin-speaking children's interpretation of the disjunction word *houzhe* in two positions in sentences with the universal quantifier (Mandarin *mei*). When *huozhe* appears in the Subject phrase of sentences with the universal quantifier *mei*, it generates a conjunctive entailment, because the Subject phrase is a Downward Entailing linguistic environment. However, when the disjunction word *huozhe* appears in the Predicate phrase of sentences with the universal quantifier *mei*, it does not generate a conjunctive entailment, because the Predicate phrase is a non-downward entailing linguistic environment.

Children's knowledge of this asymmetry was investigated using a Truth Value Judgment task with three-to five-year-old monolingual Mandarin-speaking children, with a mean age of 4;10. The finding was that children, like adults, interpreted disjunction as generating a conjunctive entailment when it appeared in the Subject phrase of the universal quantifier *mei*, but not when it appeared in the Predicate phrase. The only difference between children and adults was in the interpretation they assigned to disjunction in the Predicate phrase. In these sentences, adults typically computed an implicature of exclusivity, whereas children failed to compute this implicature. So, Mandarin-speaking children accepted test sentences of both kinds by assigning an inclusive-*or* interpretation to disjunction (see also

Notley, Thornton & Crain 2013, for a similar study with four-to-five-year-old English-speaking children).

One of the most striking examples of a difference in the interpretation of disjunction by children and adults was found in studies of the acquisition of Japanese by Goro and Akiba (2004a, b). As noted earlier, adult speakers of Japanese assign the [+PPI] value to the Disjunction Parameter, so adult Japanese-speakers assign 'disjunctive' truth conditions to negated disjunctions. In the Goro and Akiba studies, however, Japanese-speaking children were found to assign the Japanese disjunctive operator *ka* a conjunctive entailment in simple negative sentences, so children were found to initially assign the [–PPI] value of the Disjunction Parameter, as anticipated by the Semantic Subset Principle.

The Goro and Akiba study interviewed three-to-six-year-old monolingual Japanese-speaking children and adults using the Truth Value Judgement Task (Crain & Thornton 1998). In this task, the children were instructed to award medals to a succession of animals. In the game, an animal was given a *gold medal* if he managed to eat both of the vegetables (the carrot and the pepper). If the animal only managed to eat one of the vegetables, he received a *silver medal* and the animal received a *black cross* if he did not manage to eat either vegetable. Following a training session, the child participants listened to a sentence uttered by a puppet, such as *The pig did not eat the carrot or the pepper*. The child's task was to judge whether the sentence uttered by the puppet was true or false. Japanese-speaking adults consistently accepted the sentence when the animal received a silver medal in the condition in which the animal ate only one of the vegetables. By contrast, the Japanese-speaking child subjects consistently rejected the puppet's sentence in this condition. Moreover, they justified their rejections of the puppet's statements by pointing out that the animal had eaten one of the vegetables, which is why it had received a silver medal. Children's responses and their justifications were taken as evidence that they assigned a conjunctive entailment to disjunction, in striking contrast to Japanese-speaking adults. The findings are clear support for

the predictions of the Semantic Subset Principle. Data from other cross-linguistic studies have obtained similar findings to those of the Goro and Akiba study of Japanese-speaking children and adults (Crain, Gardner, Gualmini & Rabbin 2002; Gualmini & Crain 2002; Lee 2010).

There have also been studies of children's interpretation of disjunction in sentences with temporal operators, such as English *before* and Mandarin *zai…zhiqian*. A study by Notley, Zhou, Jensen and Crain (2012) investigated the interpretations of sentences incorporating disjunction and these temporal terms by monolingual Mandarin-speaking and monolingual English-speaking children. The finding was that 4- and 5-year-old children acquiring either language assigned the conjunctive interpretation to disjunction in the target sentences; children acquiring both languages adopted the [–PPI] value of the Disjunction Parameter, as predicted by the Semantic Subset Principle. The findings from Mandarin-speaking children contrasted with those from Mandarin-speaking adults, who adopted the [+PPI] setting of the Disjunction Parameter. The difference between the interpretation assigned by Mandarin-speaking children and adults are difficult to explain on the experience-based approach to language development.

Bilingual Child Language

The acquisition of the scope interactions between logical operators and temporal connectives has not been previously investigated in bilingual children. There have been studies, however, investigating the interpretation of disjunction in negative sentences by adults learning a second language. One study was by Grüter, Lieberman and Gualmini (2010). These researchers investigated the interpretation of negated disjunctions by Japanese-speaking adults acquiring English as a second language. At issue was whether the first language remained fully accessible to L2 learners in the initial stages of second language learning (Schwartz & Sprouse 1994; Haznedar & Schwartz 1997; cf. Epstein, Flynn & Martohardjono 1996). For Japanese L2 learners of English, full transfer could well be problematic because,

as we have seen, negative sentences with disjunction are true in Japanese in a broader range of circumstances than the corresponding sentences in English. That is, Japanese and English stand in a superset/subset relation in the scope assignments they generate for negative sentences with disjunction. Indeed, the L2 Japanese speakers accepted English negated disjunctions 84% of the time in circumstances that were associated with the superset value of the Disjunction Parameter [+PPI], where only one of the disjuncts was false. A control group of monolingual English-speaking adults accepted the test sentences only 31% of the time in the same circumstances, revealing a strong preference for the subset value of the Disjunction Parameter [–PPI]. The fact that the Japanese-speaking adults acquiring English as an L2 over-accepted English negative sentences with disjunction suggests that they did not invoke the subset value [–PPI] of the Disjunction Parameter, which they had presumably adopted as children acquiring Japanese. Rather, these L2 learners transferred the superset [+PPI] value from the final (adult) state of their first language.

The present study investigates children's acquisition of two languages that are in a subset/superset relationship, English and Turkish. Just as monolingual children do across languages, we predicted that bilingual children would assign the subset (English) value of the Disjunction Parameter to interpretation of disjunction phrases that appear in the scope of Downward Entailing operators, both in English and in Turkish. Since Turkish-speaking adults adopt the alternative superset value of the Disjunction Parameter, the pattern of responses by children was expected to differ from that of adults when the test sentences were presented in Turkish, but not when they were presented in English. If so, then this would provide compelling evidence for the Principles and Parameters account and the Semantic Subset principle, but would represent circumstantial evidence against the experience-based account of language development.

Experiment

Participants

The participants were four 5- to 6-year-old children and their mothers, all from upper middle class families. The children were Australian born and living in Sydney, Australia. Three of the children were girls and one was a boy. Two of the children were twins, and one was an only child (LA). None of the children had any reported hearing or language difficulties. The children were all enrolled in first grade at elementary school. The language spoken among siblings in the families was almost always English. All the mothers had a bachelor's degree and the fathers had all earned a postgraduate degree in an English speaking country. Information about the participants is summarised in Table 1. Both parents had native-like command of English.

Table 1: Demographic information

Children				***Mothers***			
ID	*Age*	*Language exposure*		*ID*	*Age*	*Language dominance*	
		Turkish	English			Turkish	English
ZE	5;11	40%	60%				
RU	5;11	40%	60%	AY	29;04	50%	50%
DE	6;01	20%	80%	FE	39	30%	70%
LA	6;09	30%	70%	OY	36;02	40%	60%

The mothers reported that both parents communicated in both Turkish and English with their children. None of the parents reported any specific pattern to language exposure by either parent when communicating with their children. As Table 1 indicates, the children's exposure to English was greater than their exposure to Turkish.

Procedures

The study took place in the homes of the participants. Prior to testing, the parents completed two detailed questionnaires about the family language environment. In the test session, the children and then their mothers were interviewed in a quiet room. The participants were tested first in Turkish and then in English. This order was selected in order to avoid influencing the

participants by first using the language with the more restricted grammatical options, viz., English. Two pre-tests were administered before the Truth Value Judgement game was administered. One pre-test was designed to ensure that the participants knew the meaning of the lexical items English *before* and Turkish *önce*. The second pre-test was designed to ensure that the participants knew the meaning of English *or* and Turkish *ya da.* The task for the participants in these pre-tests was to judge the truth of a story that was acted out in front of them in the experimental workspace. The puppet's sentence was pre-recorded in either Turkish or English, by a female native speaker of Australian English and a female native speaker of Turkish. The participants were directed to adopt the same language as the experimenter. None of the children or mothers had any difficulty in switching from one language to the other. The responses of the participants were audio recorded, for later transcription. The responses were coded either as *rejected* or *accepted*. The inter-rater reliability for the Turkish sentences was checked by a native speaker of Turkish, and the inter-rater reliability for the English sentences was checked by a native speaker of Australian English. There were no conflicts between the raters, so inter-rater reliability was 100%.

Materials

Pre-test 1: Temporal Operators *before* (Turkish *önce*)

This pre-test checked that the participants understood the temporal term *before*. The participants were asked to follow instructions and place some toy characters in a swimming pool in a particular order. Two of the instructions were in Turkish, followed by two instructions in English. As shown in Table 2, English *before* and Turkish *önce* were introduced in two situations. First, they were introduced in a situation where the order in which the events were mentioned was the same as the conceptually correct order in which the events occurred. Second, they were introduced in a situation in which the order of mention conflicted with the conceptual order.

Table: 2 Pre-test 1: *Before/ Önce* in Turkish and in English

Before pre-test	Turkish	English
Before OM*	Korsanı cadıyı koyma*dan önce* havuza koyar mısın? (Could you put the pirate before you put the witch in the pool?)	Could you put the panda in the pool *before* you put the zebra in the pool?
Reverse OM	Cadıyı koyma*dan önce* korsanı havuza koyar mısın? (Before you put the witch, could you put the pirate in the pool?)	*Before* you put the zebra in the pool, could you put the panda in the pool?

OM* Order of mention

Pre-test 2: Disjunction words *or/ya da*

The second pre-test probed the participants' interpretation of *or* in English and *ya da* in Turkish. This pre-test was used to assess the meaning of disjunction by investigating whether participants generated the conjunctive interpretation of disjunction when it appears in the scope of negation in the surface syntax. In order to ensure that disjunction generated a conjunctive entailment in Turkish, negation was used in a higher clause than the clause that contained disjunction, as in example (8). For consistency, we used the same sentence structure in the English version of the pre-test, as illustrated in (9).

In the Turkish version of the pre-test with disjunction, two characters were involved in four competitive games in each language. One of these animals, e.g., a dog, made predictions about the performance of the competitors in each competitive game. On a typical trial, the two competitors, a witch and a princess, were involved in a lifting game. There were 4 items that they could attempt to lift: a shoe, a truck, a leaf and a cake. The dog predicted that the witch would be able to lift the leaf, but not the shoe or the truck. Then the dog closed his eyes. While the dog's eyes were closed, the witch lifted both the leaf and the shoe. When the dog opened his eyes, he repeated his prediction in Turkish, using the sentence in (8).

