COMPREHENSION OF TURKISH RELATIVE CLAUSES IN BROCA'S APHASICS AND CHILDREN

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ABSTRACT

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Abstract

The aim of this thesis is to test two hypotheses. The first one is about the nature of comprehension impairment in Broca's aphasia, namely the Trace Deletion Hypothesis (TDH), and the other is about the similarity between child and aphasic language, namely the Regression Hypothesis. According to TDH, agrammatic patients are impaired in comprehension of certain structures that are formed by movement transformation whereas they show normal comprehension in canonical structures. TDH proposes that patients use a default strategy, which assigns the first NP the agent role. As for the

Regression hypothesis, children follow a hierarchy while acquiring a language, which is also followed by aphasic patients in the reversed order. That is, what is learnt last is lost first as a result of brain damage. In order to test these two hypotheses, we designed a psycholinguistic test in which the comprehension of Turkish relative clauses is tested via sentence-picture matching task. The same test is applied to children, agrammatic patients, and normal control subjects. We expected that Broca's patients would be impaired in their comprehension of subject relative clauses in order for TDH to be confirmed and that children would also exhibit the same impairment as the agrammatic patients in order for the Regression Hypothesis to be supported. The results we obtained were not compatible with the TDH hypothesis in that the patients did not show comprehension deficit in subject relatives but they had problems in object relative clauses, which led us to conclude that TDH did not offer a cross-linguistic explanation for the nature of comprehension deficit in agrammatism and that even if the traces were deleted, the default strategy applied in each language was a parametric feature. We propose that Turkish patients assign the agent role to the first NP that is in the pre-verbal position, which is called the pre-verbal strategy. Also, we hypothesize that the difficulty the Turkish agrammatic patients present might be due to an impairment in another feature, which is agreement morphology rather than the deletion of traces. This study is compatible with the Regression Hypothesis in that both the patients and children exhibited similar impairment in the comprehension of object relative clauses.

Keywords: Broca's aphasia, Turkish, language acquisition, relative clauses, Trace Deletion Hypothesis,Regression Hypothesis

ÖZ

TÜRKÇE İLGİ TÜMLEÇLERİNİN BROCA AFAZİLİ HASTALAR VE ÇOCUKLAR TARAFINDAN ANLAŞILMASI

Kükürt, Duygu

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Bu tez iki hipotezi test etmeyi amaçlamaktadır. Birinci hipotez Broka afazili hastalarda görülen anlama bozukluğu hakkında olan İz Silme Hipotezidir (İSH) . Diğeri ise dil edinim sürecindeki çocuklar ile afazili hastaların dil yapısındaki benzerlikler ile ilgili olan Gerileme Hipotezidir. İSH'ye göre Broka afazili hastalar sadece dönüşümsel taşıma içeren yapıları anlamada güçlük çekerken, dönüşümsel taşıma içermeyen normal cümlelerde normal anlama davranışı göstermektedirler. İSH hastaların dönüşümsel taşıma içeren yapılarla karşılaştıklarında gördükleri ilk AÖ'ye (Ad Öbeği) yapıcı rolü yüklediklerini öne sürmektedir. Gerileme hipotezine göre, afazili hastalar çocukların

dil edinim sürecinde izledikleri hiyerarşinin tam tersi yönde söz kaybına maruz kalırlar. Yani dil edinim sürecinde en son öğrenilen şey beyin hasarı sonucunda ilk kaybedilecektir. Bu iki hipotezi test etmek için psikodilbilimsel test kullanılmıştır. Hastalardan ve çocuklardan duydukları cümlenin anlattığı resmi seçmeleri istenmiştir. İSH'nin doğrulanabilmesi için Broka hastalarının özne ilgi tümleçlerinde şans performansı gösterirken düz ve nesne ilgi tümleçlerinde şans üstü (normal) performans göstermeleri ve GH'nin doğrulanabilmesi için de çocukların afazili hastalara benzer bir performans göstermeleri beklenmiştir. Elde edilen sonuçlar İSH'nin tersi yönünde olup hastalar ve çocuklar beklenenin aksine nesne ilgi tümleçlerinde şans performansı göstermişlerdir. Bu sonuçlar göstermektedir ki dönüşümsel taşıma içeren yapılarda rol yükleme işini üstlenen izler silinse bile kullanılan strateji parametrik (değiştirgen) bir özelliktir. Ayrıca bu çalışmada ana dili Türkçe olan hastaların ve çocukların gördükleri ilk AÖ'ye değil fiilden önceki ilk AÖ'ye yapıcı rolünü yükledikleri gözlemlenmiştir. Son olarak, hastalarda ve çocuklarda gözlemlenen anlama güçlüğünün nesne ilgi tümleçlerinin içerdiği uyum biçimbilimsel eklerden kaynaklanabileceği ileri sürülmüştür.

Anahtar Kelimeler: Broka afazisi, Türkçe, dil edinimi, ilgi tümleçleri, İz Silme Hipotezi, Gerileme Hipotezi

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INTRODUCTION

Broca's aphasia, also called agrammatism, has been characterized by non-fluent and effortful production of language, i.e. telegraphic speech, characterized by the omission of closed-class words, flat and monotonous intonation patterns, and preserved or mildly impaired comprehension of basic structures. It is caused by damage to the area involving the frontal operculum and also the pre-motor and motor regions of the brain that lie behind and above Broca's area. Lesions deep within the white matter and the basal ganglia of the brain can also cause Broca's aphasia (Caplan, 1987).

Notwithstanding their intact ability in comprehension of basic structures, Broca's patients have been reported to exhibit deficit in understanding some complex structures. Hence, there has been growing interest in the specification of comprehension patterns and the precise nature of comprehension deficits in Broca's aphasics.

Different accounts have been put forward in order to provide an explanation for disturbances in Broca's aphasia. There have been linguistic but non-syntactic accounts regarding agrammatism as phonological (Kean, 1977), or lexical disorder (Bradley,

Garrett and Zurif, 1980; Saffran, Schwartz and Martin, 1990). Another account, which we shall devote more attention to in this study, has taken agrammatism as a syntactic deficit. In an instance of syntactic accounts, Caramazza and Zurif (1976) proposed that agrammatic Broca's aphasics lacked "syntactic-like algorithmic processes". Similarly, it was found that agrammatic patients presented impaired comprehension patterns in semantically reversible passives; on the contrary, they performed well in non-reversible passives and active sentences (Schwartz, Saffran, and Martin 1980, Caplan and Futter 1986, Grodzinsky, Finkelstein, Nicol and Zurif 1988). Finally, Zurif and Pinango (1999) noted that Broca's patients showed a consistent pattern in their comprehension abilities.

The present thesis shall address one of the most controversial theories expounded within the boundary of syntactic accounts of agrammatism, namely *Trace Deletion Hypothesis* (TDH) or *Trace Based Account* (TBA), being a more recent reformulation of TDH, set forth by Grodzinsky (1989; 1995). According to the TDH, agrammatic patients failed in assigning correct thematic roles to the structures that were transformationally derived. The reason he suggested for this was that the chains combining the trace and the moved element were deleted in agrammatic comprehension and these patients applied a default strategy that assigns the first NP they encounter the agent role. Considering the sentence "[The man]$_i$ was followed t_i by the woman" the patient cannot keep track of the trace t_i by which the patient role assigned to the first NP [the man]$_i$ and assigns an agent role to it. On the other hand, realizing the other agent role assigned normally by the preposition "by", the patient finds himself in a position where he has to make a choice between two NPs or agent roles. This is the explanation offered by Grodzinsky (1989) in support of TDH.

However, the divergent data provided by Hickok and Avrutin (1994) forced Grodzin-

sky to reformulate his account, under the name of Trace Based Account (TBA), so that it could account for different cases. Hickok and Avrutin (1994) reported that agrammatic patients, contrary to Grodzinsky's expectation, did not perform at chance level in some of the object wh-questions. This led Hickok and Avrutin (1994) to conclude that the problematic structures were all transformationally-derived and referential. Taking into account this new finding, Grodzinsky (1995) proposed that agrammatic aphasics do not have access to the traces and they apply the default strategy only to referential NPs, which are context-bound (discourse-linked). That is, in order for an NP to create problem for an agrammatic patient it must be both transformationally-derived and referential so that the patient can apply the default strategy, which is called R(eferential)-strategy in TBA.

On the other hand, there is another group of people, children, who suffer from similar limitations to Broca's aphasics although they have no brain damage. Some of the common difficulties exhibited by children and Broca's patients are effortful and telegraphic speech, deletion of function words, problems in intonation, as well as problems in producing and comprehending certain complex structures. Jakobson's (1971) *regression hypothesis* is one of the earliest accounts provided regarding the similarities between child and agrammatic language. According to regression hypothesis, what is learned last in the acquisition period is lost first as a result of brain damage. That is, a child proceeds from one acquisition stage to another (from simple to complex), and an agrammatic aphasic follows the same hierarchy in the reversed order. Grodzinsky (1990), Grodzinsky and Reinhart (1993), and Avrutin(1999) are some of the researchers providing support for the regression hypothesis in terms of comprehension. That is, Grodzinsky (1990) and Grodzinsky and Reinhart (1993) assert that children do not

form some structures, namely transformations or binding conditions, enabling them to understand some complex sentences until the end of acquisitional stages, whereby showing similar patterns to Broca's patients, who lose access to traces, in comprehending transformationally-moved elements.

This brings us to the questions aimed to be addressed in this thesis. First of all, the question arises as to whether the hypotheses posited by Grodzinsky (1989; 1995) are cross-linguistically and cognitively plausible. Another issue dealt with within the scope of this thesis is whether there exists a similarity in comprehension patterns exhibited by children and Broca's aphasic patients. In other words, whether the regression hypothesis set forth by Jakobson (1971) is applicable to Turkish children and agrammatic patients.

In order to fulfill our first aim, we conducted an experiment designed to test comprehension abilities presented by Broca's patients, whose native language is Turkish. Standard sentence-picture matching task was used in the experiment. Our main concern was to find whether Turkish patients performed at above chance level in canonical structures, without any movement transformations, and at chance level in constructions involving transformational movement. Constructed by movement transformations, Turkish relative clauses (henceforth RC) were chosen as a medium of comparison with the canonical sentences. As for the evaluation of the regression hypothesis, the same task was applied to children, whose age ranged between 41 and 52 months.

In order for the TDH to be confirmed, we expected Turkish children and agrammatic patients to perform at chance level in subject RC constructions and at above chance level in object RCs and canonical sentences. One should note that the structure which

must be problematic in Turkish is different from that of English (i.e. in English, subjects show chance level in object RCs but in Turkish they must do so in subject RCs), which is due to head-final characteristic of Turkish language.

What we gathered as a result of statistical analyses was that children and Broca's aphasics exhibited similar limitations in the comprehension of object RC constructions whereas they showed above chance performance in comprehension of subject RCs and canonical sentences, which confirms the Regression hypothesis in terms of comprehension of RCs only. On the other hand, the data are incompatible with Grodzinsky's (1989) TDH. We propose that this kind of disruption might be due to the impairment of another feature, agreement morphology, which is present in object RCs but missing in subject RCs. It is also suggested that these subjects might be using a heuristic depending on the canonical word order (SOV) and marking the NP in the preverbal position as a patient of the action.

CHAPTER II

GOVERNMENT-BINDING THEORY AND TURKISH

This chapter is divided into two sections: the first section deals with Government and Binding Theory and the second one presents an overview of Turkish syntax, more specifically, Turkish RCs.

II.1 Government and Binding Theory

The central focus of this section will be the basic notions in Government and Binding Theory (GB-theory) put forward by Chomsky in 1981. Specifically, we shall focus on *transformations*, namely NP-movement and WH-movement, and essentials of Binding Theory so that the concepts on which the TDH and TBA stand could become clearer. Lastly, we shall discuss basic features of RC constructions in English.

In *Lectures on Government and Binding* Chomsky (1981) initiates his arguments by giving the subcomponents of the system that constitutes the principles shared by all human languages and that enables human beings to learn language without any effort, namely Universal Grammar (UG). Chomsky (1981) states that there are two

requirements to be met by the theory of UG: it must be general enough in order to explain the variety of possible grammars and at the same time specific enough so that it can "account for the fact that each of these grammars develops in the mind on the basis of quite limited experience." (p.3) That is, UG must shed light on the absolute universals common to all human languages as well as providing options for the language-specific parameters. As for the subsystems of UG, two domains are offered, which are subparts of the rule system and subcomponents of principles (p. 5).

II.1.1 Subparts of the Rule System

(i) Lexicon: it includes the necessary information a native speaker innately possesses about the words of his native language such as morpho-phonological, syntactic, categorial, and contextual features.

(ii) Syntax:

(a) Categorial Component: it forms D-structure (deep structure) together with lexicon. Preconditions of X-bar theory (X' theory) are fulfilled at this level. We shall further explore the characteristics of D-structure and X' theory below.

(b) Transformational Component: Base rules generated at D-structure are mapped onto S-structure (surface structure) via the transformation called Move α.

(iii) PF Component: Phonetic form is "the overt realization or the spell-out of the sentence" (Haegeman, 1994, p. 493).

(iv) LF Component: it links S-structure with logical form (LF). Representations of form and meaning are symbolized; that is, "logico-semantic" features of a sentence

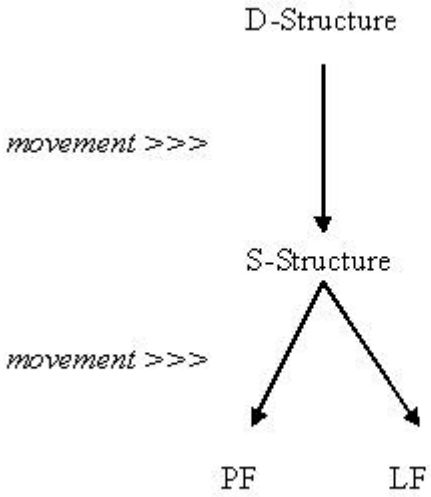

Figure II.1: The model of Grammar in GB

are determined at this component (Haegeman, 1994, p. 491).

The model of grammar, composed of subsystems of rules, is shown in (Figure II.1):

II.1.2 Subcomponents of the Theory

(i) Bounding Theory: it forms locality conditions for certain processes such as movement, i.e. it specifies the boundaries for the transformational elements e.g., how far a constituent can be moved.

(ii) Government Theory: it deals with the connection between the head of a constituent and the dependant categories.

(iii) θ-theory: it is in charge of assigning thematic roles (θ-roles) such as agent, patient, experiencer, etc.

(iv) Binding Theory: it sets the rules about the relations of pronouns, names, and anaphors to their antecedents.

(v) Case Theory: it focuses on the morphological requirement stating that a lexical NP must be morphologically realized and this can only be fulfilled via case assignment (Lasnik and Uriagereka, 1990, p. 10).

(vi) Control Theory: it specifies the reference of abstract pronominal element called PRO, i.e. the element which must be coindexed with PRO.

Having looked at the components of UG, we need to further analyze the criteria and principles essential for the establishment of a sound theory of language. First of all, we shall have a look at the relations between the verbs and their arguments, namely *thematic roles (θ-roles)*. For instance, in English if an argument NP is in the subject position the verb is expected to assign the AGENT role to it whereas the PATIENT role is assigned to an argument in the object position. According to *θ-criterion* it is essential that all NPs bear only one θ-role and each θ-role be assigned to only one argument. Here, the NP arguments having a referential function must be distinguished from the arguments that have no referential function such as idioms, non-arguments (expletive "it" in "It is important that you be on time."), and existential "there" in "There are red tulips in the vase" in that only the former including names, variables, anaphors, pronouns can be in a *θ-position* and thus be assigned a θ-role (Chomsky, 1981, pp. 35-36).

The fact that sentence structure is specified by the lexical information forces the specification of the link between the lexicon and sentence structure, which constitutes the *Projection Principle*. It is characterized as follows: "representations at each syntactic level (i.e., LF, and D- and S-structure) are projected from the lexicon, in that they observe the subcategorization properties of lexical items." (p. 29). Moreover, no

matter what kind of an argument structure it has each sentence must have a subject, which can be PRO, trace (phonetically null category, which is supposed to be existing in the mental representation as a bound variable to the moved element)[1] of an NP or an NP that is phonetically realized at the level of LF representation. This establishes the *Extended Projection Principle* (Haegeman, 1994, p. 69).

Determination of θ-role requires not only inherent lexical features of lexical component (i.e., heads of phrase categories e.g. V is the head in VP) but also grammatical functions (GF) such as subject-of, object-of, complement-of, etc., both of which take place at D-structure (Chomsky, 1981, p.42-43). Chomsky (1981) refers to the positions where GFs are assigned as *A-positions*. That is, an A-position, which could be composed of arguments such as names and variables appearing at D-structure, is potentially a θ-position (p. 47). Besides, as Lasnik and Uriagereka (1990) emphasize θ-properties that appear at D-structure should also appear in the same way at other syntactic levels (p.28). For instance, if an NP is a complement of a V at D-structure, in line with the Projection Principle it obligatorily requires an NP, which could well be a different one at S-structure as well.

As we noted at the beginning of our discussion, D-structure is the level in which the requirements of X' theory are met. X' theory is the module of grammar that organizes the phrase structure rules and forms a hierarchical order by bringing together the shared characteristics of all phrase structures. Thus, according to X' theory (Haegeman, 1994, p.105); (Lasnik and Uriagereka, 1990, p.1):

[1] Here we do not question psychological reality of traces in mental representations for it is far beyond the scope of this thesis. There exist contradicting results gathered from various priming effect experiments on the existence/non-existence of priming effects in the so-called empty position vacated by transformationally moved element. For a comprehensive discussion on this issue see (Chomsky, 1980, pp. 146-178)

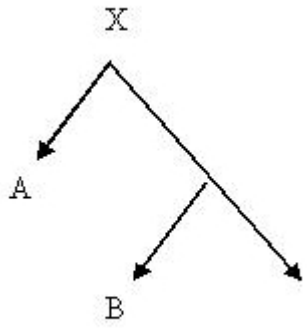

Figure II.2: Representation of c-command

(i) Every phrase is a projection of a lexical head;

(ii) The head of the projection is a zero projection (X^0) and it is a terminal node; X^n immediately dominates X^{n-1} till X^0.

It is crucial to bring up at this point the two structural relations in phrase structure, namely c-command and government.

(1) **c-command**

Node A c-commands node B iff

(i) A and B do not dominate each other; and

(ii) Every branching node dominating A also dominates B.

To define government in terms of c-command, there needs to be a mutual c-command (Haegeman, 1994, p.135):

(2) **government**

Node A governs node B iff

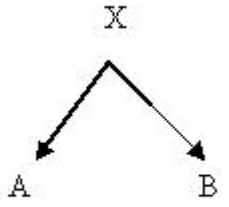

Figure II.3: Representation of Government

(i) A is a governor;[2]

(ii) A and B c-command each other; and

(iii) There is no barrier (maximal projections) between A and B.

Another module of grammar responsible for the distribution of NPs is the *Case Theory*, which we shall briefly examine. The fact that every lexical NP (NPs that are phonetically realized) should have an abstract case assigned at S-structure forms the Case Filter. Figure II.4 represents the distinction between abstract and morphological case and case assignment.

Combining what we have gathered so far, namely θ theory and Case filter, we come up with an important device called *visibility requirement*, which will also play a crucial role in the formation of transformations. All three notions are related in that in order for an NP to be assigned a θ-role it is required to be visible, and in order for an NP to be visible it must be assigned an abstract case. Hence, unless an NP is case marked, it violates the θ-criterion.

It must be noted that θ-role assignment takes place at D-structure while the case-

[2] According to the GB theory "the head of a phrase governs the complement [just as]... the verb governs the object [and]... the element which governs is called the governor; the element that is governed is called the governee" (Haegeman, 1994, p. 86). That is, the head of a phrase is always the governor like N being the governor in an NP and V in a VP.

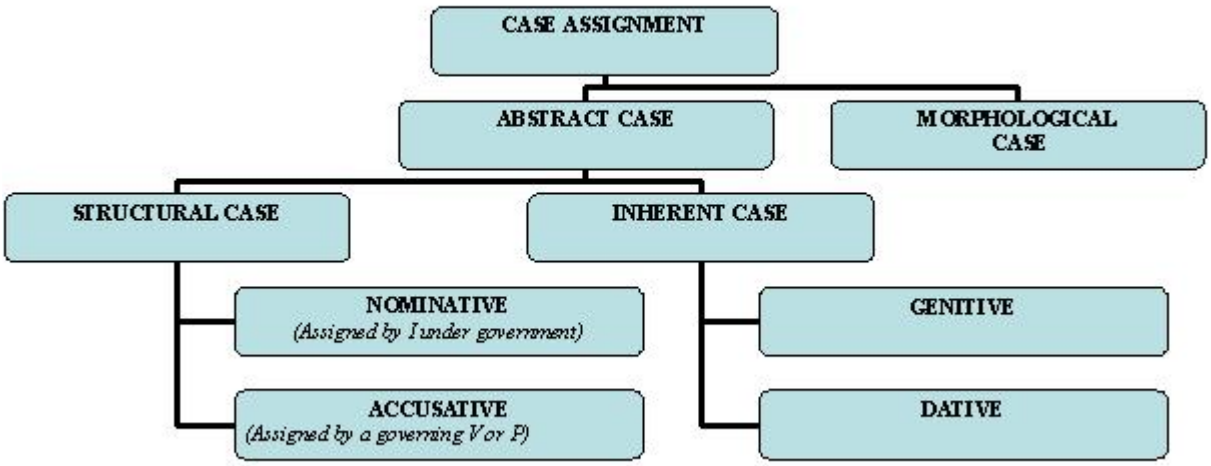

Figure II.4: Model of Case Assignment

marking and visibility condition are fulfilled at S-structure, and hence we are led to formulate a device for mapping the features ascribed at D-structure onto S-structure, namely *movement*. Basically, we shall have a look at two types of movement, which are NP- and WH-movement.

II.1.3 NP Movement

Let us analyze the syntactic structures of the sentence "The president was assassinated by a famous murderer." in order to have a description of NP movement and its characteristics.

(3) a. $[_{IP}\ e\ [_{I'}$ was $[_{VP}$ assassinated $[_{NP}$ the president] by a famous murderer]]]].

b. $[_{IP}\ [_{NP}$ The president$_i$ $[_{I'}$ was $[_{VP}$ assassinated $[e_i]$ by a famous murderer]]]].

The sentences (3a) and (3b) are D-structure and S-structure representations, respectively. In the first one NP 'the president,' which is the internal argument of the

verb 'assassinate', is in the object position. However, it must go out of the VP so as to have case assigned and become visible since the passive verb cannot assign the structural accusative case in the VP-internal position. On one hand, if it moves to [Spec, IP] (Spec of IP) position, it cannot receive its internal θ-role, but on the other hand the problem of θ-marking cannot be solved even if it stays inside due to its invisibility. Thus, somehow we need to keep both of these representations to obey the structure preserving property (i.e., the θ-criterion and Projection principle should equally be taken into consideration at both levels). As we notice in the S-structure of the above sentence (ii), there remains an empty position [e] (trace) created by the NP that has vacated its VP-internal position and the link between D-and S-structure (chain) is preserved with the help of coindexation [e_i]. The element that has moved is called the antecedent of the trace. To put it more clearly, e stands for the vacant position left by the moved element, which is also called trace, described as "an empty category which encodes the base-position of a moved constituent", chain is defined as "the sequence of two positions"— the vacant position and the position to which element is moved—, and lastly, coindexation is a means of marking two positions as part of a chain (Haegeman, 1994, p. 190). Haegeman (1994) summarizes the characteristics of NP-movement as follows (p.315): NP-movement is case-driven; it must move in order not to violate case-filter, the landing site of movement is empty position; landing site is an NP and A-position. θ-role is assigned at the *foot* of the chain, which is the lowest position; no θ-role is assigned to the landing site of movement and it is therefore called a θ-position. Also, case is assigned at this position to the head of the chain, which is the highest position. Both θ-role and case are assigned only once. Movement results in a trace and a chain is formed via the coindexation of the trace with the antecedent. The coindexed

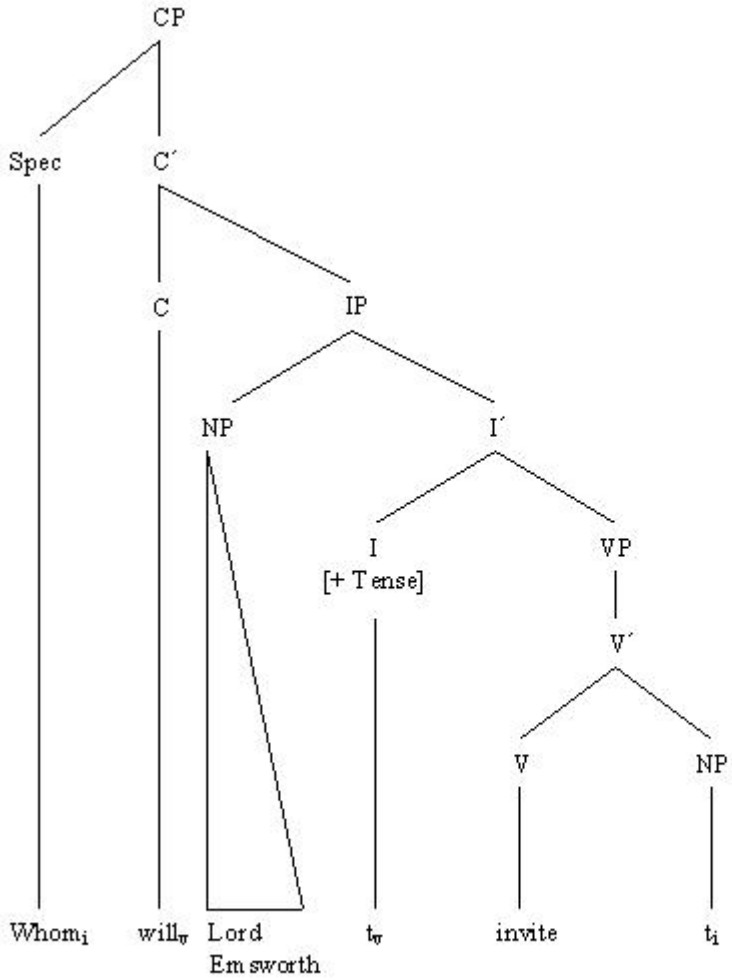

Figure II.5: D-structure of 'Whom will Lord Emsworth invite?'

trace is a non-pronominal anaphor and controlled by the Principle A of the binding theory, which we will explore below. The *head* of a chain is an A-position so the chain is called *A-chain*.

II.1.4 WH Movement

The typical structures where wh-movement is observed are interrogative sentences and RCs. In non-embedded interrogative sentences first the auxiliary moves to the position

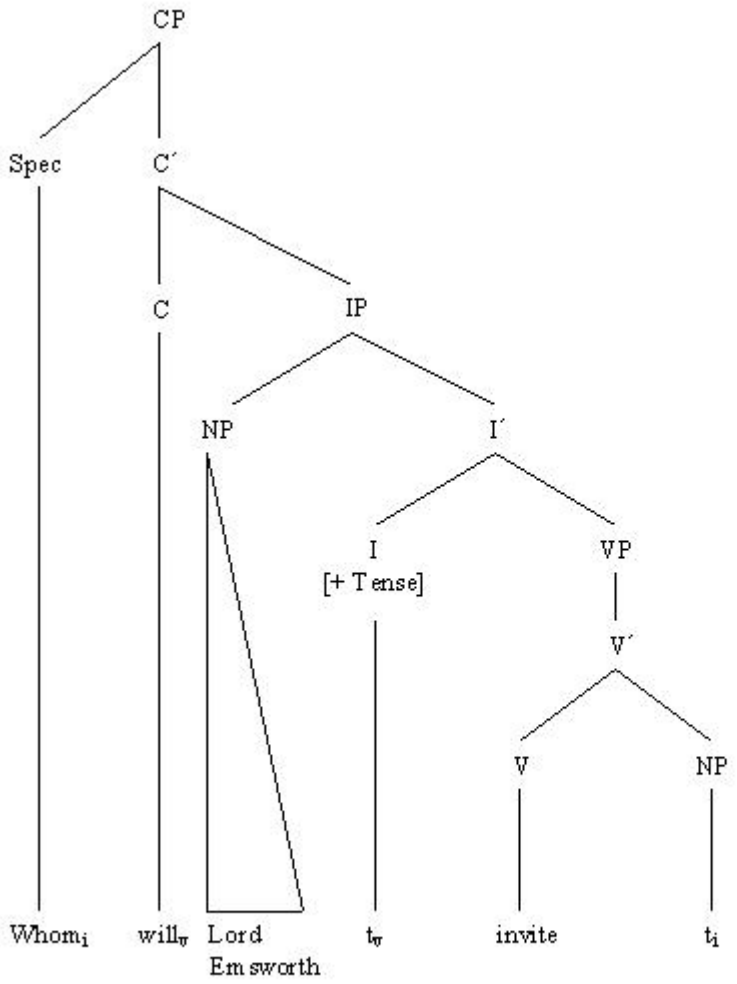

Figure II.6: S-structure of 'Whom will Lord Emsworth invite?'

headed by C and then the wh-phrase moves to the sentence initial position. It is this second movement, which leaves a trace at the vacated position, just like it does in the NP movement. To illustrate, let us look at the D-and S-structure (FigureII.5 and II.6)of the following sentence:[3]

(4) Whom will Lord Emsworth invite?

On the other hand, different from non-embedded questions, which are subjected to short movement,[4] wh-word in embedded questions moves beyond its own clause and is subjected to long movement. Auxiliary sits in situ in long movement rather than moving to the C position as in the short movement:

(5) Whom do you think that Lord Emsworth invite?

Another property to be touched on in this section is that the moved elements are not restricted to NPs only but can be Adverb Phrase, PP, or an AP, i.e. either an argument of the verb or an adjunct depending on the θ-role assigned to it (Haegeman, 1994, p.373). NP (6a-c); Adverb Phrase (6d-f); PP (6g-h); AP (6j):

(6) a. [What] do you do?

b. [Which movie] did you see?

c. [Whose book] have you borrowed?

d. [Where] will you stay on your holiday?

[3] Examples and figures in this subsection are due to (Haegeman, 1994, p. 372 and 377)

[4] Short and long movement terms are defined with respect to the movement site. That is, if a wh-element moves to the [Spec, CP] position in its own clause it is said to apply short movement whereas if it moves to the [Spec, CP] of a higher clause long movement is applied (Haegeman, 1994, p. 378).

e. [When] will you meet?

f. [Why] do you have to stay home?

g. [To whom] did you talk on the phone?

h. [At which] hotel are you going stay?

i. [How] does he play the piano?

j. [How long] will you stay there?

Summarizing, A'-position is not reserved for any specific category so the elements of different categories do not occupy the place of a fixed category. Instead, [Spec, CP] position is ready to accept any category for which the wh-constituent is labeled. That is, we can take wh-phrase as substituting for an unoccupied position (Haegeman, 1994, p. 382). Wh-movement can also apply another strategy called adjunction, which we shall leave aside in this thesis.

Recall that we have defined A-positions as the positions where GFs are realized and that the movement from one θ-position to another is called A-movement. What if the movement occurs to a non-θ-position? Let us analyze an example in which the constituent moves to a non-A-position:

(7) a. I wonder [who [Jane loves t]

b. I wonder [Jane loves who]

As represented in D-structure position (7b), before movement takes place the V assigns object θ-role to the wh-word *who*, which moves to the [Spec, CP] position rather than to an A-position. Thus, the landing site of wh-movement is different from

Table II.1: Features of Transformations

MOVEMENT	CHAIN	ANTECEDENT	TRACE
NP-Movement A-movement	A-chain	+Case	-Case
WH-Movement	A'-chain	-Case	+Case

that of NP-movement in that the latter moves to an A-position whereas the former moves to a position called A'-position.

Here a question arises as to whether wh-constituent has to be visible in order to be θ-marked at D-structure. Remember that the passive verb do not have the capacity to assign structural case and that NPs have to move to a place where they can be θ-marked; on the contrary, wh-traces are visible on the grounds that they are assigned case. That is why they are permitted to move to a position where no θ-role assignment takes place. Thus, GB states that both movements are implemented from the same position: "if it is Case-marked, then NP-movement should not apply, and if it is not Case-marked, then wh-movement should not apply..." (Chomsky, 1981, p. 178).

The differences between NP-movement and WH-movement are summarized in Table II.1.

We have noted that bounding theory determines the distance of a moved element; that is, it specifies the bounding nodes for transformations. Movements apply in cyclic fashion, which means that in order for a constituent to move to the highest position it must follow a path including vacant landing sites at intermediate levels, which serve as ports to pause. However, as the ports are pre-determined, traces should follow the rules of bounding stating that movement is carried out in *successive cycles*. This property of movement gives rise to *subjacency condition*, which formulates that wh-movement can cross at most one bounding node consisting IP and NP. Haegeman (1994) gives the

following examples to (a) illustrate successive cyclic characteristic of transformations (p. 403)[5] and (b) the violation of subjacency condition (p. 408):[6]

(8) a. [$_{CP1}$ How$_i$ did [$_{IP1}$ you say [$_{CP2}$ t_i that [$_{IP2}$ Jeeves thinks [$_{CP3}$ t_i that [$_{IP3}$ Lord Emsworth will solve this problem t_i]]]]]]?

b. * [$_{NP}$ the man [whom$_i$ [$_{IP\#}$ Emsworth made [$_{NP\#}$ the claim [t'_i that [$_{IP}$ he will invite t_i]]]]]]

Whether subjacency is a universal characteristic or not had been a question under debate due to some examples of grammatical sentences in certain languages such as Italian. Rizzi (1982) (as cited by Haegeman (1994, p. 412)) proposed that subjacency condition is universal and that the dissociation between languages results from the fact that the bounding nodes that violate subjacency may differ in each language such that while in English crossing NP and IP would violate the subjacency condition, in Italian NP and CP do so. Thus, subjacency is seen as a parameter set differently in each language, and later we shall see that it is a useful indicator of whether or not movement takes place in a construction.

II.1.5 Binding

The Binding Theory is the part of grammar which arranges the rules for the correct interpretation of NPs such as pronouns, anaphors, and R-expressions. To properly characterize the binding condition for each of these NP types, let us have a look at how we interpret them in the following sentences:

[5] In (8a) the wh-element (how) moves to the sentence initial position in three steps: first it moves to [Spec,CP3], then to [Spec,CP2], and then to [Spec,CP1]

[6] In (8b) the wh-word (whom) moves to clause initial position violating the subjacency condition (i.e., crossing two bounding nodes which are marked by #).