(8) *Test item:* Doğru mu bilmişim? Demiştim ki cadıyı yaprağı kaldırırken göreceksin ama ayakkabıyı ya da kamyonu kaldırırken görmeyeceksin. Doğru mu bilmişim?

‘Did I guess right? I said you would see the witch lift the leaf, but I said that you would not see the witch lift the shoe or the truck. Was I right?’

On a typical trial in the English version, the competitors were a panda and a zebra. They were involved in a jumping game, with four objects to jump on: a bed, a table, a bath and a sofa. The dog predicted that the panda would jump on the bed, but not on the table or the sofa. When the dog had its eyes closed, the panda jumped on the bed and on the table. When the dog opened his eyes, he repeated his prediction, using sentence (9). The expected responses to (8) and (9) were *No*.

(9) *Test item*: Did I guess right? I said you would see the panda jump on the bed, but I said that you would not see the panda jump on the table or the sofa. Was I right?

A second set of stories was designed to elicit *Yes* responses from children. In a typical story in the Turkish version, the princess was attempting to find some lost or hidden objects. There were four objects to be to found: a star, a shell, a fish and a boat. The dog predicted that the princess would be able to find the star, but not the fish or the boat. While the dog had its eyes closed, the princess was only able to find the star. When the dog opened its eyes, it repeated the prediction, as in (10).

(10) *Test item:* Doğru mu bilmişim? Demiştim ki prenses yıldızı bulacak ama balığı ya da gemiyi bulmayacak. Doğru mu bilmişim?

‘Did I guess right? I said that the princess would find the star, but not the fish or the boat. Was I right?’

In the English version, a zebra and a panda participated in an eating competition. There were 4 things to eat: a cake, an ice-cream, a strawberry and grapes. The dog predicted that the zebra would eat the cake, but not the strawberry or the ice-cream. When the dog closed its eyes, the zebra ate just the cake. When the dog opened its eyes, it repeated its prediction, as in (11). The expected responses for the sentences in (10) and (11) were Y*es*.

(11) *Test item:* Did I guess right? I said that the zebra would eat the cake, but not the strawberry or the ice-cream. Was I right?

The Truth Value Judgment Task

The English version of the Truth Value Judgment task was adapted from the version reported in Notley, Zhou, Jensen and Crain (2012). The Turkish version of the task was designed to be as similar as possible to the English version. In the task, the participants watched two power-point slide shows that depicted short stories in which three animals competed against two other competitors in the Sydney Animal Olympic Games and in the Istanbul Animal Olympic Games. The winning animal received a gold medal, the first runner up received a silver medal and the second runner up was given a sad face. There were 4 races and a filler sentence following each race, in both versions of the task. In both versions, on two of the trials, the animal competitors finished the race in first place, and received a gold medal and on the other two trials, the animal competitors finished in second place, and received a silver medal.

Table 3 presents an example for two conditions both for the Turkish and the English versions of the task, including fillers. A puppet produced all of the sentences in Table 3. The puppet appeared on the computer screen at the conclusion of each story and said what it thought had happened in the story. As indicated in the table, the English test sentences were true when the animal mentioned in the subject noun phrase of the sentence received a gold medal (First-Place condition), and the Turkish sentences were true when this animal received a silver medal (Second-Place condition). Whenever participants produced a *No* response, they were presented with a *Yes* filler and whenever participants produced a *Yes* response, they were presented with a *No* filler. In the First-Place condition, when the participants accepted the gold medal sentences, this was interpreted as evidence that they had generated a conjunctive entailment. When participants accepted the test sentences in the Second-Place condition, this was interpreted as evidence that they had generated a disjunctive interpretation.

Table 3: Sample test items and fillers

	Turkish	English
a. Gold medal	Ejderha bitiş çizgisine kediden ya da zebradan önce vardı. (The dragon reached the finish line before the cat or the zebra) Context: Dragon was 1st.	The dog reached the finish line before the turtle or the bunny. Context: Dog was 1st
i. Filler right	Kirpi bitiş çizgisine hem zebra hem de kediden sonra vardı. (The hedgehog reached the finish line after both the zebra and the cat)	The monkey reached the finish line after both the turtle and the bunny.
ii. Filler wrong	Kirpi yarışı kedi ve zebrayla aynı anda bitirdi. (The hedgehog reached the finish line at the same time as the cat and the zebra)	The turtle reached the finish line at the same time as the bunny and the turtle.
b. Silver medal	Kirpi bitiş çizgisine cadıdan ya da korsandan önce vardı. (The hedgehog reached the finish line before the witch or the pirate) Context: Witch was 1st.	The turtle brought his shell back before the fish or the horse. Context: Fish was 1st
i. Filler right	Fare yarışı en son bitiren hayvandı. (The mouse was the last to finish the race)	The monkey brought his shell back last.
ii. Filler wrong	Fare yarışı ilk bitiren hayvandı. (The mouse was the first to finish the race.)	The monkey brought his shell first.

Research Questions and Predictions

The present study was designed to distinguish between two alternative predictions about how bilingual children initially assign a meaning to words for disjunction across human languages. On the experience-based approach, bilingual children are expected to assign a meaning to words and phrases based on the adult input. If so, then both the bilingual children and the mothers are expected to accept the sentences in English in the First-Place condition, but reject them in the Second-Place condition. On the experience-based approach, both bilingual children and their mothers are expected to accept the target sentences in Turkish in the Second-Place condition. It is less clear how the bilingual mothers and their children should be expected to respond in the First-Place condition. Disjunction is likely to give rise to an implicature of exclusivity in this condition, so the bilingual mothers are expected to reject the

Turkish test sentences, at least to some extent. In any event, children should accept and reject them to the same extent, on the experience-based account.

The Principles and Parameters approach makes a different set of predictions, which are based on the Semantic Subset Principle. Adopting the Disjunction Parameter, we are led to expect bilingual children to initially assign the parameter value on which the temporal term (English *before*, Turkish *önce*) takes scope over disjunction [–PPI]. In this case, disjunction would generate a conjunctive entailment both in the English sentences and in the Turkish sentences, despite the fact that disjunction phrases are [+PPI] for adult speakers of Turkish. If this line of reasoning is correct, bilingual children are expected to produce the same (subset) pattern of responses in both languages. More specifically, bilingual children should produce the same linguistic behaviour as their mothers in responding to the English target sentences, but they should differ from their mothers in responding to the Turkish sentences. Under the guidance of the Semantic Subset Principle to generate a conjunctive entailment for disjunction in sentences with the temporal operator *önce*, bilingual children are expected to accept the Turkish sentences in the First-Place condition, but reject them in the Second-Place condition. A different pattern is expected for their mothers. The mothers are expected to accept the Turkish target sentences in the Second-Place condition, but to reject them in the First-Place condition, at least to some extent, due to an implicature of exclusivity.

Results

Pre-test with temporal operators: before/önce

The bilingual children were 100% (16/16) accurate in responding to the *before* trials in English and to the *önce* trials in Turkish. The mothers were also 100% accurate in tasks in both languages (12/12). This is taken as evidence that the bilingual children and their mothers in the present study had knowledge of the semantics of *before/önce*.

Pre-test with disjunction words: or/ya da

The bilingual children assigned the conjunctive interpretation to the English *or* and the Turkish *ya da* trials (32/32), as did the mothers (24/24). Both the mothers and the children accepted the true sentences 100% of the time and rejected the false ones 100% of the time. This is evidence that both the bilingual children and their mothers generated the conjunctive entailment for disjunction words in negative sentences in both languages, at least when disjunction and negation reside in different clauses (see footnote 9). This is further confirmation that disjunction is inclusive-*or*, both in English and in Turkish.

We now report the findings for the four bilingual children on the test sentences they encountered in the main session of the experiment, followed by the findings for their mothers. Figure 1 summarizes the findings for the children. As the figure indicates, these children accepted both the English and the Turkish test sentences 87.5% of the time (7/8) in the First-Place condition, and they rejected them 75% of the time in Second-Place condition (6/8)[16].

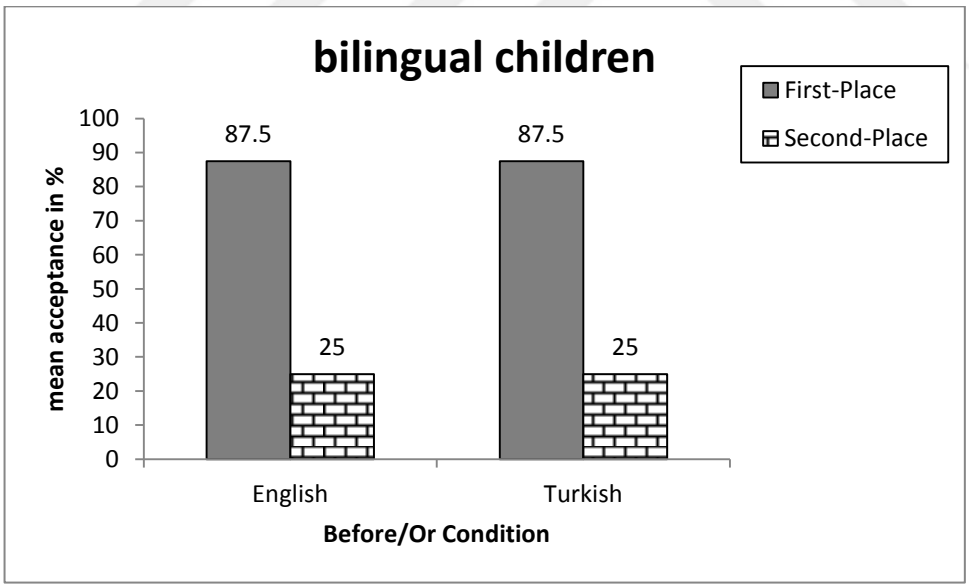

Figure 1: Acceptances by bilingual children

Figure 2 summarizes the responses by the mothers of the bilingual children. As the figure indicates, the three adult bilingual participants accepted the English sentences 66.6% of the time in the First-Place condition (4/6), and rejected them the same proportion of the time in

[16] See Appendix 1 for individual child responses.

the Second-Place condition. When tested in Turkish, the same participants accepted the sentences in the First-Place condition 83.3% of the time (5/6), and accepted the test sentences 100% of the time in the Second-Place condition (6/6).