(9) a. Jane believes her.

b. Jane knows that John believes her.

c. Jane loves herself.

d. Jill and Jim love each other.

e. Jill invited her friends to her wedding.

Regarding the sentences (a) and (b) above, we can easily assert that in (a) the pronoun 'her' cannot refer to the agent of the verb, which is Jane, while in (b) the pronoun 'her' might refer to Jane. Without any information about binding, it may be formulated that the pronoun in (a) and its possible antecedent are both situated within the same clause whereas in (b) the pronoun occurs in a different clause than the antecedent. This finding leads us to state that a pronoun cannot be bound within the same clause.

The reflexive 'herself' in (c) and reciprocal 'each other' in (d) are called *anaphors* and they are different from pronouns in that they must be bound in the same clause. That is, we need to have their antecedent inside the clause so that we can correctly interpret them.

The last sentence (e) includes two NPs 'Jill' and 'her friends' that are interpretable without any antecedent. That is, they are chosen from the universe of discourse and called referential expressions (*R-expressions*), namely the expressions that inherently have the characteristic of referentiality and hence unbound at all times.

To restate the binding conditions for the NPs above using the GB terminology it is necessary to specify the features of NPs and define some related concepts (Haegeman,

1994, pp. 240-241):

- **Anaphors:** [+ Anaphor, -Pronominal]
- **Pronouns:** [- Anaphor, +Pronominal]
- **R-expressions:** [- Anaphor, -Pronominal]

II.1.5.1 A-binding

(10) X A-binds Y iff

(i) X is an A-position;

(ii) X c-commands Y;

(iii) X and Y are coindexed.

II.1.5.2 Governing Category

The minimal domain[7] containing X, its governor and an accessible subject/SUBJECT constitute the Governing Category for X.

II.1.5.3 Subject/SUBJECT

Subject is the NP in [Spec,XP] and SUBJECT is finite AGR.

II.1.5.4 Accessible Subject/SUBJECT

X is an accessible Subject/SUBJECT for Y if the coindexation of X and Y does not violate any grammatical principles.

[7] Governing category is considered to be the binding domain, which is defined as the domain in which reflexives are bound by an NP in an A-position. Take the sentence "Bertie hurt himself" as an example, "...the reflexive element himself must be bound by the subject NP Bertie" (Haegeman, 1994, p.206). As for the minimal domain, let "a" be a constituent including "b,c, and d" the minimal domain for "d" is "a" including "b and c".

II.1.5.5 Binding Theory

- **Principle A:** An NP with the feature [+Anaphor] must be bound in its governing category.
- **Principle B:** An NP with the feature [+Pronominal] must be free in its governing category.
- **Principle C:** R-expressions must be free everywhere.

II.1.6 Null Elements

So far we have defined two types of non-overt NPs (*null elements*), NP-trace and Wh-trace, and it is useful to define another type of zero element called PRO and list the differences between trace and PRO. Haegeman (1994) gives the following examples to illustrate each type of null elements (p. 433):

- **PRO:** John$_i$ would prefer very much [PRO$_i$ to invite Bill].
- **NP-trace:** [$_{IP}$ Bill$_i$ will be invited t_i].
- **WH-trace:** [$_{CP}$ Whom$_i$ would [$_{IP}$ John prefer [$_{CP}$ t'_i for [$_{IP}$ us to invite t_i]]]]?

All of the null elements have an NP antecedent at S-structure: PRO is coindexed with John, NP-and WH-trace is coindexed with Bill and John, respectively. However, there are some properties leading us to identify whether a null element is a PRO or a trace (Chomsky, 1981, p. 56). Firstly, trace is governed but PRO is ungoverned. Secondly, while the antecedent of trace is not in a θ-position and hence both trace and antecedent share a θ-role, the antecedent of PRO has an independent θ-role. Lastly, the antecedent-trace relation should obey the subjacency condition; on the contrary,

Table II.2: Typology of NPs and Binding Conditions

TYPE	OVERT	NON-OVERT	BINDING PRINCIPLE
[+Anaphor,-Pronominal]	Anaphors	NP-trace	Principle A
[-Anaphor,+Pronominal]	Pronouns	?	Principle B
[-Anaphor,-Pronominal]	R-Expressions	WH-trace	Principle C
[+Anaphor,+Pronominal]	—	PRO	Principle A&B

antecedent-PRO relation does not have to do so. As for the binding conditions, since NP-trace and PRO both share the [+ Anaphor] property they should follow Principle A of binding condition, different from Wh-trace obeying Principle C. PRO is additionally subject to Principle B as it has [+Pronominal] feature.

Haegeman (1994) comes up with a chart defining the typology of NPs (p. 436), which we shall copy in TableII.2 adding the binding conditions for each type.

Remember that NPs are licensed through visibility, which is satisfied via assignment of abstract case. Similarly, it can be stated that PRO must be ungoverned so that it can be licensed. On the other hand, traces need to fulfill a special kind of government condition in order to be licensed. The licensing condition for traces is formulated under the Empty Category Principle (p. 442):

(11) **Empty Category Principle (ECP)**

(i) Traces must be properly governed.

(ii) A properly governs B iff A θ-governs B or A antecedent-governs B.

(iii) A θ-governs B iff A governs B and A θ-marks B.

(iv) A antecedent-governs B iff A governs B and A is coindexed with B.

II.1.7 Relative Clauses

In this section, sticking to the terms and features relevant to our purposes, we shall point out general properties of RCs in brief. First of all, a RC construction is composed of a complex NP in which the head noun is modified by a clause (CP). Haegeman (1994) gives the following sentence as an example (p.406):[8]

(12) I know [$_{NP}$ the man [$_{CP}$ whom [$_{IP}$ Emsworth will invite]]].

Since there is a tensed auxiliary (will) and a subject NP, the RC is taken to be an IP, following a relative pronoun whom. Here, the relative pronoun is in [Spec, CP] position since it is a maximal projection[9] and the C position can only be occupied by heads. As far as the verb is concerned, invite requires an internal argument and since no overt element is present it is assumed that the verb is followed by a trace, having "whom as its antecedent". The S-structure and D-structure of the RC in the sentence above are given in (13a) and (13b), respectively:

(13) a. [$_{CP}$ whom$_i$ [$_{IP}$ Emsworth will invite t_i]]]?

b. [$_{CP}$ [$_{IP}$ Emsworth will [$_{VP}$ invite whom]]]?

It is claimed that wh-movement is involved in the construction of RCs. Haegeman (1994) takes the subjacency condition as a diagnostic for wh-movement since this type of movement is always liable to subjacency condition. For instance, in the following sentence we witness the violation of subjacency condition:[10]

[8] All the examples in this section are due to Haegeman (1994)

[9] "According to X-bar theory, all phrases are headed by one head... The head of the projection is a zero projection (X_0). Heads are terminal nodes: they dominate words. X′ theory distinguishes two further levels of projection. Complements combine with X to form X′-projections [(iii)]; adjuncts combine with X′ to form X′ -projections [(ii)]. the specifier combines with the topmost X′ to form the maximal projection XP [where (i) XP –>Spec; X′ (ii) $X_{\prime}$–> X′;YP (iii) X′ –> X ;YP]" (Haegeman, 1994, p. 104-105).

[10] # shows the places where subjacency is violated.

(14) * [$_{NP}$ the man [whom$_i$ [$_{IP\#}$ Emsworth made [$_{NP\#}$ the claim [t'_i that [$_{IP}$ he will invite t_i]]]]]].

In some RC constructions, there is no overt wh-element. This leads us to the question as to what kind of an empty element in the RC could be. For instance, in (15) example the empty category e is governed by V, hence it cannot be PRO. Moreover, it cannot be a NP-trace since it is case-marked: *invite* is an active verb that case-marks the NP in the [NP,V$_\prime$] position. Thus, the claim that e is a wh-trace, whose antecedent is non-overt, remains to be considered.

(15) This is [$_{NP}$ the man [$_{CP1}$ that [$_{IP}$ John claims [$_{CP2}$ that [$_{IP}$ he will invite e]]]]]

Non-overt antecedent of the wh-trace is marked as OP (non-overt operator), which is similar to an overt wh-element in that it moves to [Spec,CP1] position from the VP-internal position. It moves through intermediate [Spec,CP2], leaving a trace t'_i in order not to violate subjacency condition:

(16) This is [$_{NP}$ the man [$_{CP1}$ OP_i that [$_{IP1}$ John claims [$_{CP2}$ t'_i that [$_{IP2}$ he will invite t_i]]]]].

In short, RCs are formed via wh-movement, which is concluded by the fact that they take into account the subjacency effects.[11] The wh-trace is not necessarily overt in all cases and non-overt wh-trace is represented by OP.

[11] There are also other types of RCs, which do not require wh-movement. However, the ones that we will deal with in this thesis are subject to wh-movement, and hence the others are irrelevant for our purposes.

II.2 Turkish

This section is organized in two subsections. In the first one, we shall give a brief overview of Turkish syntax, trying as much as we can to remain partial to any linguistic theory. The second half of this section shall be devoted to an overview of RC constructions in Turkish, which is one of the complex structures derived by movement transformations and laying suitable grounds to test Grodzinsky's (1989) TDH.

II.2.1 An Overview of Turkish

Turkish is an agglutinative language of the Altaic family. Due to this property, syntax and morphology does not appear readily as distinct packages as they do in, say, Germanic languages. Besides the encoding of grammatical categories such as case, agreement and tense, some syntactic constructions like relativization and passivization as well are rendered by suffixation to the root (Temürcü, 2001, p. 3):

(17) a. sokak -ta -ki -ler -in

street-LOC-REL-PLU-GEN

'of those who are on the street'

b. gör -ül -ebil -ir -sin

see-PASS-ABLE-AOR-2sg

'you can be seen.'

Turkish has a quite rich verbal morphology. Categories of tense, aspect and modality are realized through suffixation to the verbal stem. Subjects agree with verbs in number and person, where agreement is encoded also through verbal morphology. Agreement suffixes follow tense-aspect-modality suffixes as exemplified in:

Table II.3: Case System of Turkish.

CASE	REALIZATION	EXAMPLE
Nominative	Null	adam, araba, Ahmet.
Accusative	-(y)H	adamı, arabayı, Ahmet'i.
Dative	-(y)A	adama, arabaya, Ahmet'e.
Locative	-dA	adamda, arabada, Ahmet'de.
Ablative	-dAn	adamdan, arabadan, Ahmet'den
Instrumental	-(y)lA	adamla, arabayla, Ahmet'le.
Genitive	-(n)Hn	adamın, arabanın, Ahmet'in.

(18) git-meli-ydik

go-NECC-PAST.1PL

'We should have gone'

Turkish has an overt case system. Most of the Turkish linguists agree that there are seven cases in Turkish (but see (Göçmen, Şehitoğlu, and Bozşahin, 1995, note 1, p. 4), which are listed together with their surface realizations and examples in Table II.3.[12]

As for the head parameter, Turkish is consistently head-final (Sezer, 1991, p. 8), meaning that heads consistently follow their complements. Following from this property, Turkish has postpositions, and nominal modifiers such as RCs, adjectives, demonstratives etc., precede their head nouns.

Possessive constructions and complementation are worth considering in this overview for they are syntactically and morphologically similar to a certain kind of RC construction, the topic of the next section. In possessive constructions, possessor NP is marked by genitive case where possessed NP bares a possessive marker marking the agreement with the possessor in person like in:

[12] Underspecified archiphonemes (represented by capital letters) designate the segments that are liable to some phonological processes. Consonants in parentheses are realized only after a vowel.

(19) a. Adam-ın kıtab-ı

man-GEN book-POSS.3sg

'The man's book.'

b. Ben-im kedi-m.

I-Gen cat-POSS.1sg

'My cat.'

The morpheme used for complementization in Turkish is -DIK. The subject of a complement phrase is marked with genitive case, and the verb of the phrase agrees with the subject in person and optionally in number.[13] Agreement is overt and maintained via verbal morphology following -DIK. In the below example, complement phrase is demarcated by brackets and parentheses around the plural morpheme designate optionality.[14]

(20) Ahmet [çocuk-lar-ın Ayşe-yi sev-dik-(ler)-i]-ni bil-iyor.

Ahmet child-PL-GEN Ayşe-ACC love-DIK-(PL)-3-ACC know-PROG

'Ahmet knows that the children love Ayşe.'

Turkish has a flexible word order, where the most frequent word order is SOV. As long as the object bares the accusative marking, all permutations are possible:

(21) a. Adam kitab-ı oku-du.

man book-ACC read-PAST

'The man read the book'

b. Adam oku-du kitab-ı.

[13] See (Kornfilt, 2000, pp. 130-131), on the limitations to the optionality of number agreement morpheme.

[14] Note that when the plural suffix -lAr is dropped -dik is realized as -diğ.

c. Kitab-ı oku-du adam.

d. Kitab-ı adam oku-du.

e. Oku-du adam kitab-ı.

f. Oku-du kitab-ı adam.

Finally, supposedly due to the rich agreement morphology, Turkish subjects may be dropped unless they are required for contextual reasons, making Turkish a null subject language. When the subjects in (22a) are dropped, phonologically null subjects of the category pro are licensed by overt agreement following the corresponding verbs.[15]

(22) a. Ben Ahmet-in araba-yı sür-düğ-ü-nü gördüm.

I Ahmet-GEN car-ACC drive-DIK-3pl-ACC see-PAST-1sg

'I saw Ahmet driving the car.'

b. pro_i pro_j araba-yı sür-düğ-ü-nü$_j$ gördüm$_i$.

II.2.2 Turkish Relative Clauses

There are two distinct relativization strategies, resulting in two different types of RC constructions. They are subject relativization (-(y)An strategy, wa strategy) and non-subject relativization (-DIK strategy, ga strategy).[16] What is common in both types is that "the head nominal is preceded by a clause in which some noun phrase [which is coindexed with the head nominal] is missing" (Barker, Hankamer, and Moore, 1990, p. 22), and there is no overt wh-element. As most of the literature on Turkish RC constructions concentrate on the conditions under which a particular strategy is employed,

[15] For a detailed analysis of pro licensing in Turkish see (Kornfilt, 2000).

[16] The terms wa and ga strategy are due to (Barker, Hankamer, and Moore, 1990).

in this short review, we will consider some accounts of Turkish RC constructions mainly around this issue.[17]

The simplest way to visualize Turkish RC constructions is to think of them as derived from an underlying sentence. For instance, let us take (23):

(23) Çocuk okul-a gid-er.

child school-DAT go-AOR

'The child goes to school'

When we are to relativize the non-subject NP okula from this sentence, -DIK morpheme is used as a complementizer, the subject *çocuk* is marked with genitive case and the complementizer is followed by a possessive suffix marking the agreement with the subject just like in a possessive construction (see above). The resulting construction is a simple RC and given in (24).

(24) [$_{RC}$ Çocuğ-un e_i git-tiğ-i] okul$_i$.

child-GEN go-DıK-POSS.3sg school.

'The school that the child goes to.'

In (24), the missing NP —or the RC gap as Barker, Hankamer, and Moore (1990) calls it— okul is the object of the matrix (top-level) verb of the RC,[18] and is designated by 'e' coindexed with the head nominal,[19] and the RC is demarcated by brackets.

On the other hand, when the relativized NP is the subject in the underlying sentence (and hence the gap is the subject of the RC matrix verb), complementization is carried

[17] Underhill (1972) seems to be the first author who attempted "to formulate the conditions under which these two [strategies] are used" (p 88). In his standard transformational approach, he used rule ordering to account for empirical facts. Since his account is outdated with subsequent work in generative grammar and shown to be empirically inadequate, we will not go into the details of it in this review.

[18] Whenever we speak of a gap as in a certain grammatical relation to the matrix verb of an RC, we mean the relation between the NP missing in RC and the matrix verb in the underlying sentence.

[19] Use of 'e' and coindexation is purely descriptive.

out by the morpheme -(y)An, and in this case no agreement morphology follows. In (25), the missing NP *çocuk* is designated by e_i.

(25) [$_{RC}$ e_i Okul-a gid-en] çocuk$_i$.

school-DAT go-(y)An child

'The child who goes to school.'

Then it follows that in simple RCs like 24 and (25) the appropriate morphological strategy is determined by the grammatical category of the missing NP. This description generalizes to more complex cases with slight modifications. When an NP embedded in a matrix constituent of the underlying sentence is relativized, what counts for the type of RC, or the choice of morphological strategy, is the grammatical category of the matrix constituent from which the relativized NP is extracted. Let us take (26) as an example for a non-subject RC (-DIK strategy):

(26) a. *pro*$_i$ [$_{C1}$ çocuğ-un okul-a git-tiğ-i-ni] gör-dük$_i$.

(we) child-GEN school-DAT go-DIK-3sg-ACC see-PAST.1pl

'We saw the child went to school.'

b. [$_{RC}$ *pro*$_i$ [$_{C1'}$ e$_j$ okul-a git-tiğ-i]-ni gör-düğ-ümüz$_i$] çocuk$_j$.

school-DAT go-DIK-3sg-ACC see-DIK-2pl child

'The child whom we saw going to the school'

In (26), although the missing NP is the subject in C1, we have a non-subject type RC, hence -DIK strategy, since C1 itself is a non-subject in the underlying sentence. As for a subject RC we give (27) as an example.

(27) a. [$_{C1}$ Müdür-ün öğretmen-i kov-acağ-ı] hemen duy-ul-du.

director-GEN teacher-ACC fire-FUT-3sg immediately hear-PASS-PAST

'It was immediately heard that the director was going to fire the teacher.'

b. [$_{RC}$ [$_{C1'}$ müdür-ün e_i kov-acağ-ı] hemen duy-ul-an] öğretmen$_i$.[20]

director-GEN fire-FUT-3sg immediately hear-PASS-(y)An teacher

'The teacher who (it) was heard immediately that the director was going to fire (him).'

In (27b) we have a subject type RC, hence -(y)An, although the missing NP *öğretmen* is the direct object in C1. Here again what counted for the type is C1 being the subject in the embedded sentence.

These descriptive generalizations are captured by Hankamer and Knecht's (1976) Mother Node Principle which says (as given in (Poole, 1992)):[21]

> If a subconstituent of a major constituent of the relative clause is relativized, the [morphological strategy] is chosen which would be appropriate for relativization of the major constituent itself. That is if the mother node dominating the [missing NP] is the subject of the relative clause, the -(y)An suffix is chosen; otherwise the -DIK suffix is chosen (p. 138).

Barker, Hankamer, and Moore (1990) attempt to characterize the distribution of relativization strategies through phrase structure relations. According to them the choice of the morphological strategy "depends on the structural relation between the gap [, i.e. the missing NP,] and the subject of the relative clause" (p21). This structural relation is called accessibility and defined as follows (p33):

(28) **Accessibility**

For two nodes x. y:

[21] Hankamer and Knecht (1976) also categorize subjectless sentences like impersonal passives and subject incorporation as using -(y)An strategy. However, we will not go into the details of such constructions since our primary concern in this thesis is basic RC.

(i) x commands y, iff x's mother dominates y.

(ii) x is accessible y iff x commands y and x does not dominate y.

In this account the choice of morphological strategy depends on the accessibility relation between the RC gap (the missing NP) and the RC subject. Speakers commit to -(y)An strategy in cases where the RC subject is not accessible to the gap and use -DIK otherwise.

The last study we will mention in this section is (Kornfilt, 2000).[22] Kornfilt addresses two questions concerning Turkish RC constructions in her paper. The first question is whether Turkish RCs are of phrasal form (e.g. deverbal adjectival phrase) or clausal form. In other words, are Turkish RCs like (29a) or (29b)?

(29) a. a running child.

b. a child who is running.

Kornfilt claims Turkish RCs to be of clausal form, i.e. like (29b). To support her claim she gives (30) (p124),

(30) [Her sabah ev-in-den okula arkadaşlarıyla koşan] bir çocuk.
every morning home-3sg-ABL school-DAT friend-PL-3sg-with run-(y)An a child
'A child who runs every early morning from his home to school with his friends.'

and notes that the same nominal modification cannot be made by construction (29a) in English, as the ungrammaticality of (31) shows.

(31) *an early every morning from his home to school with his friends running child.

[22] Kornfilt (2000) investigates three different classes of RCs: regular simple RCs, complex RCs, and non-subject relativization in constructions with expletive subjects. We are concerned here only with the first class of constructions.

She provides further support for her claim on the grounds that Turkish RCs "can host sentential ('speaker-oriented') adverbs, and that the nominalized verb can have modal suffixes" (p124) like in (15), which is a clausal property.

(32) Oya-nın heralde sev-e-me-diğ-i bir insan.

Oya-GEN probably love-ABıL-NEG-DıK-3sg a person

'A person whom Oya probably cannot love.'

Thus Kornfilt concludes that Turkish RC constructions are, from a structural point of view, clausal like in English. Kornfilt's conclusion is particularly important for our concerns in this thesis in that it makes the comparison of psycholinguistic data on English RCs and those on Turkish RCs meaningful.

Kornfilt argues that the difference between Turkish and English RCs is that an English RC has an overt wh-element whereas Turkish has an empty operator corresponding to it. The movement of this phonologically null operator leaves a phonologically empty bound variable (i.e. RC gap) in the modifying domain of an RC construction. Kornfilt bases her proposal about the underlying structure of Turkish RCs on subjacency[23] effects, and gives (33) as an example where these effects are observed (p125).

(33) *[Hasan-ın [[e_i geçen yaz e_j ben-i gör-en] kişi-leri]-i tanı-dığ-ı] ada$_j$.

Hasan-GEN last summer I-ACC see-(y)An person-PL-ACC know-DIK-3sg island

Intended reading: 'The island (such that) Hasan knows the people who saw me (on it) last summer.'

According to Kornfilt the fact that (33) fails to deliver the intended reading can be explained by attributing it the structure in (34).

[23] Recall from the previous section that subjacency condition requires that "movement cannot cross more than one bounding node, where bounding nodes are IP and NP." (Haegeman, 1994, p. 402)

(34) *[$_{CP}$ Op_j [$_{IP}$ Hasan-ın [$_{DP}$ [$_{CP}$ Op_i [$_{IP}$ e_i geçen yaz e_j ben-i gör-en]] kişi-leri]-i tanı-dığ-ı]] ada$_j$.

Example (34) demonstrates that the first operator Op_i has moved to [Spec,CP] leaving behind the gap e_i. Now as the nearest [Spec,CP] position is occupied by Op_i, the second operator Op_j has to move to the further [Spec,CP] position violating the subjacency condition. Having such an operator-variable structure, as Kornfilt notes (p127), provides further support for the claim that Turkish RCs are genuine clauses like their English counterparts.

The second aim of Kornfilt's(2000) paper is to offer an explanatory account of the distribution of morphological strategies of relativization in Turkish. Kornfilt uses a generalized version of Binding Condition B and the fact that Turkish is a null subject language (see above) in her account.

Kornfilt argues that the key point in the choice of relativization strategy "is not the morphology of [complementation] per se, but rather whether there is overt agreement morphology present or not" (p128). This observation is significant in connection with a generalized version of the Condition B of the Binding Theory which is as follows:

(35) A pronoun must be (A′-) free in the smallest Complete Functional Complex (CFC) which contains it.

This condition predicts the ungrammaticality of the presence of a resumptive pronoun[24] in (36) (Kornfilt, 2000, p. 129), since the resumptive pronoun o is bound by Op_i in a domain (CP) where it should be free according to (35).

[24] Resumptive pronouns are those that refer to the relativized NP in a RC.

(36) [$_{CP}$ Op_i [(*o$_i$) ada-da ben-i gör-en]] kişi.

(*he) island-LOC I-ACC see-(y)An person

'The person$_i$ who$_i$ (*he_i) saw me on the island.'

Similarly, a subject RC in which overt agreement is present is ruled out by (35). Recall from the previous section that whenever there is an overt agreement in a clause a phonologically null subject *pro* is licensed since Turkish is a null subject language, and this *pro* would be bound by the abstract operator of the RC violating (35). This hypothetical situation is illustrated in (37).

(37) [Op_i [*pro_i Adam-ı sev-en]] kadın.

man-ACC love-(y)An woman

In actuality the pro_i in (37) is not licensed[25] since -(y)An strategy has no overt agreement. Thus the choice of a strategy with bare agreement morphology for subject RCs is explained resorting to binding condition (35) and *pro* licensing.

In this chapter, we have outlined some of the crucial notions and concepts in GB-theory, which would enable us to follow the rules and concepts adopted by TDH or TBA. Then, we have provided some features of Turkish language in general and reviewed some accounts made about RC constructions in Turkish since RCs provide an appropriate setting to evaluate TDH. The next chapter is devoted to the exposition of some background on the relationship between brain and language and language acquisition, and the details of the accounts put to the test in this thesis.

[25] Remember again that we have been provided with Empty category principle (ECP), which was formulated to account for a licensing condition for traces, "i.e. legitimated in certain positions."

CHAPTER III

BACKGROUND

The main purpose in this chapter is to give background information about the main topics of this thesis. The chapter is organized in two sections: the first section is devoted to aphasia research in general and more specifically the first hypotheses to be tested, namely Grodzinsky's (1989) *Trace Deletion Hypothesis*(henceforth, *TDH*) and (1995) *Trace Based Account*(henceforth, *TBA*); the second section deals with some aspects of language acquisition and the next theory to be questioned, which is Jakobson's(1971) *Regression Hypothesis*.

III.1 Aphasia

In this section we aim to provide a historical review of aphasia research until present. Our main focus will be on Broca's aphasia. We shall summarize different points of view about the relationship between brain and language. Then, we shall focus on various theories advanced to account for the features of syntactic deficit in Broca's aphasia. Particular attention will be given to Grodzinsky's *TDH* and *TBA*.

III.1.1 Historical Background

Caplan (1987) reviews two distinct camps, namely *localizationist*s and *holist*s, subscribed to different points of view on the relationship between brain and language. While the former held that language was processed via the functioning of centers and connections among them, the latter maintained that rather than specific centers, the entire brain was at work in order to carry out the individual tasks of language processing. These accounts opposed each other in modeling different aspects of function. That is, the *localizationist camp* dealt with the fundamental acts of language use, i.e. speaking, listening, repetition, naming, and reading, without taking into consideration psychological phenomena such as attention and motivation, whereas the *holist*s regarded these psychological aspects as crucial to be modeled. Among the accounts that will be outlined, in terms of the historical development, *connectionism* and *process models* can be considered as *localizationist* in contrast to the *hierarchical* and *global models* pursuing the *holist* point of view.

III.1.1.1 Connectionist Models

It was the second half of the nineteenth century when the first works on the localization of language emerged with Paul Broca's presentation claiming that "faculty of articulate language" resided in the foot of the third frontal gyrus of the left hemisphere. The reason why he referred only to the articulatory function of language ability was that his patient, whose brain was analyzed after the autopsy, had had no problems either with receptive abilities or non-linguistic communication while producing very little verbal output. After this first clinical case of "*aphemia*", the term coined by Broca, he

presented eight more similar cases, which led him to conclude that the functions of two cerebral hemispheres were different from each other and that it was the left hemisphere that was responsible for language production.

Another significant theory of language disorders was brought about by Carl Wernicke in 1874 stating that different activities were performed by different regions of the brain and that lesions in different sites caused various abilities to cease to function. Actually, he is considered to be the founder of *connectionist models*. Upon analyses of autopsied brains, Wernicke concluded that a stroke located in "the region of the first temporal gyrus on the left, occupying approximately the middle third of the gyrus and extending posteriorly towards the parietal lobe" (Caplan, 1987, p.51) caused problems in spoken language comprehension and that a lesion in the first temporal gyrus may result in a disorder including not only the receptive systems but also the expressive ones. That is, he was the first to describe a path lying between Broca's and Wernicke's areas, which reasonably led to another type of aphasia. So according to his model, the gray matter around the Sylvian fissure was divided into two function poles, namely temporal and frontal portions, responsible for auditory-sensory and motor-speech mechanisms, respectively. In the same way, he suggested that language ability was composed of major functions such as comprehension, speaking, writing, listening, naming, and reading, etc. each of which was represented in one or more centers as well as the pathways between them, which constituted the roots of *connectionist theory* in which each psycholinguistic function was considered as a unique entity controlled by cerebral centers interacting with each other.

Also crucial to indicate among the classical models of language disorders is Lichtheim's (1985) (as cited in (Caplan, 1987)) specification of all aphasic syndromes that was also

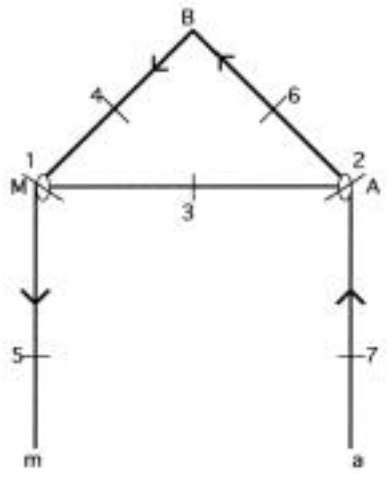

Figure III.1: Lichtheim's diagram of the language system. A, Wernicke's area; B, concept center; M, Broca's area; a –> A, auditory input to Wernicke's area; M –> m, motor output from Broca's area. A –> M, tract connecting Wernicke's and Broca's areas; A –> B, pathway essential for understanding spoken input; B –> M, pathway essential for meaningful verbal output. Lesions: at A, Wernicke's aphasia; at M, Broca's aphasia; a –> A, pure word deafness; M –> m, articulatory disorder (aphemia); A –> M, conduction aphasia; A –> B, transcortical sensory aphasia; B –> M, transcortical motor aphasia.

based on Wernicke's *connectionist model*. Lichtheim put special emphasis on the information flow between the centers and specified the kind of aphasia that would emerge in case of damage to links connecting the major areas. Figure III.1 summarizes his specification.

An example of symptom analysis based on Lichtheim's taxonomy was Geschwind's (1965) (as cited in (Caplan, 1987)) modern *connectionist* classification of aphasic syndromes according to which "the brain [made] use of duplicate or multiple mechanisms for accomplishing a task." (Caplan, 1987, p.74). Apart from Lichtheim's seven aphasia types, Geschwind proposed three more syndromes, which were anomic aphasia, global aphasia, and isolation of speech area. According to his classification, a patient with anomic aphasia presented difficulty only in naming the pictures and objects whereas in global aphasia the patient lost his ability in all language modalities, and lastly isolation

of speech area deprived the patient of speaking and understanding while leaving the repetition ability intact.

III.1.1.2 Hierarchical Models

Different from the *connectionist camp* viewing language as a composition of functions resided in or controlled by one or more centers all functioning simultaneously, *hierarchical models* considered language as the outcome of different levels functioning in succession. John Huglings Jackson (1874) (as cited in (Caplan, 1987)), one of the leading figures initiating the *hierarchical models* of behavior, claimed that functions were organized in such a way that they were ranked one above another along the dimension of complexity. For instance, some basic functions such as respiration, sleep, and cardiac rhythm were carried out automatically, intermediate functions such as response to pain required restricted level of complexity whereas higher level functions such as use of language were accomplished voluntarily without being bound to any stimulus (p.90). The most important aspect of his theory was that propositions composed of chunks expressing the relationship between events and objects, rather than words, were considered as the basic units of language. As Jackson proposed, receptive aspects of words and automatic parts of language were carried out by the non-dominant hemisphere whereas the dominant hemisphere took part in the expressive use of propositional language (Caplan, 1987, p.94). However, his account, as Caplan (1987) points out, lacked some important aspects of neurolinguistic theory as it did not include much information on the neural (anatomical) basis of language and thus provided no explanation for specific patterns of loss in language disorders (p.94).

In 1940s, following Jackson's approach, Roman Jakobson (1971) was the first to

draw attention to similarity between hierarchical manner of child language acquisition and function loss in aphasia. That is, he asserted that since each function was organized from basic to complex, the ones of the greatest complexity were lost first due to damage representing the reversed order of stages in language acquisition. However, his hypothesis was limited to phonetic inventory only, Caplan (1987) comments on it as follows: "[he] constructed a hierarchy of phonemic contrasts which reflected a basic principle -the tendency towards utilization of maximum contrasts first- and which is a major determinant of the nature of the phonemic inventories of the individual languages of the world." (p.97).

Another theory of hierarchical features of language was advanced by Jason Brown in 1980s. It was different from Jackson's in that it took into consideration the anatomical basis for the hierarchical organization of linguistic units. It established a link between the ontogenetic growth of the brain, ontogenetic order of acquisition of linguistic structures, on-line processing of linguistic tasks, and the symptoms of language disorders. In other words, ontogenesis of nervous system was reflected in the neural stages of language processing; simpler linguistic tasks were achieved by more primitive structures and more advanced neural structures undertook control of more complex ones.

III.1.1.3 Global Models

Global models, especially Goldstein's (1984) work, being affected by gestalt framework, tried to incorporate aphasic syndromes with general psychological factors. Goldstein (1984) regarded aphasia as the disorder of inner speech, which was caused by a disturbance in the functioning of other psychological components as a whole: "...it follows that every individual speech-performance is understandable only from the aspect of its

relation to the function of the total organism in its endeavor to realize itself as much as possible in the given situation." (Goldstein, 1984, p. 21), and hence it was called the "organismic view".

III.1.1.4 Process Models

Lastly, according to the *process models*, which was proposed by (Luria, 1947) (as cited in (Caplan, 1987)), language activities were comprised of a number of distinctive processing units, each of which was realized in a different brain region. On this view, although distinctive in terms of feature and location, all these components interacted with each other (acting in parallel and in series) in order to form complex psychological functions of language. Besides, Luria (1947) claimed that each specific region was also devoted to a non-linguistic function, underlying goal of which was quite similar in nature to the linguistic one. For instance, it was stated that because of the non-linguistic role of the frontal lobes, which was to control the ability to form plans and intentions, damage to this area would lead to the inability to initiate speech.

Thus, we have summarized the first hundred years of accounts in the field of brain-language relationship. As we proceeded we came up with two different camps, namely the *localizationists* and *holists*. The main difference between them is that the former believed that isolation of psycholinguistic functions was possible while the latter denied it. Yet both agreed that various simple functions worked together to make possible more complex ones. Another common feature of the theories above is that all of them were clinically derived and most of them were based on the qualitative nature of a patient's performance. Despite some lacking features, some of these theories, especially

Geschwind's (1965) model of aphasic syndromes, are still taken as the basis of diagnosis due to the simplicity they provide.