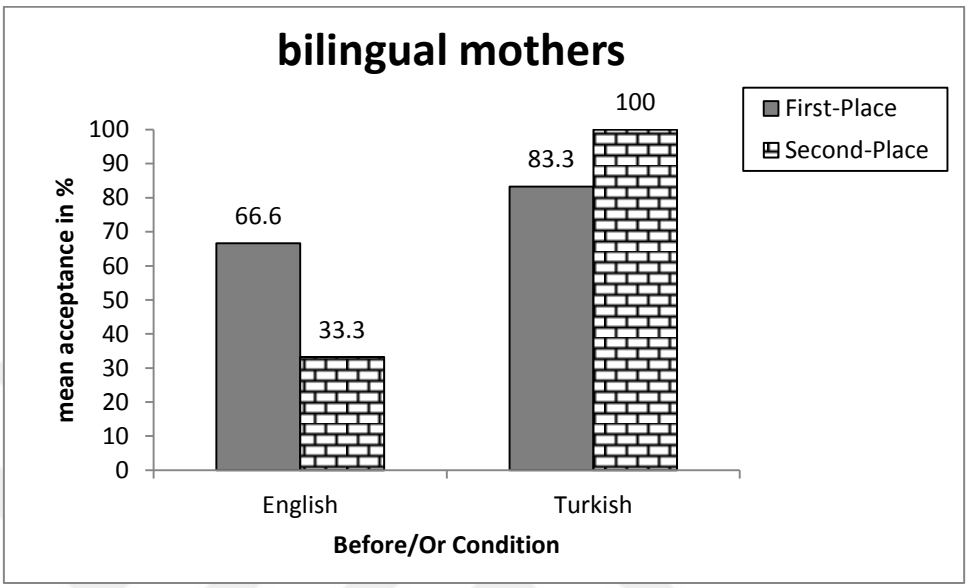

Figure 2: Acceptances by bilingual mothers

A Mann-Whitney U test showed that the responses by children and by their mothers to the English test sentences were not significantly different, either in the First-Place condition (z = 19, p = .573) or in the Second-Place condition (z = 23, p = .950). Turning to the Turkish sentences, a Mann-Whitney U test revealed that the mothers differed significantly from their children in their pattern of responses in the Second-Place condition, (z = 42, p= .020), but not in the First-Place condition (z = 26, p = .852).

Discussion

According to the Principles and Parameters approach, the bilingual child participants were expected to manifest the same pattern of response in English and in Turkish. In both languages, children were expected to accept the test sentences in the First-Place condition, but to reject them in the Second-Place condition. This is exactly what we found. We interpret this findings as evidence that bilingual children interpret disjunction phrases *in situ* in both

languages, such that the temporal term *before* was assigned to scope over the disjunction phrase for children, as predicted by the Semantic Subset Principle. Like the bilingual children, the mothers rejected the English test sentences in the Second-Place condition. In response to the Turkish test sentences, however, the mothers manifested a different pattern of responses in the Second-Place condition, as compared to the children. The children rejected the Turkish test sentences in the Second-Place condition (75%), whereas their mothers accepted them (100%). This difference in the behaviour by children and adults is difficult to reconcile with the experience-based approach to language development.

Both the bilingual children and their mothers accepted the English test sentences in the First-Place condition, although children accepted them more often than their mothers (87.5% versus 66.6%). Although we predicted that children would accept the test sentence in the First-Place condition both in English and in Turkish, we expected adult Turkish-speakers to reject Turkish sentences in the First-Place condition, at least some of the time. As noted earlier, Turkish sentences are (logically) true in the circumstances depicted in the First-Place condition, when the disjunction phrase takes scope over the temporal term *before* (*önce*). However, we expected adult Turkish-speakers to compute an implicature of exclusivity in this condition, because the corresponding sentences in which conjunction replaced disjunction are also true. This expectation was not borne out, however. For the moment, we simply suggest that these particular Turkish-speaking adults were influenced by their knowledge of English, where the test sentences are only true in the First-Place condition. Later we offer some evidence for this interpretation of the findings.

General Discussion

It is worth considering how the findings from the present study can be reconciled in some way with the experience-based account. The experience-based account contends that children are guided by experience in their interpretation of disjunction. In the present study of bilingual

children, this appears to be disconfirmed. In particular, the experience-based approach would appear to have difficulty explaining the observed differences between the bilingual children and their mothers in response to the Turkish test sentences. The bilingual adults accepted the Turkish sentences in both the First-Place condition and in the Second-Place condition, whereas children accepted them in the First-Place condition, but rejected them in the Second-Place condition. The different rates of acceptance by adults and children to Turkish sentences in the Second-Place condition would seem to run counter to the expectations of the experience-based approach.

It is worth considering one way to reconcile the findings and the experience-based account. This is the possibility that bilingual children were influenced by the fact that their mothers accepted both the Turkish and the English test sentences in the First-Place condition. Assuming that adults use sentences in circumstances in which they find them acceptable, the bilingual mothers we interviewed were likely to produce sentences with disjunction and the temporal term *before*/*önce* in both languages, in circumstances corresponding to the First-Place condition. On the other hand, children would encounter these sentences in the Second-Place condition when their mothers spoke to them in Turkish, but not when they spoke to them in English. If the experience children encountered from both languages were somehow combined in children's grammars, then this could explain why children developed a preference for resolving scope ambiguities in the same way in both languages.

There is another arrow in the quiver of the Principles and Parameters approach, however. This approach predicts that monolingual Turkish-speaking children will demonstrate the same pattern of responses as the bilingual children did in the present study. More specifically, monolingual Turkish-speaking children are expected to accept Turkish sentences with disjunction and the temporal term *before*/*önce* in the First-Place condition, but to reject the same sentences in the Second-Place condition, just as the bilingual children did. If so, this would undermine the possibility that the responses by the bilingual children to

Turkish sentences in the present study were influenced by the English input they received from their bilingual mothers.

Fortunately, the findings of two experimental studies, one testing monolingual English-speaking children and one testing monolingual Turkish-speaking children, can help decide between the alternative accounts of the responses by the bilingual children in the present study. Both studies also interviewed monolingual adult controls, so the findings from both children and adults can be directly compared, in both languages. The authors of the present chapter conducted the study with monolingual Turkish-speaking children. The findings of the study of English-speaking children and adults were reported in Notley, Zhou, Jensen and Crain (2012).

We will present the findings for the child participants first. In the Turkish study, there were 24 monolingual children, 11 girls and 13 boys, ranging in age from 4; 01-5; 11, with a mean age of 4; 08. The English study tested a younger group of 15 monolingual English-speaking children, 9 girls and 6 boys, ranging in age from 3; 04-5; 0, with a mean age of 4; 04. The findings are summarized in Figure 3. As the figure indicates, the monolingual Turkish-speaking children accepted the test sentences with disjunction and the temporal term *önce* 81% of the time in the First-Place condition, but only 31% of the time in the Second-Place condition. The bilingual children who participated in the present study had a remarkably similar pattern of responses; they accepted the Turkish test sentences 87.5% of the time in the First-Place condition, but only 25% of the time in Second-Place condition. Figure 3 also summarizes the responses of the monolingual English-speaking children. As predicted, these children manifested a similar pattern of responses to both monolingual and bilingual Turkish-speaking children. The English-speaking children accepted test sentences with disjunction and the temporal term *before* 90% of the time in the First-Place condition, but only 7% of the time in the Second-Place condition.

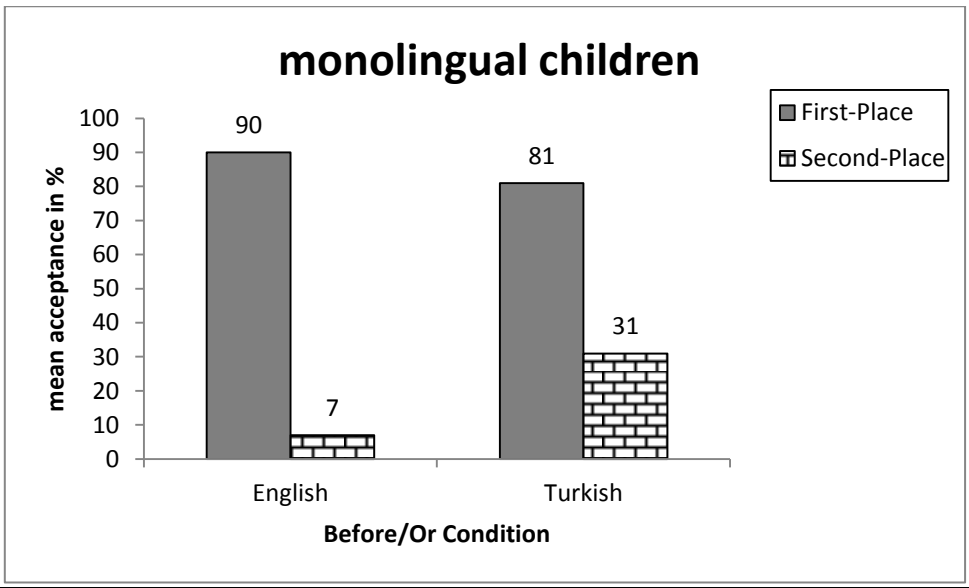

Figure 3: Acceptances by monolingual English- and Turkish-speaking children

These findings clearly comport with the predictions of the Principles and Parameters approach. The pattern of responses by the monolingual Turkish-speaking children and by the English-speaking children were similar to each other, and the pattern of responses by both groups of children were similar to that produced by the bilingual children in the present study.

If the patterns of responses by children are similar across languages, the patterns of responses by adults could not have been more different. The 26 Turkish-speaking adults that we interviewed accepted the test sentences only 12% of the time in the First-Place condition, whereas they accepted them 100% of the time in the Second-Place condition. The 20 English-speaking adults interviewed in the Notley, Zhou, Jensen and Crain (2012) study exhibited the opposite pattern. They accepted the test sentences 100% of the time in the First-Place condition, but only 2% of the time in the Second-Place condition. The findings are summarized in Figure 4.

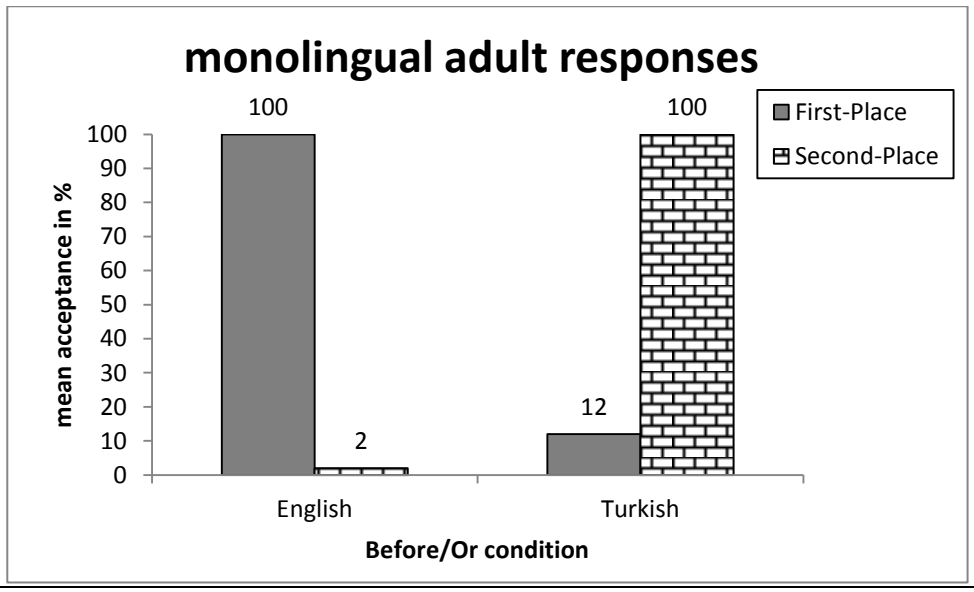

Figure 4: Acceptances by English- and Turkish-speaking adults

In view of the findings from this study of monolingual Turkish-speaking children and adults, it seems unlikely that language transfer was a contributing factor for the bilingual children we interviewed in the present study. Both bilingual and monolingual Turkish-speaking children were found to assign the subset [–PPI] reading to sentences with disjunction and the temporal term *before/önce*), such that disjunction generated a conjunctive entailment. This made the test sentences true in the First-Place condition, but false in the Second-Place condition.