III.1.2 Linguistic Aphasiology

As opposed to the classical views of brain-language relationship, a new perspective called linguistic aphasiology emerged in the 1960s. What distinguished this new approach from the previous ones was that language was no more a body of activities such as listening, speaking, reading, but a rule-based system composed mainly of syntactic, phonological, and semantic levels. It established a powerful link between the linguistic theories of language structure and processing as well as cognitive and psycholinguistic aspects of language behavior. The analysis of brain damaged people has since been considered as a valuable source of information about the structure and processing of normal linguistic system.

III.1.2.1 Redefinition of Cerebral Centers

In accordance with this new perspective, Zurif (1980) presented the linguistic analysis of cerebral language centers. According to this redefinition of language centers, syntax was located in the anterior end — Broca's area and its vicinity — while Wernicke's area housed semantics. It was different from modality-based and classical localizationist accounts in that it proposed that language centers should not be defined according to linguistic activities, but according to linguistic structures. Yet, this point of view could also be identified as localizationist due to its attempt to associate each center with a specific linguistic feature. More importantly, Zurif stated that Broca's aphasics had not only production problems but also comprehension deficit. Thus, since Zurif's endeavor

to redefine the centers, more attention has been given to the specific nature of Broca's aphasia. At this point we shall briefly point out different hypotheses made about the characteristics of deficits in Broca's aphasia: *non-syntactic* and *syntactic accounts*.

III.1.2.2 Agrammatism as a non-syntactic Deficit

There have been non-syntactic accounts of agrammatic aphasia stating that the deficit is caused by phonological or lexical disorder. Kean (1977) claimed that phonological damage resulted in a problem in the processing of closed-class elements while Bradley, Garrett, and Zurif (1980) proposed that it was the lexical damage that caused disruptive use of those closed-class elements. Also, Schwartz, Saffran, and Marin (1980) and Grimshaw and Rosen (1990) claimed that comprehension deficit involved the lexical level where thematic role assignment took place. We shall not dwell on each view here since our main focus will be one of the accounts made within the boundary of the notion considering agrammatism as purely a syntactic deficit.

III.1.2.3 Agrammatism as a Syntactic Deficit

In purely syntactic description of agrammatic aphasia, both production and comprehension deficits are rooted in the syntactic processor. First of all, Caramazza and Zurif (1976) suggested that Broca's aphasics lacked 'syntactic-like algorithmic processes' and that these patients failed in comprehending semantically reversible RC constructions in which both of the actors can equally act as an agent as well as patient (e.g., 'The girl that the boy is pushing is tall', both the girl and the boy can push one another) compared to the non-reversible ones (e.g., 'The ball that the boy is kicking is red', only the boy can kick the ball whereas the reverse is semantically impossible). That is, when there was

no semantic or pragmatic hint to guess the thematic roles of the constituents (such as agent, patient, theme, goal, source, etc.), i.e. when agrammatic patients were left with syntactic cues only, they had difficulty assigning these roles correctly while performing at above chance level with non-reversible ones. Likewise, Caplan and Futter (1986) showed that agrammatic patients performed well in comprehending active sentences as well as reversible passive structures while they were disrupted in non-reversible passive sentences due to lack of semantic cues. What Caplan and Futter (1986) presented as a prima facie reason for this type of impairment was that "[the patient] attempt[ed] to interpret a simplified syntactic structure, consisting of linear sequence of lexical categories, according to a number of simple interpretive strategies"(p.117). According to this strategy, agrammatic patients "assign the thematic roles of agent, theme, and goal to N1, N2, and N3 in structures of the form N1 - V - N2 - N3, where N1 does not already bear a thematic role." (p. 128). Yet, they called on further research in order to specify whether this strategy is a part of "nonlinguistic or pre-linguistic strategies, or a residuum of basic English structure".

Besides, regarding the comprehension deficit in non-reversible passives, Schwartz, Saffran, and Marin (1980) found themselves in accord with Caplan and Futter (1986). Results revealed in other studies also tally with those presented by (Caplan and Futter, 1986), in that reversible and non-reversible active were understood at above chance level whereas non-reversible passive sentences were performed at chance level (Schwartz, Saffran, and Marin, 1980; Grodzinsky et al., 1988). More recently, Zurif and Pinango (1999) interpreted the consistency observed in Broca's aphasics' comprehension capacity as a matter of canonicity. That is, they had comprehension problems in non-canonical forms such as passives, object relatives, object clefts, etc., whereas they

showed normal comprehension of canonical structures, namely actives, subject RCs, and subject clefts (p.133). One important conclusion they came up with was that "whatever prevents Wernicke's patients from correctly assigning thematic roles in a sentence, it is not the same as the cause of agrammatism in Broca's aphasia." (note2, p.135).

III.1.3 Trace Deletion Hypothesis

One of the most significant consequences of the last account is that it has changed over the conception of aphasia as a modality-specific deficit to a more sound notion claiming that Broca's area and its vicinity is recruited for syntactic processing of all modalities. Although seemed reasonable, this point of view lacks well-founded linguistic analysis of this particular deficit in that it does not account for the reasons why these patients performed well in canonical structures while they failed to do so in non-canonical ones. One could base this deficit analysis upon non-linguistic factors such as limited buffer size and processing capacity as well as linguistic ones such as sentence complexity or lexical damage. Thus, there needs to be a better defined syntactic account of Broca's aphasia.

To this end, Grodzinsky (1989) proposed a new account of comprehension deficit in agrammatism, namely *TDH*. As the *TDH* suggests, the consistency that agrammatic Broca's patients show in comprehension might result from an absence of a feature, which is common to all non-canonical structures. As shown by Grodzinsky, this common feature is the application of movement transformations. That is, these patients have difficulty assigning thematic roles only to transformationally-derived structures. Building his account in the framework of Government and Binding Theory (Chomsky,

1981), Grodzinsky argued that since syntactic traces were deleted, Broca's patients could not assign correct theta roles to the NPs. Thus, the patient used a heuristic akin to the one offered by Caplan and Futter (1986), i.e. assign an agent role to the first NP without a theta role (Grodzinsky, 1986). To form this heuristic, Grodzinsky (1986) consulted the movement rules of Government and Binding Theory and concluded as follows (pp. 144-145):

(38) (a) Noun phrases in thematic positions have thematic roles assigned to them.

(b) A noun phrase in a non-thematic position can inherit the theta-role of a thematic position if it heads a chain that has a theta position as a member.

(c) Default Principle: A NP which has not been assigned a thematic role by (a) or (b) should be assigned a theta role according to a list which universally associates default values to positions.

(39) [The man]$_i$ was followed t_i by [the woman].

Default Agent Syntactic Agent

According to this account, for (39), the patient, being unaware of the thematic role assigned to the NP (the man) by the chain (following the rule b), applies the default strategy and comes up with an agent role. On the other hand, the other NP (the woman) is assigned an agent role according to the rule (a), i.e. "in a normal fashion by the preposition". Having two agents in this sentence, the agrammatic patient applies the default strategy by choosing one of the Agents without committing to any syntactic knowledge of traces. By this way, this strategy violates the rule of *Theta Criterion*, which states that each thematic role can be assigned only once.

III.1.3.1 Support for *TDH*

Some studies have been advanced in support of Grodzinsky's hypothesis. First of all, the *TDH* predicted that patients' ability to judge grammaticality for the sentences that included transformational movement would also be impaired, which was supported by Grodzinsky and Finkel (1998). They designed a study in which Broca's patients were asked to determine the plausibility of sentences including violations of movement as well as violations of other syntactic principles. More specifically, the conditions they tested are exemplified as follows (p. 285):

- **NP-movement:** It seems likely that John will win./*John seems that it is likely to win.
- **Wh-movement:** Which woman did David think John saw?/ *Which woman did David think that saw John?
- **Superiority:** I don't know who said what./ *I don't know what who saw.
- **Adjunct/Complement:** When did John do what?/ *What did John do when?
- **Filled Gaps:** Who did John see?/ * Who did John see Joe?
- **Bad Complement:** The children threw the football over the fence./ * The children sang the football over the fence.
- **Place of Auxiliary:** They could leave town./ * Have they could leave town?
- **Negation:** John hasn't left the office./ * John didn't have left the office./ *John sat not.

It was found that the patients performed well on most of the conditions such as filled gaps, bad complement, place of auxiliary, and negation, except for those requiring the detection of movement of phrasal constituents such as NP-movement, wh-movement, superiority, and adjunct/complement conditions. Thus, they concluded that their study was on a par with the *TDH* claiming that agrammatic patients had impaired ability to judge grammaticality of structures employing transformational movement.

Grodzinsky (2000) reports an experiment conducted on the comprehension patterns in Japanese agrammatic patients to highlight cross-linguistic validity of his theory. In particular, he describes the work of Hagiwara (1993) who tested whether different word orders affected the comprehension patterns in Broca's aphasics. He informed that in Japanese, apart from the unscrambled word order (SOV), which was taken as the basic word order, there was a scrambled one (OSV) and that movement transformation was applied in OSV. In this case, it was expected that the movement in the latter type of sentences would go undetected, thereby leading the patients to assign Agent θ-role twice and to apply the default strategy. Let us take the example illustrating the Japanese agrammatic patients' performance in structures involving movement transformations, as given in Grodzinsky (2000, p.8):

(40) **Active:**

a. *Non-scrambled (basic):*

Taro-ga Hanako-o nagutta (**above chance)**

Taro-NOM Hanako-ACC hit

'Taro hit Hanako'

b. *Scrambled (secondary):*

Hanakoi-o Taro-ga ti nagutta (**chance)**

(40′) a. S O V (**above chance)**

Agent Theme

b. O_i S t_i V (**chance)**

Agent Agent

As for the passive voice, Grodzinsky demonstrated that there were again two forms of structure: indirect and direct. Although they had passive inflection (-are) on the verb, the indirect passives were not derived by transformational movement but base-generated, while the direct passives were formed by movement transformation, and hence chance performance was anticipated in the direct passives.

(41) **Passive:**

a. *Direct (derived):*

Taro-ga$_i$ Hanako-ni t_i nag-rare-ta (**chance)**

Taro-NOM Hanako-by hit-PASS-PAST

'Taro was hit by Hanako'

b. *Indirect(not derived):*

Okaasan-ga musuko-ni kaze-o hik-are-ta (**above chance)**

Mother-NOM a son-by a cold-ACC catch-PASS-PAST

'Mother had (her) son catch a cold on her'

Grodzinsky (2000) finds further support for the *TDH* in real-time processing experiments. For instance, Swinney et al. (1984) (cited in Grodzinsky (2000)) proved that Broca's aphasics failed to show normal priming in constructions that involved

movement while they did better in other structures. They further pointed out that even though the link between the trace and its antecedent provided access to intact comprehension by reactivating the antecedent in the position of its trace in normal subjects, Broca's aphasics were impaired in this ability, which could be attributed to the possibility that they deleted the traces and thus there was no bridge between the trace and its antecedent.

(42) The priest enjoyed the drink (1) that the caterer was (2) serving t (3) to the guests.

Considering the example above, Grodzinsky (2000) maintains that "...if a target word, say, juice, is presented visually to the [normal] subjects at points (1), (2), or (3) when they are listening to the sentence, and the subjects have to make lexical decision on it, priming effects will be documented at (1) and (3) but not at (2)." (p. 11). However, in this study Broca's aphasics showed priming effects only at (1) due to the lack of reactivation of the antecedent at the trace level.

III.1.3.2 Challenges for *TDH*

Although the *TDH* has obtained significant support from different studies, a piece of incompatible data have also been available, some of which enforced the reformulation of Grodzinsky's thesis. Especially noteworthy is the account proposed by Hickok and Avrutin (1996), who tested the comprehension of agrammatic patients in the subject and object wh-questions. The results they attained provided some interesting information that accounted for the asymmetry in the structures derived by movement transformation. That is to say, the patients performed well in the structures which are

not discourse linked (D-linked) irrespective of whether they were in subject or object position.

(43) a. Which boy pushed the girl? (above chance)

b. Which boy did the girl push t? (chance)

c. Who pushed the girl? (above chance)

d. Who did the girl push t? (above chance)

There are two types of chains according to Pesetsky (1987): if a wh-phrase, like 'which,' must refer to sets pre-established in discourse, i.e."to members of a set that both speaker and hearer have in mind," it is called Discourse(D)-linked wh-phrase, and wh-phrases that do not refer to previous discourse are called non-discourse (D)-linked wh-phrases. Following the assumption that only non-D-linked wh-phrases are operators and they must occupy an Ā position at LF, Pesetsky claims that only non-D-linked wh-phrases can move at LF and are sensitive to subjacency, the ECP, and other movement conditions while D-linked wh-phrases are interpreted with the help of unselective binding as they are not counted as operators(Cinque, 1990). What Pesetsky calls D-linked is called referential in Cinque (1990) and "referentiality" is defined in as the ability to refer to specific members of a set in the mind of the speaker or pre-established in discourse.

Following Pesetsky, Cinque (1990) notes that only D-linked or referential phrases can involve in a binding relation both at S-structure and at LF while non-referential (non-D-linked) phrases can only include antecedent government relations. Thus, whether

a phrase should enter a government and binding chain is determined by its being referentiality.

As we emphasized earlier, the *TDH* predicts chance performance at (43b) and (43d). Following Pesetsky (1987), Hickok and Avrutin (1996) suggested that the comprehension of which-questions required contextual as well as syntactic and lexical information, which they claimed accounted for the results above. However, the question arouse as to whether the subjects did not need discourse-related information in (6a) as they performed at above chance level at this structure. At this point they took up the proposal made by Cinque (1990) stating that there were two types of movement relations, namely *government chains* and *binding chains*, and that the former was non-referential, i.e. not discourse-linked, while the latter was referential and needed contextual clues. Thus, they claimed that agrammatic patients could not access the *binding* chains, because they required contextual information apart from syntactic and lexical information, but their ability to comprehend *government* chains remained intact.

III.1.4 Trace Based Account

The distinction between *government* and *binding* chains led Grodzinsky (1995) to reformulate his previous theory and to come up with a revised strategy: *TBA*. The default strategy originated in the *TDH* changed into *Referential Strategy*, which was applicable to referential (D-linked) wh-words only. Thus, in structures which were formed by movement transformations, if the moved constituent was in the object position and referential (requiring contextual information), the patients failed to form the chain and showed deficit in the correct θ-role assignment (Balogh and Grodzinsky, 2000). The formulation of the *TBA* is given below (Grodzinsky, 1995, p. 80).

(44) *TBA*, (Grodzinsky, 1995):

a. *Trace Deletion*: traces in θ-positions are deleted from agrammatic representation.

b. *R(eferential) Strategy:* Assign a referential NP a role by its linear position if it has no θ-role.

III.1.5 More Challenges to *TDH*

Another attempt to refute the *TDH* was offered by Beretta and Munn (1998). They claimed that the default strategy in the *TDH* was not plausible since the task was prepared in such a way that forced the patients to make the wrong decision. Recall that the default strategy required patients to assign both NPs an agent role and randomly choose one of them. Berretta and Munn's concern was that none of the pictures in the standard picture-sentence matching experiments had two agents, Making the patients fail to comprehend the sentence properly. To fill this gap, they rearranged the activity and prepared the double-agent picture task instead of the standard pictures (Beretta and Munn, 1998, pp.406-409):

(45) [The giraffe]$_i$ was kicked t_i by the woman.

Default AGENT Syntactic AGENT (Agrammatic Representation)

The standard picture task included three pictures where the giraffe was kicking the woman, the giraffe was kicking a man, and the woman was kicking the giraffe. However, as there was no picture (with two agents) corresponding to the agrammatic representation, the patients, as they claimed, showed chance performance in this task.

In their version, on the other hand, there was one picture in which the giraffe and the dog were kicking the woman, another where the woman and the dog were kicking the giraffe, and the other picture showed the woman and the giraffe while kicking the dog. What they expected was that the impaired representation would incorrectly choose the third picture in which both the woman and the giraffe were in the agent position. Yet, the patients did not perform as they expected, and hence they concluded that the *TDH* was wrong. Beretta and Munn (1998) consider their design as the only convincing proposal having been provided to date so as to defeat the *TDH*.

However, the study apparently suffers from a number of limitations. Fist of all, not all of the sentences they present are reversible such as "The giraffe was shot by the boy" and "The boy was painted by the monkey". In real world, neither can a giraffe shot a boy nor can a monkey paint a boy and this would, consequently, mislead the patients. Also, rather than providing the patients with an opportunity to make the correct decision, the double-agent picture task creates more confusion as they include a third actor or a recipient in the picture although not mentioned at any point in the given sentence, e.g., there is a dog kicking either the woman or the giraffe or being kicked by both of them for the sentence "The giraffe was kicked by the woman." In a way, they force the patients not to choose the double-agent picture, quite ironically, ending up with what they try hard to refrain from. Moreover, also for the *TDH*, it would be rational to expect the patients not to choose the picture in which both the woman and the giraffe are agents kicking the dog since the *TDH* takes for granted on the part of the agrammatic listener the fact that only one of the participants must be the doer of the action, which in turn is why they apply the default strategy and choose an agent randomly. Lastly, and more importantly, the results they obtain from

the two-agent standard picture task (patients performing above chance level on actives while at chance level on passive sentences) are quite compatible with the data the *TDH* offers.