The fact that monolingual Turkish-speaking adults rejected the test sentences 88% of the time in the First-Place condition undermines the experience-based 'frequency' account of the responses by bilingual children. Recall that, according to this account, both monolingual Turkish-speaking adults and English-speaking adults were expected to use sentences with disjunction and the temporal term (*before/önce*) in the same circumstances, with disjunction generating a conjunctive entailment, thereby elevating the frequency of this structure in children's experience. Although the behaviour of the bilingual mothers we interviewed could be cited in support of this learnability scenario, the findings from monolingual Turkish-speaking adults sit less well with the expectations of the experience-based approach. It is worth noting in addition that monolingual Turkish-speaking adults were observed to compute

an implicature of exclusivity for disjunction in Turkish, in contrast to the findings from the bilingual mothers we interviewed (see Figure 2).

This reinforces our conclusion that the bilingual adults we interviewed were influenced by scope relations that they assign to the English test sentences when they were responding to the Turkish test sentences. The observation that monolingual Turkish-speaking adults rejected the test sentences in the First-Place condition not only lends additional support to the parametric account we offered for differences in scope assignments across languages, it also substantially enlarges the differences between child and adult Turkish-speakers, yielding differences in linguistic behaviour that are difficult to reconcile with the experience-based account.

Conclusion

The present study confirmed the predictions of the Principles and Parameters approach about children's initial scope assignments. Children were presented with English and Turkish sentences like the ones in (12) and (13). If the temporal terms *before*/*önce* were analysed as taking scope over the disjunction phrase (*before* > *or*), as predicted by the account we offered, then participants would be expected to accept the test sentences in the First-Place condition but reject them in the Second-Place condition. On the other hand, if the disjunction phrase was analysed as taking scope over these temporal terms *before/önce***,** then participants would be expected to accept the test sentences in the Second-Place condition. Whether or not adult participants rejected the sentences in the First-Place condition on the (*or* > *before*) scope assignment would depend on whether or not they computed an implicature of exclusivity for the disjunction phrase. If so, then adult participants would be expected to reject the test sentences in the First-Place condition.

(12) The hedgehog finished the race **before** the zebra **or** the kangaroo.

(13) Kirpi yarış-ı zebra **ya da** kanguru-**dan** **önce** bitir-di.

Hedgehog race-ACC zebra or kangaroo-ABL before finish-PAST

'The hedgehog finished the race before the zebra or the kangaroo.'

First-Place Condition: The hedgehog finished before the zebra and before the kangaroo.

Second-Place Condition: The hedgehog finished before the zebra, but not before the kangaroo.

From a logical point of view, the alternative scope assignments afforded for the sentences in (12) and (13) stand in a subset/superset relation. The English (*before* > *or*) scope assignment makes sentences like (12) true in a subset of the circumstances that verify the corresponding Turkish sentences, at least for adult Turkish-speakers. The alternative scope assignments were attributed to the Disjunction Parameter. According to the Disjunction Parameter, certain disjunction phrases are Positive Polarity Items in some languages, but not in others. In Turkish, ablative case marked disjunction phrases, such as the one in (13), are expected to take scope over the Turkish temporal term *önce* 'before', since Turkish adopts the [+PPI] value of the Disjunction Parameter. By contrast, disjunction is consistently [–PPI] in English, so it is interpreted *in situ* in sentences like (12). Finally, when the scope assignments of sentences stand in a subset/superset relations across languages, the Semantic Subset Principle compels children acquiring all languages to initially adopt the subset value of the relevant parameter, [–PPI]. This leads to the prediction that both monolingual and bilingual children acquiring Turkish will adopt the subset scope assignment (*before* > *or*) for sentences like (13), leading children to accept (13) in the First-Place condition but to reject it in the Second-Place condition.

As predicted by this acquisition scenario, the bilingual children we interviewed accepted the test sentences in the First-Place condition, but rejected them in the Second-Place condition, both in English and in Turkish. This pattern was taken as evidence that children assigned the conjunctive interpretation to disjunction in sentences with the temporal operator

before (Turkish *önce*), both in English and in Turkish. Unlike the bilingual children, the mothers produced a different pattern of responses in Turkish, as compared to English. Taken together with the findings of previous research, the results from the present study favour the Principle and Parameters approach to language development. Although the superset [+PPI] interpretation of sentences with disjunction and the temporal term *önce* is strongly preferred by Turkish adults, we found that both monolingual Turkish-speaking bilingual children favour the subset [–PPI] interpretation of these sentences. This suggests that bilingual Turkish-speaking children do not base their semantic scope assignments on the experience they encounter from adult speakers of Turkish, as anticipated by the experience-based approach.

References

Ambridge, B. & Lieven, E. V. M. 2011. *Child Language Acquisition: Contrasting theoretical approaches*. Cambridge, UK: Cambridge University Press.

Amidon, A. & Carey, P. 1972. Why five-year-olds cannot understand before and after. *Journal of Verbal Learning and Verbal Behavior* 11: 417–423.

Barrie-Blackley, S. 1973. Six-year-old children's understanding of sentences adjoined with time adverbs. *Journal of Psycholinguistic Research* 2: 153–165.

Berwick, R.1985. *Acquisition of Syntactic Knowledge*. Cambridge, MA: MIT Press.

Chomsky, N. 1981. *Lectures on Government and Binding*. Dordrecht: Foris.

Chomsky, N. 1995. *The Minimalist program*. Cambridge, MA: MIT Press.

Clark, E. V. 1971. On the acquisition of the meaning of before and after. *Journal of Verbal Learning and Verbal Behavior* 10: 266–275.

Crain, S. 1982. Temporal terms: mastery by age five. In *Papers and Reports on Child Language Development*, *Proceedings of the Fourteenth Annual Stanford Child Language Research Forum* 21: 33–38. Stanford University.

Crain, S. 2008. The interpretation of disjunction in Universal Grammar. *Language and Speech* 5: 151–169.

Crain, S. 2012. *Emergence of meaning*. Cambridge: Cambridge University Press.

Crain, S. Gardner, A., Gualmini, A. & Rabbin, B. 2002. Children's command of negation. In *Proceedings of the 3rd Tokyo Conference on Psycholinguistics*, Y. Otsu (eds.), 71–95. Tokyo: Hituzi Publishing Company.

Crain, S., Goro, T. & Thornton, R. 2006. Language acquisition is language change. *Journal of Psycholinguistic Research* 35: 31–49.

Crain, S., Goro, T., Notley, A. & Zhou, P. 2013. A parametric account of scope in child language. In *Advances in language acquisition* , S. Stavrakaki, M. Lalioti & P. Konstantinopoulou (eds.), 63–71. Cambridge: Cambridge Scholar Publishing.

Crain, S., Gualmini, A. & Pietroski, P. 2005. Brass tracks in linguistic theory: innate grammatical principles. In *The Innate Mind: Structure and contents*, P. Carruthers, S. Laurence & S. Stitch (eds.), 175–197. New York: Oxford University Press.

Crain, S. & Khlentzos, D. 2008. Is logic innate? *Biolinguistics* 2 (1): 24–56.

Crain, S., Ni, W. & Conway, L. 1994. Learning, parsing and modularity. In *Perspectives on sentence processing*, C. Clifton Jr., L. Frazier & K. Rayner (eds.), 443–467. Hillside, NJ: Lawrence Erlbaum.

Crain, S. & Thornton, R. 1998. *Investigations in Universal Grammar: A guide to experiments on the acquisition of syntax and semantics*. Cambridge, MA: MIT Press.

Epstein, S., Flynn, S. & Martohardjono, G. 1996. Second language acquisition: Theoretical and experimental issues in contemporary research. *Brain and Behavioral Sciences* 19: 677–758.

Ferreiro, E. & Sinclair, H. 1971. Temporal relations in language. *International Journal of Psychology* 6: 39–47.

Goldberg, A. E. 2003. Constructions: a new theoretical approach to language. *Trends in Cognitive Science* 7(5): 219–224.

Goro, T. 2004. The emergence of Universal Grammar in the emergence of language: the acquisition of Japanese logical connectives and positive polarity. Unpublished master's thesis, University of Maryland.

Goro, T. 2007. Language-specific constraints on scope interpretation in first language acquisition. PhD dissertation, University of Maryland.

Goro, T. & Akiba, S. 2004a. The acquisition of disjunction and positive polarity in Japanese. In *WCCFL 23 Proceedings*, V. Chand, A. Kelleher, A. J. Rodriguez & B. Schmeiser (eds.), 251–264. Somerville, MA: Cascadilla Press.

Goro, T. & Akiba, S. 2004b. Japanese disjunction and the acquisition of positive polarity. In *Proceedings of the Fifth Tokyo Conference on Psycholinguistics*, Y. Otsu (eds.), 137–162. Tokyo: Hituzi Shobo Publishing Company.

Gorrell, P., Crain, S. & Fodor, J. 1989. Contextual information and temporal terms. *Journal of Child Language* 16: 623–632.

Göksel, A. & Kerslake, C. 2005. *Turkish, A comprehensive grammar*. London: Routledge.

Grice, H. P. 1975. Logic and conversation. In *Syntax and Semantics*, vol. 3: *Speech Acts*, P. Cole & J. Morgan (eds.), 41–58. London: Academic Press.

Grüter, T., Lieberman, M. & Gualmini, A. 2010. Acquiring the scope of disjunction and negation in L2: A Bidirectional Study of learners of Japanese and English. *Language Acquisition* 17(3): 127–154.

Grüter, T. & Paradis, J. (Eds.) (2014). Input and experience in bilingual development [Trends in language Acquisition Research (TILAR), 13]. Amsterdam: John Benjamins.

Gualmini, A. & Crain, S. 2002. Why No Child or Adult Must Learn De Morgan's Laws. In *Proceedings of the 26th Boston University Conference on Language Development*: 243–254. Cascadilla Press, Somerville, MA.

Guasti, M. T., Chierchia, G., Crain, S., Foppolo, F., Gualmini, A. & Meroni, L. 2005. Why children and adults sometimes (but not always) compute implicatures. *Language and Cognitive Processes* 20(5): 667–696.

Hatch, E. 1971. The young child's comprehension of time connectives. *Child Development* 42: 211–213.

Haznedar, B. & Schwartz, B. D. 1997. Are there optional infinitives in child L2 acquisition? In *Proceedings of the 21st Annual Boston University Conference on Language Acquisition*, E. Hughes, M. Hughes & A. Greenhill (eds.), 231–239. Cascadilla Press, Somerville, MA.

Lee, O. S. 2010. Acquisition of Korean disjunction under negation. *University of Hawaii Working Papers in Linguistics* 41(7): 1–12.

Lieven, E. V. M. & Tomasello, M. 2008. Children's first language acquisition from a usage-based perspective: In *Handbook of Cognitive Linguistics and Second Language Acquisition*, P. Robinson & N. Ellis (eds.), 168–196. New York: Routledge.

Morris, B. 2008. Logically speaking: evidence for item-based acquisition of the connectives AND and OR. *Journal of Cognition and Development* 9(1): 67–88.

Notley, A., Zhou, P., Jensen, B. & Crain, S. 2012. Children's interpretation of disjunction in the scope of 'before': a comparison of English and Mandarin. *Journal of Child Language* 39(3): 482–522.

Notley, A., Thornton, R. & Crain, S. 2013. English-speaking children's Interpretation of disjunction in the scope of 'not every'. *Biolinguistics* 6(1): 32–69.

Noveck, I. A. 2001. When children are more logical than adults: Investigations of scalar implicature. *Cognition* 78(2): 165–188.

Pinker, S. 1984. *Language Learnability and Language Development*. Cambridge MA: Harvard University Press.

Rowland, C. 2014. *Understanding child language acquisition.* New York: Routledge.

Schwartz, B. D. & Sprouse, R. 1994. Word order and nominative case in non-native language acquisition: a longitudinal study of (L1 Turkish) German interlanguage. In *Language acquisition studies in generative grammar*, T. Hoekstra & B. D. Schwartz (eds.), 317–368. Amsterdam: John Benjamins.

Su, Y. & Crain, S. 2013. Children's Knowledge of disjunction and universal quantification in Mandarin Chinese. *Language and Linguistics* 14(3): 599–631.

Szabolcsi, A. 2002. Hungarian disjunctions and positive polarity. In *Approaches to Hungarian 8,* I. Kenesei & P. Siptar (eds.), 217–241. Budapest: Akademiai Kiado.

Thornton, R. & Crain, S. 2013. Parameters: The pluses and the minuses. In *The Cambridge handbook of generative syntax,* M. den Dikken (ed.), 927–970. Cambridge: Cambridge University Press.

Tomasello, M. 2000. First steps toward a usage-based theory of language acquisition. *Cognitive Linguistics* 11 (1): 61–82.

Tomasello, M. 2003. *Constructing a Language: A Usage based Theory of Language Acquisition*. Cambridge: Harvard University Press.

Appendix 1:

	English		Turkish	
Children	*First-Place Items* (n = 2)	*Second-Place Items* (n = 2)	*First-Place Items* (n = 2)	*Second-Place Items* (n = 2)
ZE	2	0	1	0
RU	2	0	2	1
DE	2	1	2	1
LA	1	1	2	0

Individual children's acceptances across conditions and languages

Chapter 6

Conclusion

Conclusion

The aim of this chapter is to summarize the major findings and to discuss the relevance of these findings for issues of language development. Then, I will make some comments about the implications of the findings, and directions for future research. This dissertation reports a series of offline experimental studies on how disjunction and conjunction are interpreted in sentences with other logical expressions. We investigated the scope relations between disjunction and conjunction in sentences with negation and in sentences with the temporal conjunction *before*. The subjects of these investigations were monolingual Turkish- and German- speaking children, and Turkish-English bilingual children. The investigation of each linguistic phenomenon centred around the question of whether or not children's initial scope assignments are tuned to the adult input. We compared this possibility with the predictions of the Semantic Subset Principle. According to the Semantic Subset Principle, both Turkish-speaking monolingual and bilingual children were expected to generate different scope assignments, as compared to adults, for certain sentences with disjunction, but not for ones with conjunction. These predictions of the two main approaches to language acquisition were put to test in a series of experimental studies.

Summary

Chapter 2 investigated how conjunction and disjunction are interpreted in negative sentences in child Turkish. The test sentences varied case marking, the logical connective, i.e., conjunction vs. disjunction, and the lexical choice of the Turkish expression for disjunction. First, we investigated Turkish-speaking children's interpretation of accusatively marked conjunction phrases in negative sentences, such as (1).

(1) Bu hayvan-cık **hem** havuç-*u* **hem** **de** biber-*i* ye**me**di.

This animal-DIM both carrot-ACC both also pepper-ACC eat-NEG-PAST

'This animal did not eat both the carrot and also the pepper'.

Second, we examined Turkish-speaking children's interpretation of disjunction in simple negative sentences with and without accusative case as in (2) and (3):

(2) Bu hayvan-cık havuç **veya** biber ye**me**di.
This animal-DIM carrot or pepper eat-NEG-PAST
'This animal did not eat carrot(s) or pepper(s)'.

(3) Bu hayvan-cık havuç-*u* **veya** biber-*i* ye**me**di.
This animal-DIM carrot-ACC or pepper-ACC eat-NEG-PAST
'This animal did not eat the carrot or the pepper'.

And finally, we investigated whether or not the introduction of different expressions for disjunction led to any differences in the scope assignments made by Turkish-speaking children and adults in negative sentences. To examine this, we investigated the interpretations assigned by Turkish-speaking children and adults to sentences like (4), with the disjunction expression *ya…ya da* 'either or', as compared to ones with the disjunction operator *veya* 'or', as in (3).

(4) Bu hayvan-cık **ya** havuç-*u* **ya da** biber-*i* ye**me**di.
This animal-DIM either carrot-ACC or pepper-ACC eat-NEG-PAST
'This animal did not eat the carrot or the pepper'.

According to the experience-based account, there is no reason to expect Turkish-speaking children to differ from adults in the scope relations they assign to the constructions investigated in Chapter 2. However, the approach invoking the Semantic Subset Principle makes several specific predictions about how Turkish-speaking children will differ from adults in the scope assignments they generate. These predictions are based on the hypothesis that languages differ in the scope assignments that are generated in sentences with disjunction and conjunction. This cross-linguistic variation is encoded in two lexical parameters, the Disjunction Parameter and the Conjunction Parameter. For each of these parameters,

sentences that are produced based on one value of each of these parameters asymmetrically entail the sentences produced by the other value. Putting this another way, one value of each of these parameters generates a subset of sentences that correspond to the other value. In cases like this, children who initially assign the superset value of the parameter in question would be hard-pressed to converge on the adult grammar, if adult speakers of the local language adopt the subset value of the parameter. Therefore, the Semantic Subset Principle dictates that all children initially begin with the subset value of these lexical parameters. This entails, however, that children will differ from adults in the acquisition of languages where adult speakers adopt the superset value. In such cases, children are expected to reject some sentences that adults accept, namely ones that conform to the superset value of the parameter, but not to the subset value. We tested this using Turkish.

If Turkish-speaking children initially adhere to *subset* values of the Disjunction Parameter and the Conjunction Parameter, this leads to a number of specific predictions about when children and adults will generate the same scope assignments, and when they will generate different scope assignments. More specifically, Turkish-speaking children and adults are not expected to differ in the interpretations they assign to negated conjunction phrases as in (1). In addition, children and adults are also expected to generate the same scope assignments to negative sentences with disjunction phrases that are not marked with accusative case, as in (2). However, Turkish-speaking children and adults are expected to differ in the scope assignments they make in interpreting negative sentences with accusatively marked disjunction phrases, as in (3) and (4). Based on the Semantic Subset Principle, children were predicted to initially assign the [–PPI] value of the Disjunction Parameter to all disjunction phrases, including ones that are marked with accusative case. By contrast, adult Turkish-speakers assign the [+PPI] value. The upshot is that children will only accept negative sentences with disjunction phrases if both of the disjuncts are false, whereas adults will accept them if either disjunct is false (or if both are, modulo pragmatic considerations).

Regardless of case marking, child participants assigned the subset (‘neither’) interpretation to negative sentences with disjunction and to negative sentences with conjunction, even in cases (e.g., sentences (3) and (4)), where adults assigned a different interpretation (‘not both’). The observed difference in the interpretation of disjunction by Turkish-speaking children and adults is difficult to reconcile with the experience-based account. On the other hand, the findings are compelling evidence for the Semantic Subset Principle.

Chapter 3 investigated whether the Turkish- and German-speaking children made the same scope assignment in negative sentences with disjunction, as illustrated in the Turkish example in (4) and the German example in (5):

(5) Dieses Tier hat **nicht** die Karotte **oder** die Paprika gegessen.
This animal did not the carrot or the pepper eat-PAST
‘This animal didn’t eat the carrot or the pepper’.

Recall that the negated disjunction phrase as in (5) receives a conjunctive interpretation in adult German, and its Turkish counterpart does not as in (4). The Semantic Subset Principle predicts that German-speaking children should assign the same scope relations as German-speaking adults do in response to sentences like (5), whereas Turkish-speaking children are expected to differ in their scope assignment as compared to Turkish-speaking adults, in response to sentences like (4). The experience-based account expects children in both languages to assign the same interpretation as adults do. Despite the observed differences between adult speakers of these two languages, children acquiring both languages showed a strong preference to assign disjunction a conjunctive interpretation in simple negative sentences. Therefore, the linguistic behaviour exhibited by Turkish-speaking children matched that of German-speaking children and adults, but differed from that of Turkish-speaking adults.

Chapter 4 was dedicated to an investigation of how bilingual children interpret disjunction phrases in sentences with the temporal conjunction *before* in Turkish and in English. Children's interpretations were compared to those of their bilingual mothers, in responding to the same test sentences. The English and Turkish constructions under investigation are illustrated in (6) and (7) respectively:

(6) The hedgehog finished the race **before** the zebra ***or*** the kangaroo. (*before* > *or*)

(7) Kirpi yarış-ı zebra ***ya da*** kanguru-dan **önce** bitirdi. (*or* > *before*)

Hedgehog race-ACC zebra or kangaroo-ABL before finish-PAST

'The hedgehog finished the race before the zebra or the kangaroo'.

If language experience shapes bilingual children's initial semantic interpretations, then bilingual children are expected to differ in the scope assignments they make in response to the Turkish and the English test sentences as in (6), and (7), just like native speakers of Turkish and English differ in scope assignments. On the experience-based account, however, children are not expected to differ from their mothers in the interpretations they assign to the same test sentences in both languages.