Caplan (1992), on the other hand, provided with results contradicting with the claim that only Broca's area and its vicinity housed specific syntactic processing of sentence comprehension. He compared the pattern of comprehension deficits in two groups of patients having left hemisphere damage alone. One of the patient groups had purely posterior lesion while the other group had both posterior and anterior lesion. The test sentences consisted of 25 different sentence types, namely structures with no referential dependencies, sentences with pronouns and reflexives, and sentences with empty noun phrases such as two-place passives, two-place cleft objects, three-place passives, subject RCs and object RCs. Performance was limited on the structures like passives and object RCs, which at first sight coincided with Grodzinsky's data; however, neither group performed better than the other, implying that comprehension deficit specific to certain structures was not only due to specific lesion site. Hence, Caplan (1992) concluded that patients with posterior lesions showed similar impairment to the patients with both posterior and anterior lesions in most of the structures including coindexation of traces and that the effect of lesions does not support the functional neuroanatomy of a particular syntactic structure. According to Caplan (1992), it is not as easy as Grodzinsky thought it to be to define how the brain represents and processes syntactic structures.

To conclude, considering the *TDH* as well as other works reviewed above, we can state that the *TDH* seems plausible for several reasons while it lacks a few important aspects. First of all, since it is based on purely syntactic account, it provides further

support for the claim that linguistic theory is the most useful tool to be used in aphasia research. Secondly, it looks consistent with the leading linguistic theories about how normal language works, i.e., how brain and language interact. It is persuasive to theorize that not the whole syntax is resided in one area and that syntax is also modular in itself. As for the limitations, to our knowledge, in none of Grodzinsky's works has it been made clear how the chance performance was statistically determined and which methods have been used in order to show certain structures were performed at or above chance level.

In this preceding section, we have outlined the theories about brain and language relationship in order to familiarize ourselves with the historical development of aphasia research and to have a wider perspective on the position that *TDH* and *TBA* occupy in this setting. Next, providing different views supporting or refuting *TDH* and *TBA*, we have analyzed the assertions made by Grodzinsky (1989;1995).

III.2 Language Acquisition

One of our aims in this thesis is to test whether there is any kind of similarities between how language is acquired and how it is lost. In order to investigate these issues, we shall first review research done into this area as well as into development of syntax, more specifically acquisition of RC, which would enable us to compare the nature of comprehension difficulties presented by children and agrammatic aphasics.

III.2.1 Similarities between Broca's Aphasics and Children

Considering the type of common difficulties experienced by children and agrammatic aphasics such as effortful and telegraphic speech, deletion of function words, problem-

atic sound patterns, and problems in producing and comprehending complex structures, it seems worth studying the nature of this similarity for it may reveal much about the brain-language relationship.[1]

The emergence of theories providing evidence in favor of the similarities between child language and agrammatic aphasic language is as early as Ribot's law, which was proposed in 1883 (Avrutin, 2000). According to this notion, what is learned last during language acquisition is prone to be lost first as a result of brain damage (p.296). For instance, it is difficult for a Broca's aphasic to produce and understand complex phonological and syntactic patterns, which appear at later stages in language development. Similarly, within the domain of phonology, Jakobson's (1971) regression hypothesis maintains that "aphasic regression has proved to be a mirror of the child's acquisition of speech sounds: it shows the child's development in reverse." (pp.240-241) He further argues that the similarity observed in phonemic patterns can also be extended to other modules of the grammatical system such as syntax.

A more recent study supporting the reverse organization of grammatical structures in aphasics as compared to child language development is (Grodzinsky, 1990). He argues that the parameter setting taking place in language acquisition proceeds from a more restrictive grammar to a freer one as the child develops from one stage to the next, whereas an agrammatic aphasic loses his command of linguistic structures just in the reverse order; i.e., from more permissible to more restricted structures. Besides, Grodzinsky and Reinhart (1993) demonstrated that the errors pertaining to restrictive nature of children's comprehension patterns were congruent with the impaired essence

[1] Although aphasic language resembles child language in many aspects, we will not deal with production element here as it is beyond the scope of this study.

of agrammatic patients. Their study illustrated that children as well as Broca's patients performed at chance level in understanding the pronouns bound by a referential NP (e.g. him is bound by Father bear in "Father bear washed him", which requires both syntactic and discourse-related operations, whereas they showed above chance performance in reflexives (e.g. "Father bear washed himself", and in pronouns bound by a quantifier (e.g. "Every bear washed him"), which requires syntactic operations only.

Moreover, it was demonstrated that children and agrammatic aphasics tended to fail in detecting errors in tense rather than agreement for the former required discourse operations as well as morphosyntactic ones (Avrutin, 1999). Avrutin (2000), different from Grodzinsky, relates the reversed similarities observed in child and aphasic language to the limited processing capacity, rather than acquisition or loss of syntactic structures. According to this view, for instance, the difficulty exhibited by Broca's patients and children in which-questions is due to the fact that, being D-linked (discourse-linked) structures requiring reference to "a set of presupposed objects to which Which-phrase could refer" (Avrutin, 2000, p. 300), they demand more processing capacity.

Thus, research has been mounting so as to support the similarities between child language and aphasic language. While some of them provide a syntactic account to explain the nature of the similarities, others explain it via the limited processing capacity. However, still more conclusive data should be gathered in order to describe the underlying cause of this parallelism. Having discussed that the sequence of loss in aphasic language exhibits the reversed course of language development in children, we now turn to characteristics of child language development in terms of acquisition of syntactic rules, especially acquisition of RCs, which constitutes the medium of comparison with Broca's aphasics in this thesis.

III.2.2 Acquisition of Syntax

The widely-held assumption in generative tradition is that children acquire their native language applying the principles and constraints of *Universal Grammar (UG)*, which is described as " biological properties that are genetically-determined and characteristic of human species... These properties determine the kinds of cognitive systems, language among them, that can develop in the human mind." (p. 28) According to the *UG theory*, principles of *UG* are restrictive enough to be shared by all possible grammars and parameters are left open so that they can be filled through experience. Since phrase structure rules act as a basis of sentence formation and are considered one of the restricted characteristics of all languages (principles), a question arises as to whether children are equipped with the knowledge of these rules. This is also crucial for the evaluation of Grodzinsky's (1995) *TDH* and (1995) *TBA*. That is, if agrammatic comprehension of structures with transformational movement lacked the information (correct θ-role assignment) carried via the so-called traces, it would mean that aphasic language did not have the full possession or attainment of phrase structure rules. Furthermore, if regression hypothesis was correct, then the child language could also be said to lack traces at early ages.

While some theories suggest that children's early utterances can be explained in terms of semantic relations such as agent-action "Daddy go", action-object "kick ball", agent-object "Jimmy car", and modifier-head "some water"; others propose that child language refers to syntactic relations such as subject, object, noun phrase, and prepositional phrase (Crain and Lillo-Martin, 1999). According to theories rejecting that children have the knowledge of phrase structure rules, semantic notions such as agent

or patient are considered easier than the syntactic ones, and a child cannot attain the knowledge of tree structures (or X-bar theory) until they are capable of producing complex utterances. That is to say, the child acquires semantics before syntax. They assume that children bring social and cognitive abilities, rather than innate linguistic capacity, into the language-learning task, and semantic information is part of the cognitive categories, which are used in any type of learning.

On the other hand, it is suggested that knowledge of phrase structure is one of the pre-wired concepts that children innately possess and hence they are ready to encounter such syntactic notions even at an early age. Golinkoff and Hirsh-Pasek (1996) summarizes this approach as follows:

> These theorists presuppose that the child come to the language-learning task with the ability to segment the linguistic stream, find word classes and grammatical categories, conduct phrase structure analyses, and set parameters. What interests these theorists is (1) exactly what principles and parameters children begin with and (2) what constitutes the "primary linguistic data" (Chomsky, 1988) for setting the switches of the parameters (p.33).

Besides, there has been some evidence in favor of the existence of phrase structure rules in the child's early grammar. For instance, children use determiners, adjectives, and prepositions always in the correct order and never produce utterances like "the that room" (Crain and Lillo-Martin, 1999). Also, it was found that they were aware of the fact that determiners could only be used with nouns rather than pronouns; indefinite article "a" could be used with singular nouns, or the pronoun "it" cannot be substituted for plural nouns (Crain and Lillo-Martin, 1999).

Different from both approaches, Bloom (1993) suggests that linguistic development takes place not as a part of cognitive development but as a distinct and complex progress. This does not entail a priori knowledge brought by the child but, as she

claims, acquiring a language is a bottom-up process, which is similar to any kind of learning. She also discusses that language learning is not domain-specific but it requires the application of domain-general cognitive strategies. It starts with the discovery of the basic notions and develops into more complex generalizations and abstractions. Thus, the child, at the beginning of the learning process, deals with more basic elements and builds on his knowledge as he proceeds through the acquisition stages, so although he starts doing linguistic analyses from the very early age on, The scope is not as large as adult language. What is more, the child not only uses semantic but syntactic notions also. Finding some utterances based on the semantic and syntactic knowledge, Bloom (1970) asserted that children acquired syntax and semantics simultaneously. To illustrate, she referred us to children's early sentences such as "Lamb go there" and "Put lamb there" and noted that in the first one, the "lamb" functioned as the subject and patient (since it was affected by the action) while in the second sentence there was a subject that was not explicitly stated (you), and "lamb" was the patient and direct object of the verb. Hence, Bloom concluded that a child must have had an access to both semantic and syntactic relations since otherwise it would have been impossible to create sentences in which the same noun "lamb" was used with the same semantic role (patient) but with different syntactic functions (subject and object). With all these approaches in mind, one could create a blended version of language acquisition in which principles of *UG* and environmental factors work hand in hand and are equally important. This is what Golinkoff and Hirsh-Pasek (1996) did in the area of language comprehension, which we shall summarize below.

III.2.3 Comprehension of Syntax

Although there have been a few attempts to account for children's production of constituent structure, little attention has been given in terms of their comprehension abilities of these grammatical structures. Firstly, the question whether children were aware of the fact that words combine into meaningful units was asked and it was found that 9-month-old children were so sensitive to clause boundaries that they paid more attention to 1-second pauses at the noun or verb phrase boundaries than to the ones within these phrases (Jusczyk et al., 1992). Secondly, some evidence has been gathered in support of the view that children, towards the end of their two-word stage (around three years of age), can differentiate which words in a sentence can form units. As Gerken, Landau, and Remez (1990) (cited in (Golinkoff and Hirsh-Pasek, 1996)) maintained in their study, children could detect sentences that lacked closed class elements such as articles, past tense markers, or quantifiers despite their telegraphic speech. Their experiment revealed that the level of comprehension decreased as the function words determining the boundaries of noun or verb phrases (i.e., "an" before an NP or "is" before a V, etc.) were replaced by nonsense words. The third question related to children's understanding of constituent structure pertains to when pre-linguistic infants become aware that the constituents should bear meaning. Bloom (1973) holds that children cannot map sentences onto events until they can form multi-word sentences that show an achievement of syntax to some degree. On the other hand, Golinkoff and Hirsh-Pasek (1996) showed that children at one-word stage could understand and respond to bizarre commands such as "smell a shoe" and "kiss the ball", which proved that they did not rely on individual words but comprehended the strings as a mean-

ingful unit and that they knew that there was a certain semantic mapping between the strings and events.

The finding that children have access to constituent structure before they produce multi-word utterances leads to the question whether they can also attend to word order device. That is, can children manage to understand that the sentence "The cat is chasing the dog" talks about a different relation from the sentence "The dog is chasing the cat" Golinkoff and Hirsh-Pasek (1996) conducted an experiment to see whether children at one-word stage could comprehend word order information in sentences and concluded that "young children appear to allocate more attention to events that match the word order they hear than to events that do not match the word order in the linguistic stimulus." (p.114). Although inflection, rather than word order, plays an important role in determining the θ-roles in some languages such as Turkish, it has been suggested that Turkish-speaking children present a better ability in sentence imitation task when the word order is SOV, which shows that they also rely on word order so as to decide "who-did-what-to-whom" (Slobin and Bever, 1982). Yet, Golinkoff and Hirsh-Pasek (1996) also admits that the fact that children are sensitive to word order does not entail the use of syntactic rules only. They have come up with a theory similar to Bloom's (1970), which contends that the semantic, prosodic, and syntactic principles interact in order for word order to be of use in comprehension. On this view this interaction also accounts for the reason why children at two-word stage have difficulty understanding thematic relations in reversible passive constructions whereas they can interpret non-reversible passives and reversible actives. Thus, it is not until a stage when children are approximately 24 months old that children develop a better syntax that enables them to comprehend more complex structures. Since passive construction

violates the canonical word order, it requires knowledge about movement transformations as well as closed class elements such as "by" or "-ed". As noted earlier, children have access to function words before they achieve complex structures, hence transformational syntax and binding relations remain to be acquired for a full comprehension of these structures. Chomsky (1957) and Hayes (1970) declared that constructions formed by transformations were acquired later than the ones without transformations. This finding is also on a par with the deficit displayed by agrammatic patients in the comprehension of reversible passive sentences (Grodzinsky (1995) and Luzzattiand et al. (2001). That is to say, if agrammatic patients exhibited the order of loss in an opposite order of language acquisition, transformational elements, acquired last, would be damaged first as a result of aphasia. As we shall see in the coming sections, point of comparison between child and aphasic language in this study will be the comprehension of reversible RCs, which is one of the complex structures employing transformational movement. Thus, we shall investigate whether Grodzinsky's (1989) *TDH* and (1995) *TBA* are consistent with our data for Turkish children and agrammatic patients. Recall that *TBA* proposes that having deleted the traces, Broca's patients use R(eferential) Strategy, which includes assigning only the referential NP, without a θ-role, an Agent role according to its linear position. The reason why this strategy is applicable only to referential elements is the claim that these patients lacked the *binding chains* only. That is, if language impairment in Broca's aphasics was the reverse order of child language development, one would expect that children acquired binding principles at later stages.

At this point, comprehension of binding principles needs to be analyzed as it is considered to be a sign that children use syntactic rather than semantic information

while comprehending the structures derived by movement transformation. Remember that binding theory posits constraints on coreference between constituents such as pronouns and anaphors and the traces (see Chapter II). The research reveals that Principle A (an anaphor must be bound in its local domain) is achieved earlier than Principle B (a pronominal must be free in its local domain) (Atkinson, 1992). Golinkof and Hirsh-Pasek (1995) tested the effect of binding theory on children's comprehension and they presented the children at around 24 months with two movies in which two distinct events are displayed: Cookie Monster made Big Bird turn, presented with the sentence "Oh, look! Cookie Monster is turning him" and the scene in which Cookie Monster and Big Bird turned together, accompanied by the sentence "Cookie Monster turns himself" (p.184). The former illustrated Principle B, while the latter was an example for Principle A. The results demonstrated that children could differentiate between these sentences and that they are aware of the binding rules for anaphors and pronouns. Also, this is consistent with the theory claiming that children do not make simpler linear analysis in order to understand the meaning of a sentence, but they are aware of the hierarchical nature of this interpretation. However, the comprehension of R-expressions has not been mentioned in Golinkof and Hirsh-Pasek (1995). Haegeman (1994) explains the R-expressions as follows:

> [R-expressions] are inherently referential: expressions such as *Poirot* and *the detective*select a referent from the universe of discourse. Given that R-expressions have independent reference, they do not need an antecedent; ... they do not tolerate binding from another element. [For instance, in the following example "His$_i$ brother likes Poirot$_{i/j*k}$ very much."] ... *he* and *Poirot* must not have the same referent: he selects an entity distinct from that referred to by *Poirot*. If *he* and *Poirot* were to be coindexed in this example then the NP *Poirot* would be bound by the pronoun and this is not allowed [by Principle C: R-expressions must be free everywhere] (pp. 226-227).

All these experiments led Golinkoff and Hirsh-Pasek (1996) to construct a model of language comprehension which embraces both innateness theory and constructivist one, hence the name coalition model of language comprehension. On one hand, they support the view that the child is pre-wired to look for certain information and that he is sensitive to "information in the syntactic domain", on the other hand they emphasize the necessity for the construction of real life input and for the gradual maturation of language "building mental representations of the world". Although all of the cues (social, environmental, lexical, morphological, prosodic, semantic, and syntactic) work together all the time, the course of language development determines which ones should bear more importance at a specific stage; i.e., children are more biased to attend to prosodic cues at the beginning of the learning process in addition to all the others, as they get older they pay attention to semantic and then syntactic cues. To word it differently, the coalition model requires that "these cues are available to the child at all times; however, they are not equally accessible to the child at different points in development." (Golinkoff and Hirsh-Pasek, 1996, p. 189). On this view, then, comprehension is "- one route to mental model building- [and] proceeds as children move from using language as a tool for internalization to using [it] as a tool for interpretation? [also it] begins with a strong reliance on acoustics, moves to a reliance on coordinated input cues from syntax, prosody, extralinguistic context, and semantics ... and culminates in a reliance mainly on syntax." (Golinkoff and Hirsh-Pasek, 1996, p. 198).

III.2.4 Acquisition and Comprehension of Relative Clauses

RC constructions appear in child language as early as three years old. However, as cited by Gleason (2001), the study conducted by Limber (1973) revealed that children

reached the full-possession of RCs only after they started school. Before this time RCs uttered by them dealt with the object of the sentence and lacked relative pronoun most of the time, e.g., "Give the chair you sitting on." (p. 196). Also, another study confirmed that children used object RCs rather than subject RCs in their spontaneous speech at the age of four ((Hamburger and Crain, 1982), cited by (Crain and Lillo-Martin, 1999)).