By contrast, if the Semantic Subset Principle dictates the initial interpretations of bilingual children, then bilingual children are expected to assign the same scope relations to the Turkish and English test sentences. More specifically, bilingual children are predicted to assign the subset interpretation in both languages, i.e., the interpretation that makes sentences true in the narrowest range of circumstances. It follows that no differences should be observed in the linguistic behaviour of bilingual children and monolingual English- and Turkish-speaking children, in response to sentences containing disjunction and the temporal term *before*. However, the bilingual children are expected to differ from their mothers in the interpretation they assign to the Turkish test sentences. The findings confirmed the predictions of the Semantic Subset Principle. Bilingual children started off by assigning the

narrowest (subset) interpretation to disjunction in sentences with the temporal term *before*, both in English and in Turkish. Now, we turn to a general discussion of the results and their relevance for live issues of language acquisition.

General Discussion

This dissertation investigated how monolingual Turkish- and German-speaking children as well as Turkish-English bilingual children interpret disjunction when it appears in sentences with negation and in sentences with the temporal term *before*. The aim was to test the predictions of the two approaches to language acquisition. One is the experience-based approach. This approach to language acquisition predicts only quantitative differences in the interpretation that children and adults assign to sentences with logical expressions. The second approach invokes the Semantic Subset Principle. More generally, this approach falls within the scope of Universal Grammar. This approach assumes that children are innately armed with principles and parameters that assist them in navigating through the course of language acquisition. In setting parameters, the Universal Grammar approach anticipates that child language may sometimes be qualitatively different from the language of adults.

The main research question addressed in this dissertation was whether or not monolingual and bilingual children are constrained by language experience, or by an innate language faculty. The results showed that Turkish- speaking children differed from Turkish adults in the interpretations they assigned to negative sentences with disjunction phrases that are marked with accusative case. However, both German-speaking children and adults were found to assign the same scope relations to negation and disjunction in negative sentences that contained disjunction phrases marked with accusative case. Similarly, bilingual children differed from their mothers in their semantic interpretations of disjunction in sentences with the temporal term *before*, but bilingual children did not differ from monolingual Turkish- and English-speaking children, regardless of the languages they were tested on.

Overall, the results confirm the predictions made by the Semantic Subset Principle. On the other hand, the experience-based account was seen to fall short in explaining the findings of the present studies. It is difficult, on that account, to understand the following facts: (a) why monolingual and the bilingual children assigned the same interpretation to disjunction in the different languages they were acquiring, (b) why Turkish-speaking children interpreted negative sentences with disjunction phrases marked with accusative case in the same way as German-speaking adults, but in a different way than Turkish-speaking adults, and (c) why bilingual children differed from their mothers in the interpretations they assigned to the Turkish sentences containing disjunction and the temporal term *before*. Simply put, the main findings from both monolingual and bilingual children tested in the experiments reported in this dissertation are difficult to reconcile with the experience-based approach to language acquisition.

The findings are almost exactly as predicted by the theory of Universal Grammar, with its ancillary assumption, the Semantic Subset Principle. The monolingual and bilingual children who participated in the experiments reported in this dissertation assigned a strong *neither* interpretation to disjunction in the scope of negation and in the scope of the temporal term *before*. As predicted by the Semantic Subset Principle, both Turkish- and German-speaking children and Turkish-English bilingual children assigned the default [–PPI] value of the Disjunction Parameter in negative sentences with disjunction phrases and in sentences with the temporal term *before*. The present findings – that children interpret disjunction phrases in the scope of downward entailing expressions (i.e. *not* and *before*) – are in line with previous studies investigating children's interpretations of negative sentences containing English–*or* (Crain, Gardner, Gualmini & Rabbin, 2002), Japanese–*ka* (Goro & Akiba, 2004a,b), Mandarin Chinese–*huozhe* (Jing, Crain & Hsu, 2005), Russian–*ili* (Verbuk, 2007), Korean–*(i)na* (Lee, 2010). Additionally, just like the monolingual English-and Mandarin-speaking children's interpretation of disjunction in sentences with the temporal term *before*

(Notley, Zhou, Jensen & Crain, 2012), monolingual Turkish children and Turkish-English bilingual children interpret similar sentences as in *The dog finished the race* ***before*** *the Kangaroo* ***or*** *the Koala*, by taking the dog to be the winner of the race while rejecting these sentences in contexts where the dog finished in second-place, both in Turkish and in English.

Monolingual Turkish-speaking children and adults assigned a strong *neither* interpretation to negated conjunction phrases with *hem…hem de* regardless of the presence of case marking. This shows that Turkish children assigned the default [+PPI] value of the Conjunction Parameter to conjunction phrases in negative sentences. The strong 'neither' interpretation that children assign to conjunction phrases in such sentences is also in line with previous studies investigating the interpretation of English *both… and* (Crain, Goro, Notley & Zhou, 2013) and its Japanese counterpart, the *mo-…mo-* construction (Goro & Akiba, 20004a).

One new contribution of this dissertation to the previous literature was the role played by the Turkish accusative case marker–(*y)ı* in the interpretation of disjunction phrases in negative sentences. The presence of Japanese accusative case marker –*wo* does not result in an interpretative difference assigned in the way that disjunction phrases are interpreted in negative sentences in Japanese. Regardless of the presence of the accusative case marker–*wo*, Japanese disjunction phrases receive a disjunctive interpretation in negative sentences. This is not the case in Turkish, however. In Turkish negative sentences, uninflected disjunction phrases receive a conjunctive interpretation, whereas accusatively case marked disjunction phrases receive a disjunctive interpretation. Turkish-speaking children initially assign the conjunctive interpretation of disjunction, because this corresponds to the subset value of both the Disjunction Parameter and the Conjunction Parameter. It is worth noting again that this means that disjunction phrases are [–PPI] for Turkish-speaking children, whereas conjunction phrases are [+PPI]. It follows that scope assignment and polarity licensing are orthogonal.

Since the [+PPI] value of the conjunction parameter does not yield the ‘not both’ interpretation of negated conjunctions in classical logic, children’s initial scope assignments are also orthogonal to classical logic. As a final note, we wish to point out that it is unlikely that the role of case markers in scope assignments is unique to Turkish. Although this is the first series of studies to uncover this relationship, this will be a fertile area for future study.

One question that needed to be addressed is why Turkish-speaking adults rejected the test sentences in the contexts (Sad-Face) that were uniquely consistent with a conjunctive interpretation of disjunction phrases, both when these phrases appeared in the scope of negation and when they appeared in the scope of the temporal term *before*. When disjunction phrases take scope over negation or when they take scope over the temporal term *before*, they are logically true in circumstance corresponding to the ‘neither’ reading. However, adults reject the test sentences in such circumstances. Our explanation for this finding, therefore, could not involve the logical truth conditions that are associated with disjunction either in logic or in human languages. The explanation had to involve something else, besides logic.

We based our explanation of the recalcitrant data on principles of pragmatics. Whenever we process sentences, we draw upon our understanding of logic, but our understanding of the meanings of sentences also involves principles of conversation, i.e., pragmatic norms that we follow and expect other language users to follow. These pragmatic norms often determine the readings that are assigned to ambiguous sentences. Pragmatic principles are known to eliminate certain truth conditions from consideration, including ones that make these ambiguous sentences true, according to the rules of logic.

One of the main principles that guides speakers in assigning interpretations to ambiguous sentences is the Principle of Cooperation (Grice, 1975). One of the maxims within this principle is the Maxim of Quantity. This maxim requires the speakers to be as informative as possible, but not more informative than required in the conversational acts they get

engaged. We cited this explanation for the adult rejections of test sentences that were logically true.

The findings reported in this dissertation also lend support to the idea of Logical Nativism. According to Logical Nativism, children are innately endowed with a faculty for accessing and combining logical expressions which operates very similarly to the rules and principles of classical (first order) logic (Crain & Khlentzos, 2008; 2010). On this account, many of the thoughts that we can express are shaped by logical concepts, which are not learned by children, and are too distant from our conscious experience to be taught by adult language users. These innate logical concepts include the sentential connectives *and* and *or*, which arguably have the same meanings in human languages as the corresponding expressions do in classical logic (Crain, 2008). Logical Nativism therefore predicts that (a) all languages access the same semantic representations of logical expressions and (b) young children learning any human language 'know' the truth conditions of logical expressions in human languages, since these are the same as the truth conditions for the corresponding symbolic expressions in classical logic. More specifically, knowledge of these logical expressions is taken to be part of Universal Grammar (Crain, Gualmini & Meroni, 2000). Given that Universal Grammar provides the truth conditions for logical words in human languages, language learners are expected to know the truth conditions associated with these words as soon as they learn the linguistic expressions of the language they are acquiring. The data presented in this dissertation are consistent with the claims of Logical Nativism, including the findings that both monolingual and bilingual children assigned the same inclusive-*or* interpretation to disjunction, regardless of the language that they were tested on.

The findings also offer support for the Continuity Hypothesis. The Continuity Hypothesis proposes that children sometimes speak fragments of a 'foreign' language for a brief period of time, based on the initial assignment of default setting of certain lexical parameters, such as the Disjunction Parameter and the Conjunction Parameter. When these

default settings do not match those of adult speakers of the local language, then the language of the child and the language of the adult will differ. Such differences between child and adult language constitute some of the most striking evidence for the theory of Universal Grammar. Following the dictates of the Semantic Subset Principle, children acquiring all human languages are expected to initially start out along the same path, even when this path differs from that of adult speakers of the local language. That is, children will begin with the same initial values of lexical parameters, regardless of the values adopted by adult speakers. Crucially, the non-adult linguistic behaviour is attested in some human language, just not in the local language. Consistent with the Continuity Hypothesis, Turkish-speaking children were observed to speak a fragment of English/German before they converge on the grammar of adult Turkish.

The final question is how the monolingual and bilingual children learn that the local language(s) also allow for a different interpretation of negative sentences with disjunction phrases that are accusatively marked, as well as in sentences with the temporal term *before* that include disjunction phrases that are marked with ablative case. It was observed that children initially adopt the [–PPI] value of the Disjunction Parameter. Because this is the subset value of the parameter, children will be guaranteed to encounter 'positive' evidence from adults informing them that they must reset the Disjunction Parameter to the [+PPI] value. This learning process is assisted by one of the sub-Maxims of the Principle of Cooperation: the Maxim of Quality. According to this maxim, speakers are encouraged to "speak truthfully." As a consequence, when child language learners encounter sentences in contexts that make the sentence false, according to the current setting of one of their lexical parameters, children are informed that these same sentences are true for adults. This enables children to make the necessary adjustment to their lexical parameters, in order to make these same sentences true, thereafter, in children's grammars. Having encountered such 'positive' evidence from adults, children learning language(s) that adopt the superset value of lexical

parameters will reset these parameters to have these same superset values, and thereby will converge on the parameter settings of the local language. Now we turn to a discussion of what could be investigated next in studies of monolingual and bilingual Turkish- and German-speaking children.

Directions for Future Research

Additional research is needed to gain further insights into the development of the comprehension of logical connectives by monolingual and bilingual children, and in children whose language is developing atypically. Further research is also needed to inform our understanding of how disjunction is interpreted in the scope of other downward entailing operators in individual languages, and across languages, by both children and adults.

In this dissertation, we have investigated children's interpretation of disjunction in negative sentences with negation and in sentences with *before*. Elements that are polarity sensitive are sensitive to downward expressions such that linguistic expressions (such as disjunction and conjunction) that are Positive Polarity Items can take different scope relations with these expressions across languages. We saw that, for adult Turkish speakers, case marking brings about a wide scope interpretation of disjunction in negative sentences, for example. However, we have yet to investigate a range of 'stronger' downward operators that have been found to cancel polarity sensitivity in other languages. These downward entailing contexts should behave the same way across languages, so we expect Turkish to pattern like the other languages that have been investigated in the literature. In this section, we will review these contexts as being potentially important in future experimental research on children acquiring Turkish.

We turn to the contexts that cancel polarity sensitivity momentarily. First, however, it is worth considering the contribution of case-marking to the interpretation of disjunction in Turkish. The findings in this dissertation showed that both Turkish-speaking children and

adults assign a conjunctive interpretation to disjunction when the disjuncts in a negative sentence were inflected in the nominative case or had no case marking. That is, when Turkish-speaking children and adults heard sentences like *A didn't do B or C* they interpreted these sentences to mean that *A didn't do B* and *A didn't do C*. When the disjuncts in these negative sentences were marked with accusative case, however, the interpretations assigned by adult Turkish-speakers changed. The adults now accepted negative sentences with disjunction in circumstances in which one of the disjuncts was false, but not both. In other words, they accepted the sentence *A didn't do B or C* as meaning *It's B or C that A didn't do*. In contrast to adults, children maintained a conjunctive interpretation regardless of case marking.

It should be noted, however, that Turkish has 6 cases. Therefore, it will instructive in future research to investigate whether case markers other than accusative case have similar effects on interpretation for adults, and whether they lack these effects on children. To begin to address this question, we conducted a preliminary study with Turkish-speaking adults. Figure 1 summarizes the main findings. As the figure indicates, adult Turkish-speakers (n = 14) assigned a conjunctive interpretation to disjunction phrases in negative sentences like *A did not do B or C*, with five case-markers (in contrast to accusative case): (i) dative, as in *Ali did not go to work or school* (ii) locative, as in *Ali did not work at home or office* , (ii) ablative, as in *Ali did not phone from home or office* (iv) genitive, as in *Ali did not use Ayşe's or Ezgi's pen,* and (v) instrumental, as in *Ali did not eat the pasta with a fork or a spoon*. It should be noted that some of these case markers are obligatory with certain verbs, so this is another important direction to pursue in future research.

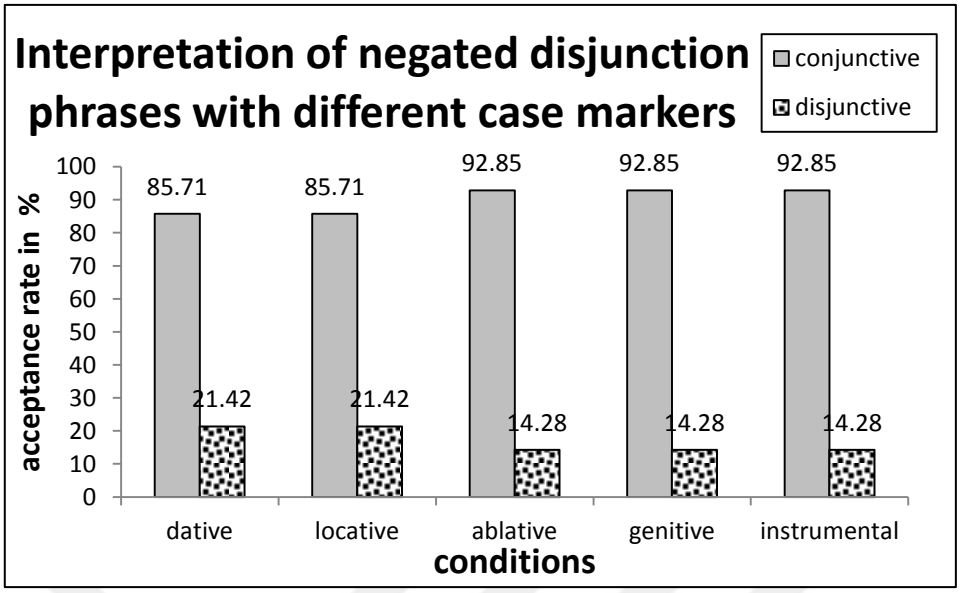

Figure 1: Rate of acceptance of the conjunctive and disjunctive interpretation of disjunction in negative Turkish sentences with different case-markers

In all of the sentence-types reported in the figure, Turkish-speaking children are also expected to assign the conjunctive interpretation to disjunction. This means that Turkish-speaking children and adults are not expected to differ in scope assignments for these sentences.

We have argued in the thesis that the differences between child and adult language are differences in scope relations, based on the fact that disjunction and conjunction words, and accusative case marking, are polarity sensitive items. We could put this analysis to the test in future research, by seeing of the polarity sensitivity of disjunction phrases and conjunction phrases is cancelled in certain linguistic environments. If so, then this would be evidence supporting the present account. As we mentioned earlier, certain downward entailing operators are ‘stronger’ than the ones we used in the present studies. These downward entailing operators have been found to cancel the polarity sensitivity of disjunction and conjunction in other languages. Therefore, it will be instructive in future research to investigate the influence of these ‘strong’ downward entailing operators in Turkish.

We have concluded, for example, that the accusative case marker is a [+PPI] item. It will be instructive, therefore, to see if the polarity sensitivity of the accusative case marker is cancelled in these ‘strong’ downward entailing linguistic contexts. If it is, then the disjunction phrases marked with accusative case should generate a conjunctive entailment when they appear in the scope of these linguistic expressions.

One ‘strong’ downward entailing operator that has been observed to cancel the polarity sensitivity of [+PPI] items is the negative quantification expression *nobody*. This contrasts with the negation word that appears within the clause, as we have seen. To ascertain whether this prediction about the cancellation of polarity sensitivity is on the right track, we conducted a preliminary study of the interpretation assigned to sentence (8) by German-speaking adults (n = 15) and the interpretation assigned to sentences (9) and (10) by Turkish-speaking adults (n = 28). As predicted, the finding was that adult speakers of both languages assigned a conjunctive interpretation to disjunction phrases in sentences with *nobody*. So, these sentences can be paraphrased as meaning: *Nobody ate an apple and nobody ate a pear.*

(8) **Niemand** aβ einen Apfel ***oder*** eine Birne.

‘Nobody ate an apple or a pear’.

(9) **Hiçkimse** elma **ya da** armut ye**me**di.

Nobody apple or pear eat-NOT-PAST

‘Nobody ate apple(s) or pear(s)’.

(10) **Hiçkimse** elma-y*ı* **ya da** armut-*u* ye**me**di.

Nobody apple-ACC or pear-ACC eat-NOT-PAST

‘Nobody ate the apple or the pear’.

Like German-speaking and Turkish-speaking adults, children acquiring both languages are expected to assign a conjunctive interpretation to these sentences, regardless of the presence of the accusative case marking.

Another linguistic context that has been found to cancel polarity sensitivity is the use of disjunction in the predicate phrase of the focus operator ONLY. Consider the Turkish examples in (11) and (12) and the German example in (13):

(11) **Sadece** Ali hikaye **ya da** şiir okudu.
Only Ali story or poem read-PAST
'Only Ali read a story or a poem'.

(12) **Sadece** Ali hikaye-y*i* **ya da** şiir-*i* okudu.
Only Ali story-ACC or poem-ACC read-PAST
'Only Ali read the story or the poem'.

(13) **Nur** Tom aβ einen Apfel **oder** eine Birne.
'Only Tom ate an apple or a pear'.

The statements as in (11), (12) and (13) express two propositions. One of these propositions is called the *presupposition* and the other is called the *assertion*. To derive the presupposition, one needs only remove the Turkish focus operator SADECE and the German focus operator NUR from these sentences. So, the presuppositions of (11) and (12) can be paraphrased as *Ali read either the story or the poem* (but not both), and the presupposition of (13) can be paraphrased as *Tom ate an apple or a pear* (but not both). This strong 'exclusive' flavour of the interpretation of the disjunction phrase in the presupposition is due to a scalar implicature.

To derive the *assertion* meaning component, sentences with focus operators can be further partitioned into a *focus element* and a *contrast set*. In (11) and (12), the focus element, which receives phonological stress, is *Ali*. The focus element in (13) is *Tom.* The contrast set consists of alternatives to the focus element. In the sentences under consideration, the contrast set includes individuals who are being contrasted with Ali and Tom. The assertion entails that the property attributed to the focus element, Ali and Tom, does not hold for any members of

the contrast set. The critical observation is that the polarity sensitivity is expected to be cancelled in the assertion of sentences with focus operators. Therefore, the disjunction phrase is expected to generate a conjunctive interpretation, as part of this meaning component. Figure 2 summarizes the interpretations assigned to disjunction when it is interpreted in the assertion by Turkish-speaking adults (n = 28) and by German-speaking adults (n = 15).

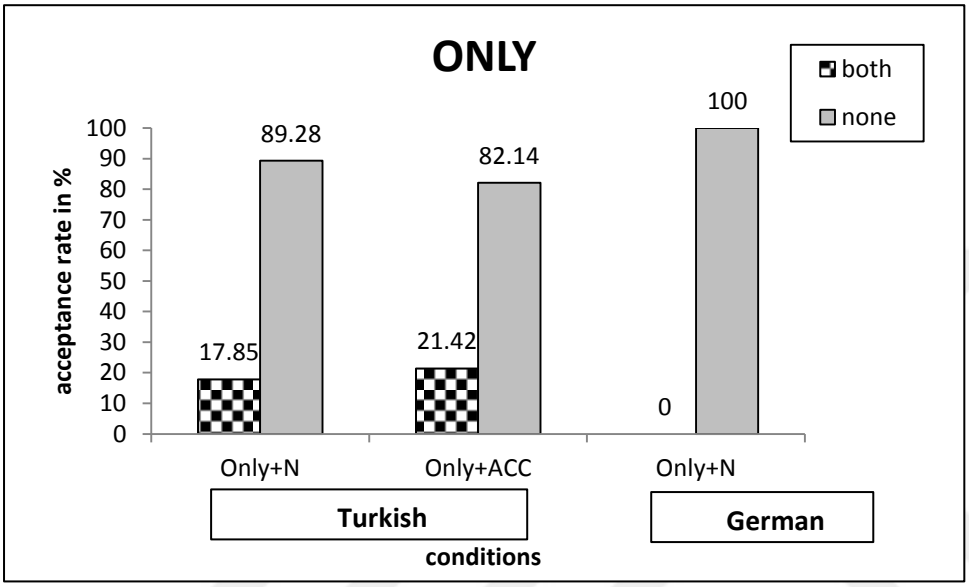

Figure 2: The interpretation of disjunction by adult Turkish- and German-speakers

As the figure indicates, the disjunction phrase was assigned a conjunctive interpretation when it was analysed as part of the assertion. So, these test sentences entail that the individuals in the contrast set did not eat the apple and did not eat the pear. The presence of accusative case marking in the Turkish sentences did not result in a difference in the assertions derived from disjunction in the scope of the focus operator ONLY. These findings are consistent with a linguistic universal that has been proposed in the literature, which is the following: '*Disjunction generates a conjunctive interpretation in the assertion of certain focus expressions in all human languages*' (Crain & Khlentzos, 2008, pp. 38; Minai, Goro & Crain, 2006). Turkish- and German-speaking children are not expected to differ in the assertions they derive from disjunction in the scope of the focus operator ONLY regardless of the presence of the accusative case. Both child groups are predicted to assign the conjunctive

interpretation to disjunction in this context just like the adult speakers of the respective languages.