On the other hand, Keenan and Comrie (1977) compared a large number of languages in terms of relativization strategies and theorized that the variation observed in different languages is due to the NP position to be relativized and that there is a universal hierarchy to be applied in all languages. According to the Accessibility Hierarchy (AH), relativization of some NP positions are more accessible to the learner or speaker of a certain language than other positions in the hierarchy and if a particular position that is higher on the hierarchy can be relativized then it enables all other lower positions to be relativized as well.

According to the AH, SU > DO > IO > OBL > GEN > OCOMP where > shows that a position to be relativized is more accessible than the others in the hierarchy. That is, on the accessibility hierarchy subject (SU) relativization is at the highest level and more accessible than direct object (DO), which occupies a higher place than indirect object (IO), which is more accessible than major oblique case "...NPs that express arguments of the main predicate, as the chest in John put the money in the chest rather than ones having a more adverbial function like *Chicago* in *John lives in Chicago* or *that day* in *John left on that day.*" (Keenan and Comrie, 1977, p. 66), which is more accessible than genitive case (GEN), and it is more accessible than object of comparison (OCOMP), which is in the lowest place in the hierarchy. To put it in

Keenan and Comrie's (1977) term (p.67):

> The Hierarchy Constraints (HCs) A language must be able to relativize subjects. Any RC-forming strategy must apply to a continuous segment of the AH. Strategies that apply at one point of the AH may in principle cease to apply at any lower point

Thus, the AH would predict that a child should acquire how to relativize SU before all other positions as the SU is the easiest, i.e. the most accessible in the hierarchy. Moreover, it is possible that a language can only relativize SU and nothing else whereas it is not possible to relativize only DO or any other position lower than the SU. That is, relativization of, say, IO in a language entails relativization of DO and SU since both of them appear before IO in the hierarchy; however, the fact that we can relativize IO does not mean that we can also relativize OBL or GEN. Keenan and Comrie (1977) states that subject relativization is a primary strategy in that " a language must have a primary strategy but need have no other." (p.68).

> The Primary Relativization Constraint (PRC) A language must have a primary RC-forming strategy. If a primary strategy in a given language can apply to a low position on the AH, then it can apply to all higher positions. A primary strategy may cut off at any point on the AH.

Several experimental studies comparing the mastery of subject RCs versus object RCs such as (MacWhinney and Pleh, 1988) in Hungarian and (Keenan and Hawkins, 1987) in English, reported that subject RCs posed less problems, which led the researchers to conclude that as we descend in the AH the processing becomes more complex. Turkish data also support AH in that children acquiring Turkish tended to use subject RCs more often than object RCs and they made greater number of errors in the production and comprehension of object RCs, which confirmed Keenan and Comrie's (1977) AH (Slobin, 1986). Besides, Slobin (1986) supported the primary RC-forming

strategy by showing that Turkmen and Azeri languages "neutralize[d] the surface distinction between subject and non-subject RCs, with use of a single form [, which is subject relativization] for all types." (p.286). To exemplify, he gives some examples from Turkmen and Azeri. In Turkmen the RC "menin yaz-an kitabım" with the intended meaning "the book that I wrote" is relativized using -(Y)an strategy although it is normally relativized using-dIk strategy in modern Turkish "benim yaz-dığ-ım kitap", similarly in Azeri the RC "sen istey-en şey" (with the intended meaning "the thing that you want") used subject relativization instead of object relativization strategy.

The failure in producing or comprehending the object RCs might be due to the genitive case assigned to the NP in the agent role, as Slobin(1986) suggests. It is important to note that children have difficulty in assigning the genitive case to the subject of an embedded clause. For instance, the nominative case is assigned to the NP "eşek" instead of the genitive case in the sentence "Eşek kaçtığını gör-düğ-ü için" with the intended meaning "He saw the donkey run away" (Slobin, 1986, p. 284). The same thing is true for the comprehension data. That is, Turkish children fail to assign an agent role to the first NP if it is in the genitive case and assign the first nominative noun an agent role instead. They do not interpret the first NP "lamanın" as an agent but they directly select the NP in the nominative case "kaz" as the doer of the action. Slobin's (1986) data indicate that children ignore the words in the lower-case but they focus only on the ones in the upper-case in the sentence "Lama-nın elle-diğ-i KAZ KEDi-Yİ ISIR-SIN."

On the other hand, Aksu-Koç and Slobin (1985) attract attention to the children's inability to produce factive nominalizations, which are constructed by the use of -dIk morphology. They tend to overgeneralize the morphology used for statement of

potentiality -mE and use it both for statements of fact and potentiality:

(46) a. Ahmed-in yüz-düğ-ü-nü bil-iyor-um.

Ahmed-GEN swim-FACT-POSS-ACC know-PROG-1SG

'I know that Ahmet swam/is swimming. [fact]'

b. Ahmed-in yüz-me-si-ni bekl-iyor-um.

Ahmed-GEN swim-POT-POSS-ACC wait-PROG-1SG

'I'm waiting for Ahmet to swim. [potentiality]'

They relate this over-generalization to the morphological complexity and underline that children acquire simper forms in which "the main clause is coreferential with the subject of the embedded clause" such as "Ahmet yüz-me-si-ni biliyor," where NP "Ahmet" is not in genitive case (p.851). Moreover, even when the factive nominalizations appear in their speech, children usually omit the genitive case and assign nominative case to the embedded subject as in the coreferential forms. Thus, they account for the avoidance of the genitive case as follows:

> As a general principle, there is probably a tendency to limit the range of functions carried out by a given case inflection, resulting here in the avoidance of using the genitive -normally the case of the possessor- to mark a subject. The simpler option, thus, is to use the -mE participle with embedded nominative subject for both factives and potentials, and upon emergence of the -dIk participle, still to avoid genitive marking of the embedded subject (p.851-852).

In line with AH, Cook (1973), who investigated the type of errors made in English RCs during the first and second language acquisition, concluded that object RCs posited more mistakes in production and that acquisition of object RCs was more difficult and problematic than that of subject for both group.[2] Another study supporting

[2] Again, this result is compatible with the studies indicating that agrammatic patients have intact comprehension of subject RCs whereas their comprehension of object RCs is problematic (Grodzinsky, 1986).

the appearance of subject RCs before object RCs in child speech is Ekmekçi's(2001). Ekmekçi investigated the nature of children's production and imitation of RCs in Turkish and demonstrated that children showed a better performance in the production of subject RCs than the object RCs. Ekmekçi's (2001) results seem compatible with the data gathered from English speaking children. However, considering Grodzinsky's (1986-1995) data and *TDH* and *TBA* one would expect Turkish children or agrammatic patients to behave in exactly the opposite manner to the English-speaking ones. Since Turkish is a head-final language (see Chapter II) the default strategy is expected to succeed in object RCs since the referential NP has already the Agent role whereas it is expected to fail in subject RCs. That is, while English-speaking children and/or patients perform well on subject RCs Turkish-speaking ones should perform well on object RCs. Thus, in this thesis, if we obtained results in line with the expected outcome Grodzinsky's (1986;1995) hypothesis would be supported; on the other hand, if our data was consistent with Ekmekçi's (2001) results, *TDH* and *TBA* would be refuted.

Some other studies reported that once children started producing RCs, which took place about four years of age, they use both object and subject RCs (Tager-Flussberg, 2001) (cited in Gleason (2001)). Tager-Flusberg noted that if the main sentence included a direct object and indirect object such as "The boy gave the dog to the bear," children tended to attach a RC to the final object rather than to the subject or direct object, e.g., "The boy gave the dog to the bear who is holding the wagon." That is, most probably it forces relatively few constraints on processing to involve an RC at the end of another clause rather than in the middle (Gleason, 2001). When Tager-Flussberg (2001) repeated the same task with three-year-old children and presented them with situations in which they could produce RC constructions, it was revealed

that their choice of giving the same information were different from the four-year-old children. While the latter group produced utterances including RCs, only at the end of the sentence, the former group came out with even simpler constructions such as "The boy gave the dog to the bear with the wagon." Thus, it was suggested that although communicating the correct message, children were inclined to express themselves using easier structures and that complex structures such as RCs might have been understood as a coordination structure (i.e., combining two propositions with and) at early ages (Gleason, 2001). To put it more plainly, Gleason (2001) reads as follows:

Children may be using their knowledge of simpler construction to guide the acquisition of more complex constructions. In this task both forms, prepositional phrases and RCs, fulfill the functions adequately, but younger children used primarily simpler prepositional phrases, whereas older children used primarily more complex RCs. Perhaps the developmental roots of RCs lie in simpler constructions. (p.196).

As for the comprehension of RC constructions, two distinct views have been proposed. One of them is the flat structure hypothesis, which aims to provide an explanation about what strategies are used by the child in order to comprehend such complex structures. On this view, children do not have adult-like hierarchical syntactic representations of RCs, but instead, they apply more basic rules that lack recursive characteristics. That is, the child builds onto his grammar and achieves an adult-level of competency gradually and hence the misanalysis of certain complex structures at early ages. Crain and Lillo-Martin (1999) further explains the misinterpretation of RCs with the following example (p.392):

(47) The dog pushed the sheep that jumped over the fence.

(48) a. The dog pushed [the sheep that jumped over the fence]

The dog pushed the sheep [... jumped over the fence]

As *the flat structure hypothesis* predicts, when the child is asked to act out the sentence in (47), the normal interpretation of which requires an analysis similar to (48a), the child does not recognize that the NP the sheep belongs to the constituent including the VP jumped over the fence and forms a structure like (48b), which corresponds to the scene where a dog is pushing a sheep and then jumping over the fence. This result also seems compatible with other studies suggesting that children had problems acting out object RC sentences like (47) (Crain and Lillo-Martin, 1999). Crain and Lillo-Martin finds this account problematic since it is not consistent with the Universal Grammar theory claiming that children have complete access to X-bar theory. Besides, they find it insufficient as it cannot account for the learnability problem. More specifically, this analysis does not account for how the incorrect mapping between sentences and meanings is recovered as the child develops.[3] What Crain and Lillo-Martin suggests to prove that the reason for children's misinterpretation of complex structures is not their limited syntactic knowledge is to refer to studies in which a more proper design of experiment is proposed. According to this method, one should consider the pragmatic information ascribed to sentences such as (47) repeated here as (49):

(49) The dog pushed the sheep that jumped over the fence.

Considering this sentence, the fact that there are other sheep one of which jumped over the fence leads one to utter this sentence justifies the use of an RC. Thus, the

[3] We shall not go into the details of the flat structure hypothesis and learnability problem since our main concern here is to provide a descriptive analysis rather than an argumentative one.

necessity to include this pragmatic information is said to be ignored in the studies providing evidence in favor of the flat structure hypothesis. Crain and Lillo-Martin cites Hamburger and Crain (1982), who included more sheep in the acting out situation for the same sentence (49) (p.396). As a result, they obtained a greater number of correct responses even from the children that were younger than the previous study with one exception, who performed only the first part of the sentence the dog pushed the sheep and ignored the second part that jumped over the fence. This exception is called Assertion Only response, which Hamburger and Crain did not take as an error.[4] However, they do not account for why children do worse in object RCs while performing better in subject RCs.

Thus, we can say that the problems in producing and comprehending RCs may be due to a syntactic immaturity, processing difficulties, or inappropriate testing methods. However, when language acquisition stages are taken into consideration we observe that the child achieves an adult proficiency gradually. This does not necessarily entail the destruction of Universal Grammar theory since it is still in line with the idea of parameter setting. Still, there needs to be a more coherent approach that would account for inconsistencies in the data provided so far.

To summarize, in this section, we have reviewed the theories supporting the similarity between child and aphasic language. We have tried to restrict ourselves to the comprehension patterns exhibited by the two groups since our main concern here is the difficulty they experience in comprehending certain complex structures. Since the theory of agrammatic comprehension we aim to test (*TDH* and *TBA*) takes up the view

[4] Here, there is not a convincing explanation why Assertion Only response is not counted as an error. It is only stated that it "is precisely the kind of response that is compatible with perfect comprehension of the test sentences" (p.396).

considering agrammatism as a syntactic disorder, we have focused on child's syntactic acquisition and comprehension. Lastly, we have brought into focus the acquisition and comprehension of RCs being the medium of comparison between agrammatic language and child language in this thesis.

This chapter has focused on the hypotheses to be addressed in this thesis as well as the peripheral topics supporting these hypotheses. In the following chapter, we shall introduce the experiment we conducted in order to test Grodzinsky's account.

CHAPTER IV

RESEARCH DESIGN

IV.1 Hypotheses Tested

The first hypothesis tested in this study is Grodzinsky's (1989) TDH. Recall from Chapter III that, for English, TDH predicts chance performance in the agrammatic comprehension of object RCs due to the deletion of traces and Default Strategy whereas it expects the patients to perform at above chance level in the subject RCs and canonical sentences. In order to investigate cross-linguistic and cognitive plausibility of TDH, we used sentence-picture matching task with the Broca's patients, whose native language is Turkish. In order for TDH to be confirmed, Turkish patients, contrary to English-speaking ones, should perform at chance level in subject RCs since Turkish is a head-final language (for details see Chapter II). To illustrate, assume that an agrammatic patient, who cannot access the theta-roles carried by traces, uses the so-called Default Strategy and linearly assigns the first NP they encounter an agent role. If the sentence includes an object RC as in (50), the default strategy should be successful in determining the correct theta-roles. That is, since the first NP in an object RC is

already an agent, they must perform at above chance level, on a par with their performance in canonical sentences. The Default Strategy should fail to assign the correct theta-roles to the constituents in subject RCs (e.g. 51) as the first NP heads a chain that has a patient theta-role, which has been inherited by the head.

(50) Adamın t_i öldürdüğü kadın$_i$. (Above chance)

(AGENT) (PATIENT)

'The woman whom the man killed.'

(51) t_i Adamı öldüren kadın$_i$. (Chance)

*(AGENT) *(PATIENT)

'The woman who killed the man'

The second hypothesis tested is the Regression Hypothesis (Jakobson 1971), which theorizes that aphasic patients exhibit similar problems to children since the structures acquired last is expected to be lost first as a result of brain damage. That is, it is expected that both Turkish children and agrammatic patients would show similar patterns in their comprehension of RCs and that they would be impaired in the comprehension of subject RCs if the TDH was cross linguistically plausible.

IV.2 Experiment

IV.2.1 Method

IV.2.1.1 Participants

Aphasic participants were chosen among the aphasic patients in "TSK (Turkish Armed Forces) Rehabilitation Center" in Turkey. The following criteria were used while selecting the participants:

(a) Left-frontal damage involving Broca's Area, supplied by CT scan (when possible), at least tree months prior to participation in this test.

(b) The patients should be neuropsychologically diagnosed as Broca's aphasics, who present effortful, non-fluent, and telegraphic speech with normal comprehension at the conversational level.

(c) Their age should be varied between 18-80 with no history of drug abuse or no disabilities in vision and hearing. They should be literate with at least 5 years of education.

Twenty patients, fourteen of which were diagnosed as Broca's aphasic were tested. However, two of these patients did not fulfill the second condition of the above criteria and hence were diagnosed as Global aphasics. Also, another so-called Broca's patient, who could not cooperate with the test instructions, was disregarded. In other words, there were eleven Broca's patients participating in this experiment (see APPENDIX for further detail).

15 neurologically intact control participants (9 males and 6 females), who approximately matched for age and educational background, were also tested (see APPENDIX).

17 children (10 girls and 7 boys) were tested (see the APPENDIX). Their age ranged between 41-52 months. These children are at a stage where basic RCs begin to appear in their speech Gleason (2001, p195).[1] All of them were neurologically intact and attended a kindergarten.

[1] Gleason (2001) reports that RCs are fully acquired only after the child starts school

IV.2.1.2 Sentences

There were three sets of sentences including subject RCs, object RCs, and sentences with no transformation i.e., canonical SOV active sentences (see the APPENDIX section). It was important that each sentence be semantically reversible (each of the parties could equally act as an agent as well as patient). The sentences consisted of at most four words with high frequency verbs. No verb had reciprocal morpheme or meaning, and there were no two-word verbs such as *yardim etmek* ('to help'). The test consisted of 30 sentences, 10 for each set.

IV.2.1.3 Pictures

There were three pictures for each sentence. Each picture described an event in which both NPs could act as a performer of the action or a recipient of it. Only one picture, among the three, represented the correct thematic roles: there was another picture showing the reversed thematic roles, and the other one represented a totally irrelevant activity in order to test the comprehension of the basic words and actions in the sentences. For instance, for the sentence "The man killed the woman" the correct picture showed a man killing a woman, the reversed picture showed a woman killing a man, and the irrelevant one showed the man and woman while they are having a lunch. The pictures were standard in their formats (see the APPENDIX).