Another downward entailing context that has the effect of cancelling the polarity sensitivity of [+PPI] items is when negation is positioned at a higher clause than the clause that contains disjunction. It will be instructive to investigate whether accusative case has a role in Turkish-children's interpretation of disjunction phrases in this linguistic environment. The prediction is that, when negation is positioned at a higher clause, the accusative case marker in the lower clause will no longer take scope over negation. For instance, when clauses which contain disjunction phrases as in *…Ali ate the apple or the pear* are embedded in a clause with negation as in *Ezgi didn't see…*, a conjunctive interpretation is generated in adult Japanese, Chinese, Russian and English. In a preliminary study, Turkish-speaking adults (n= 23) were asked to judge sentences containing the disjunction operator *ya da* in either accusatively marked or uninflected noun phrases, embedded in the superordinate clause as in *Ezgi did not see*….Two of the subordinate clauses contained the converbial–*(y)ken*, which is tense/aspect neutral. The *see+ken* condition can be translated into English as *Ezgi did not see Ali eat an apple or a pear* and the *see+ken+acc* condition can be translated as *Ezgi did not see Ali eat the apple or the pear*. The last two of the subordinate clauses contained the converbial–*dIk*, which expresses relative past or present and is followed by possessive or case suffixes. The *see+dIk* condition can be translated into English as *Ezgi did not see (that) Ali ate an apple or a pear* and the *see+dIk+acc* condition can be translated as *Ezgi did not see (that) Ali ate the apple or the pear*. It is important to note that in both the *see+dIk* and the *see+dIk+acc* conditions, the converbial –*dIk* has to carry the accusative case marking. Adult responses are summarized in Figure 3:

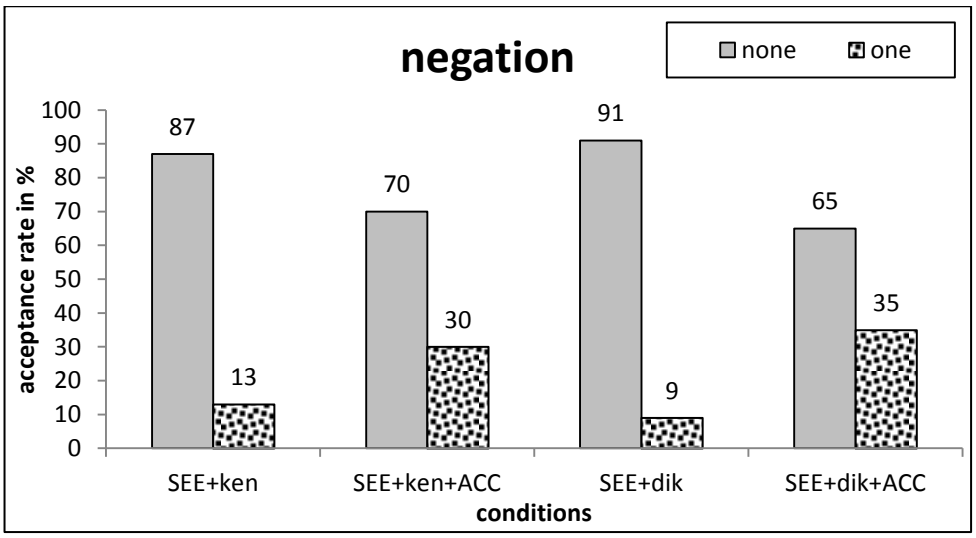

Figure 3:Acceptances of negated disjunction phrases without and without accusative case

As shown in Figure 3, Turkish-speaking adults assigned a conjunctive interpretation to disjunction phrases both with and without accusative case, when negation appeared in a higher clause than the one that contained disjunction. In the *see+dIk+acc* condition, the polarity sensitivity, of the two obligatory accusative case markers was cancelled. Fifteen out of the 23 adults assigned a conjunctive interpretation to the test sentence in the *see+dIk+acc* condition and sixteen of the same 23 participants did so in the *see+ken+acc* condition. We expect Turkish-speaking children to behave like adults and to generate a conjunctive interpretation of disjunction in all the test sentences across the four conditions regardless of the presence of the accusative case.

Implications

Knowing how children interpret sentences with logical connectives is important evidence on how they learn to reason with them. Logical connectives, such as those investigated within the scope of this dissertation, belong to a larger set of connectives called discourse connectives. Accurate use of these connectives is an essential skill both for first and second language learners, since they provide explicit cues about the logical relationships between referents and

clauses that help the users of a language to construct the mental representation of the meaning of written or spoken discourse. Overuse of connectives has been reported in the essays of second language learners (Granger & Tyson, 1996; Yang & Sun, 2012; Narita, Sato & Sugiura, 2004; Lee, 2013), in the oral narratives of children with specific language impairment (Lopes, Bento & Perissinoto, 2008) as well as those of bilingual children (Fiestas, Bedore, Pena & Nagy, 2005). Underuse of discourse connectives has also been reported in the oral narratives of bilingual adolescents (Ordónez, 2005). Thus, cross-linguistic research on logical connectives provides insight on how they are acquired and has implications for second language classrooms as well as speech pathologists in the sense that cross-linguistic findings provide evidence for speech pathologists for directing therapeutic processes in an effective way as well as considering narrative abilities assessment during the language diagnosis processes and for second language teachers for curriculum design and material development.

References

Crain, S. (2008). The interpretation of disjunction in Universal Grammar. *Language and Speech*, 51, 151–169.

Crain, S. & Khlentzos, D. (2008). Is logic innate? *Biolinguistics,* 2 (1), 24–56.

Crain, S. & Khlentzos, D. (2010).The logic instinct. *Mind and Language*, 25, 30–65.

Crain, S., Gardner, A., Gualmini, A. & Rabbin, B. (2002). Children's command of negation. In Y. Otsu (Ed.), *Proceedings of the Third Tokyo Conference on Psycholinguistics* (pp. 71–95). Tokyo: Hituzi Publishing Company.

Crain, S., Goro, T., Notley, A. & Zhou, P. (2013). A parametric account of scope in child language. In S. Stavrakaki, M. Lalioti & P. Konstantinopoulou (Eds.), *Advances in language acquisition* (pp. 63–71). Cambridge: Cambridge Scholar Publishing.

Crain, S., Gualmini, A. & Meroni, L. (2000). The acquisition of logical words. Logos and Language. *Journal of General Linguistics and Language Theory*, 1: 49–59.

Fiestas, C. E., Bedore, L. M., Pena, E. D. & Nagy, V. J. (2005). Use of mazes in the narrative language samples of bilingual and monolingual 4- to 7- year old children. In J. Cohen, K. T. McAlister, K. Rolstad & J. MacSwan (Eds.), *ISB 4: Proceedings of the 4th International Symposium on Bilingualism* (pp. 730–740). Somerville, MA: Cascadilla Press.

Goro, T. & Akiba, S. (2004a). The acquisition of disjunction and positive polarity in Japanese. In V. Chand, A. Kelleher, A. J. Rodriguez & B. Schmeiser (Eds.), *WCCFL 23 Proceedings* (pp. 251–64). Somerville, MA: Cascadilla Press.

Goro, T. & Akiba, S. (2004b). Japanese disjunction and the acquisition of positive polarity. In Y. Otsu (Ed.), *Proceedings of the Fifth Tokyo Conference on Psycholinguistics* (pp. 137–162).Tokyo: Hituzi Shobo Publishing Company.

Granger, S. & Tyson, S. (1996). Connector usage in the English essay writing of native and non-native EFL speakers of English. *World Englishes*, 15, 17–27.

Grice, H. P. (1975). Logic and conversation. In P. Cole & J. Morgan (Eds.), *Syntax and Semantics, vol. 3: Speech Acts* (pp. 41–58). London: Academic Press.

Jing, C. H., Crain, S. & Hsu, C. F. (2005). The interpretation of focus in Chinese child vs. adult language. In Y. Otsu (Ed.), *Proceedings of the 6th Tokyo Conference on Psycholinguistics* (pp. 165–190).Tokyo: Hituzi Publishing Company.

Lee, K. (2013). Korean ESL learners' use of connectors in English essay writing. *English Language Teaching*, 25 (2), 81–103.

Lee, O. S. (2010). Acquisition of Korean disjunction under negation. *Working Papers in Linguistics*, 41(7), 1–12.University of Hawaii.

Lopes, D. M., Bento, A. C. P. & Perissinoto J. (2008). Narration of stories by children with specific language impairment. *Pro-Fono Revista de Atualização Cientifica*, 20 (2), 93–98.

Minai, U., Goro, T. & Crain, S. (2006). Covert downward entailment in child English and Japanese. *The Proceedings of the Inaugural Conference on Generative Approaches to Language Acquisition–North America (GALANA) – University of Connecticut Occasional Papers in Linguistics,* 4, (pp. 217–228).

Narita, M., Sato, C. & Sugiura, M. (2004). Connector usage in the English essay writing of Japanese EFL learners. *Fourth International Conference on Language Resources and Evaluation* (pp. 1171–1174).

Notley, A., Zhou, P., Jensen, B. & Crain, S. (2012). Children's interpretation of disjunction in the scope of 'before': a comparison of English and Mandarin. *Journal of Child Language*, 9(3), 482–522.

Ordónez, C. L. (2005). Narrative skills of Colombian adolescents in an elite bilingual school. In J. Cohen, K. T. McAlister, K. Rolstad & J. MacSwan (Eds.), *ISB 4: Proceedings of the 4th International Symposium on Bilingualism* (pp. 1765–1783). Somerville, MA: Cascadilla Press.

Verbuk, A. (2007). The acquisition of the Russian Or. In E. Bainbridge & B. Agbayani (Eds.), *Proceedings of the thirty-fourth Western Conference on Linguistics (WECOL 2006)* (pp. 443–455). Fresno: California State University Fresno, Department of Linguistics.

Yang, W. & Sun, Y. (2012). The use of cohesive devices in argumentative writing by Chinese EFL learners at different proficiency levels. *Linguistics and Education*, 23, 31–48.

Appendix