IV.2.1.4 Procedure

Each participant was tested individually in a hospital room setting. The sentences were randomized in triplets with the same order for every patient (see the APPENDIX). Different from adult participants, children were told that they were going to play a

competition game. They were also tested individually but the sessions were arranged according to child's interest. They were free to have a break and move around the room if they liked. They were also allowed to make up stories about the pictures so that they were not bored. Also, they received continuous praise to be encouraged. The participants were told that they could ask for repetitions or a break if they needed. Each sentence was repeated two or three times although the participant had not asked for it. They were given three or four trials before the experiment in order to make sure that they understood the task. They were instructed to listen to each sentence and choose the correct picture among the three by pointing at it. The instruction was as follows:

"You are going to see three pictures. They are all different from each other. Look at the pictures very carefully. When you are ready, I am going to read a sentence. That sentence will describe one of the pictures. Listen to me very carefully and show me the picture that I am talking about. There is only one correct answer. You can listen to the sentence more than once. Now look at the first set of pictures, which picture describes **'The man who killed the woman is black'...**"

CHAPTER V

RESULTS

V.1 Between-Subject Effects

There were three groups of subjects, namely Broca's aphasics, normal children, and normal adults, and three types of sentences, i.e. subject RC, object RC, or a canonical sentence. In order to show the effects of subject and sentence type on the comprehension of sentences, a Repeated Measures Multivariate Analysis of Variance (MANOVA) was conducted (Figure V.1). There was a significant main effect of group, $F(2, 40) = 47.731; p < .01$ (see Table V.1). Multiple comparisons revealed that there was a statistically significant difference between the normal adult subjects and the other groups (Broca's aphasics and normal children) $p < .01$ whereas there was no difference between normal children and Broca's aphasics $p > .05$ (see Table V.1).

Table V.1: Tests of Between-subject Effects.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	7568.548	1	7568.548	2278.240	.000
Subject Type	317.131	2	158.566	47.731	.000
Error	132.884	40	3.322		

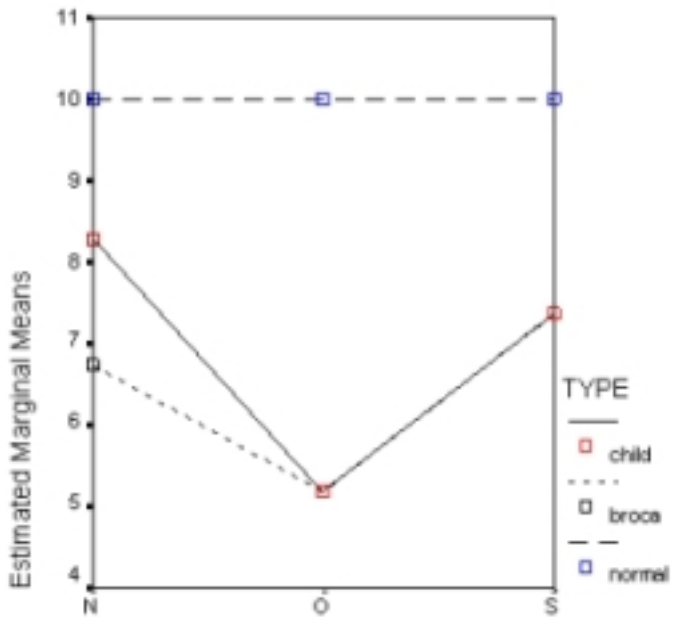

Figure V.1: Plot of MANOVA Results.

Table V.2: Multiple Comparisons.

	(I)TYPE	(J)TYPE	Mean Difference (I,J)	Std. Error	Sig.
Tukey HSD	child	broca	.5169	.40720	.420
		normal	-3.0588	.37278	.000
	broca	child	-.5169	.40720	.420
		normal	-3.5758	.41773	.000
	normal	child	3.0588	.37278	.000
		broca	3.5758	.41773	.000

Table V.3: Tests of Within-subject Effects.

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
SENTENCE TYPE	Sphericity Assumed	62.896	2	31.448	23.878	.000
	Greenhouse-Geisser	62.896	1.752	35.904	23.878	.000
	Huynh-Heldt	62.896	1.917	32.808	23.878	.000
	Lower-bound	62.896	1.000	62.896	23.878	.000
ERROR	Sphericity Assumed	105.362	80	1.317		
	Greenhouse-Geisser	105.362	70.071	1.504		
	Huynh-Heldt	105.362	76.684	1.374		
	Lower-bound	105.362	40.000	2.634		

Table V.4: Pairwise Comparisons

(I) Sentence Type	(J) Sentence Type	Mean Difference (I,J)	Std. Error	Sig.
Canonical	Object RC	1.554	.284	.000
	Subject RC	.102	.201	1.000
Object RC	Canonical	-1.554	.284	.000
	Subject RC	-1.453	.262	.000
Subject RC	Canonical	-.102	.201	1.000
	Object RC	1.453	.284	.000

V.2 Within-Subject Effects

There was a statistically significant effect of sentence type on the comprehension of the events described in the sentences, $F(2, 80) = 23.87; p < .01$ (see Table V.3, in that relatively low success rate was observed in sentences including object RCs (see Table V.4. However, pair-wise comparisons failed to show a significant difference between the subject RCs and canonical sentences $p < .01$ (see Table V.4.

V.3 Chi-square Test

The number of correct, reversed, and irrelevant answers for each sentence was calculated (Figure V.2and V.2), the number of more than 6 correct answers for each sentence type was specified, and in order to compare the success rate within Broca, child, and normal

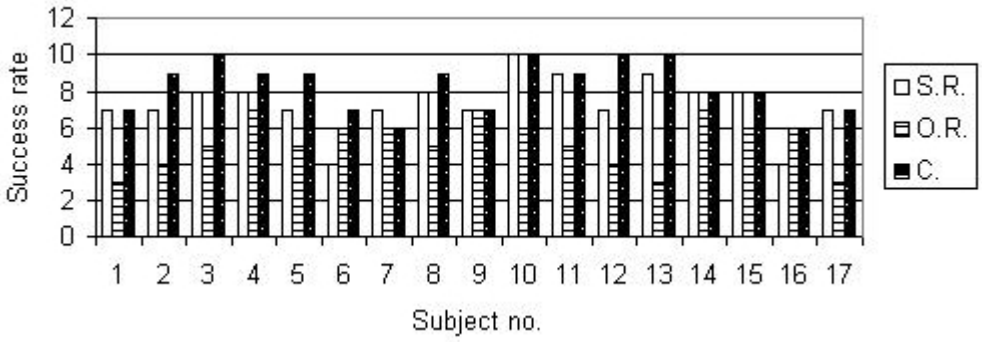

Figure V.2: Success rate of each child for each sentence type.

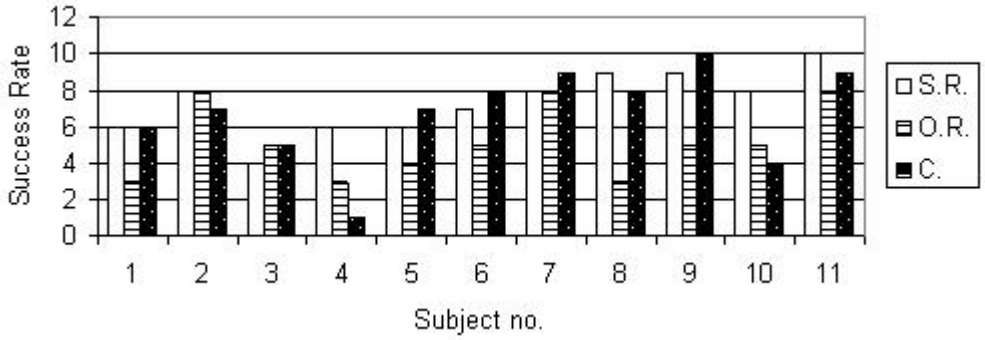

Figure V.3: Success rate of each Broca's aphasic for each sentence type.

Table V.5: Percentages of Participants with above Accuracy Performance

	Above 6 correct answers of type canonical	Above 6 correct answers of type subject RC	Above 6 correct answers of type object RC
Children	100%	88.2%	47.1%
Broca's	72.7%	90.9%	27.3%
Controls	100%	100%	100%

Table V.6: Chi-square Results

Sentence Type	Value	Assymp. Sig. (2-sided)
Canonical	8.870	.012
Subject RC	2.744	.254
Object RC	16.156	.000

groups chi-square test was applied. As can be seen in Table V.5 and V.6, there is a significant interaction between sentence and subject type in that while the control group performed with 100% accuracy in all the three types of sentences, Broca's patients performed relatively poorly in canonical sentences; $F(2) = 8.870$, $p < .05$. Also there was no significant difference between Broca's, child, and normal groups in terms of their performance in subject RCs; $F(2) = 2.744$, $p > .05$, and significant difference was observed between normals and Broca's and children in their performance of object RCs; $F(2) = 16.156$, $p < .01$.

CHAPTER VI

DISCUSSION

Recall that we have had two hypotheses to test: Jakobson's (1971) Regression Hypothesis and Grodzinsky's (1989) TDH and (1995) TBA. The first hypothesis expects to obtain similarity between children and Broca's aphasics in terms of difficulty they experience in comprehending the complex structures, and the second hypothesis predicts that head-final feature of Turkish will lead Turkish patients to perform in a dissimilar manner to the English ones, who show chance performance in object RCs. That is, it is expected that Turkish patients will perform at chance level in subject RCs when compared to object RCs and canonical structures.

The results we have obtained above are consistent with the claim that Broca's aphasia impairs the comprehension of object RCs in a manner similar to young children. It is an important point not to generalize the data about RCs to other structures since it does not embrace other syntactic complex structures such as passives, object clefts, or causatives. Thus, we should err on the side of caution to concur with the Regression Hypothesis and we should conclude that children and agrammatic patients presented

similar patterns in comprehension of RCs by performing well in subject RCs and in canonical structures and relatively badly in object RCs.

Our data also support Keenan and Comrie's (1977) AH in that Turkish children acquired subject RCs earlier than object RCs, and Broca's patients, consistent with the Regression hypothesis, have problem in the comprehension of object RCs, which appear later in the hierarchy. That is, the agrammatic impairment follows the reversed order of AH.

At this point, there arise two questions concerning the underlying nature of the comprehension deficit exhibited by children and Broca's patients in the first place, and what strategy is being used in order to compensate for this deficit in the second.

As for the first concern, one could offer the explanation that although these groups of people know what they are supposed to do, they cannot complete executing the process, which puts a heavier weight on working memory than the canonical structures. Another possibility is that the traces are deleted in the mental representation of these patients and thus they cannot assign thematic roles properly. What we propose for the particular deficit presented by Turkish children and Broca's aphasics is that these patients may be impaired in their ability to process agreement morphology.

In order to conclude that the problem is caused by processing deficit or short term memory impairment, performance on real-time tasks should be considered. As for the deletion of traces, the present study is inconclusive about the deletion of traces. However, although the traces are deleted as Grodzinsky hypothesized, neither the default not referential strategy he proposed works for Turkish, which makes his theory incompatible for Turkish. At this point it is reasonable to look for to look for a feature missing in agrammatic or child language, which is not shared by the two types of RC

constructions. A crucial point to make at this point is that different from English RCs, in Turkish there are morphological difference between the two RC constructions. That is, in Turkish semantic roles and agreement are realized via different morphemes. Recall from Chapter II that if the relativized NP is a non-subject, NP with the role of syntactic agent must be marked with genitive case, and the complementizer is followed by a possessive suffix that marks the agreement with the subject, whereas if the subject in the underlying sentence is relativized, no agreement morphology marker is applied, we give (52) as an example:

(52) a. [$_{RC}$ t_i Adam-ı öldür-en] kadın$_i$

man-ACC kill-(y)An woman

'The woman who killed the man.'

b. [$_{RC}$ Adam-ın t_i öldür-düğ-ü] kadın$_i$

man-GEN kill-DIK-POSS.1sg woman

'The woman whom the man killed.'

This distinction might bring into the idea that Turkish Broca's aphasics and children following a normal path of language acquisition cannot access to the -DIK complementation or genitive case. This proposal makes our study compatible with Slobin's (1986) data reporting that children "are reluctant to interpret a sentence-initial noun in the genitive as an agent they skip over the first noun [and pick] the first nominative noun as agent" (p. 284) and Aksu-Koç and Slobin (1985) data presenting that children tended to ignore factive nominalization that is achieved by -dIk and use potentiality marker -mE for both meanings. However, in order to agree with this, one should demonstrate that these groups of subjects exhibit problems in comprehending

simple DIK-nominalization and possessive constructions that do not employ movement transformations as in the example below:

(53) a. [$_{CP}$ Ben-im sen-i sev-diğ-im]-i bili-yor-sun.

I-GEN you-ACC love-DIK-POSS.1sg-ACC know-PROG-2sg

'You know that I love you'

b. Ahmet-in kitab-ı

Ahmet-GEN book-POSS.3sg

'Ahmet's book.'

We call on further research in order to test whether or not these groups of patients have difficulty in comprehending these basic constructions. This can be best done by grammaticality judgment tests as it is impossible to represent most of the verbs in these constructions by pictures as they are stative. However, it is quite a challenging task to prepare and apply grammaticality judgment tasks since most of the native speakers, let alone patients or children, are not aware of the strategies applied while deciding on the grammaticality. Actually, we attempted to test some structures in order to see whether the problem is syntactic or morphological in nature but it resulted in failure for only two patients among the eleven were able to cooperate with it. Even these two patients could not see that there must be a syntactic problem in the sentence and tended to focus on semantic features alone.

When it comes to the second concern as to what strategy is used while assigning thematic roles to the NPs in complex structures, we observe that subjects' knowledge about the canonical word-order might be at work. To put it differently, our subjects assigned correct theta-roles to the relativized NPs in subject position whereas most

of the time they assigned the reversed roles to the relativized NPs in object position. This leads us to consider a default strategy, *pre-verbal* strategy, in which patients commit to the OV ordering in verb phrases and assign the patient role to the NP in preverbal position. This strategy might account for their success in the subject RCs, as exemplified in (54).

(54) a. [$_{RC}$ t_i Adam-ı öldür-en] kadın$_i$

O V

PATIENT

b. [$_{RC}$ Adam-ın t_i öldür-düğ-ü] kadın$_i$

*O V

*PATIENT

The *pre-verbal* strategy is incompatible with Caplan and Futter (1989) since Turkish agrammatic patients do not assign the first NP the agent role. We conclude that strategies Grodzinsky (1989; 1995) offered, namely the Default strategy and the Referential strategy, are not cross-linguistically plausible. We claim that the type of the default strategy must be a parametric feature although trace deletion was a universal feature of agrammatic deficit and that the pre-verbal strategy must be what Turkish agrammatic patients as well as children are using in order to compensate for their deficit. Moreover, the *pre-verbal* strategy offered in this study gets its power from its applicability to almost all accounts of agrammatism such as TDH or TBA, agrammatism as a processing disorder, reversal of AH, and impairment in possessive agreement morphology.

CHAPTER VII

CONCLUSION

In this thesis, we have investigated the cross-linguistic validity of Grodzinsky's (1989) TDH and (1995) TBA and Jakobson's (1971) Regression Hypothesis. To do this, using the standard sentence-picture matching task including canonical and RC constructions, we tested comprehension patterns presented by Turkish Broca's patients and normal children aged between 41 and 52 months. In order to confirm the two hypotheses, we expected to find parallel difficulties exhibited in subject RCs. As a result, our data demonstrated that children and Broca's patients showed similar deficit in comprehending object RCs whereas their comprehension of canonical structures and subject RCs remained intact, which did not conform to TDH. In accord with this data, we proposed that these subjects might have problems with the application of agreement morphology and that they might be using their intuitions about the basic word-order (SOV) and assigning the patient role directly to the NP in the preverbal position. In the end, we came to the conclusion that this thesis neither concurs with the TBA nor does it dispute it, but calls on further research in order to test whether there are distinct

chains in Turkish used in transformations and to clarify the underlying reasons why these subjects exhibit impairment in object RC constructions and what strategies they apply in order to compensate for their impairment.

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Appendix A

Test Sentences

Sentence	**Type**
1- Çocuk adamı sardı.	N
2- Adamın ittiği kadın şişman.	O
3- Çocuğa vuran anne üzgün.	S
4- Kadının öldürdüğü adam esmer.	O
5- Adama sarılan çocuk küçük.	S
6- Adam kadını tokatladı.	N
7- Ayıyı ısıran köpek siyah.	S
8- Kadının öptüğü çocuk ayakta.	O
9- Adam kadını sevdi.	N
10- Kadın adamı yumrukladı.	N
11- Kadını seven adam mutlu.	S
12- Filin kovladığı aslan benekli.	O
13- Ayının ısırdığı köpek siyah.	O

Sentence	**Type**
14- Çocuk anneye vurdu.	N
15- Adamı yumruklayan kadın sarışın.	S
16- Aslan fili kovaladı.	N
17- Adamın yumrukladığı kadın sarışın.	O
18- Çocuk kadını öptü.	N
19- Adamı tokatlayan kadın şapkalı.	S
20- Kadının sevdiği adam mutlu.	O
21- Adamı iten kadın şişman.	S
22- Köpek ayıyı ısırdı.	N
23- Kadın adamı öldürdü.	N
24- Fili kovalayan aslan benekli.	S
25- Kadını öpen çocuk ayakta.	S
26- Adamın tokatladığı kadın şapkalı.	O
27- Çocuğun vurduğu anne üzgün.	O
28- Adam kadını itti.	N
29- Adamın sarıldıdığı çocuk küçük.	O
30- Kadını öldüren adam esmer.	S

Appendix B

Subject Information

B.1 Broca's Patients

Subject	Sex	Age (years)	Education	Etiology
ab	f	49	11	Hemorrhagic infarct & cerebral abscess
ay	m	30	11	CVA
fk	f	57	5	Left parietal infarct
hk	m	39	5	Epileptic attack,
iu	m	65	13	Acute infarct in the left MCA region, ischemic and gliotic changes in pons and left cerebral hemisphere
kk	m	33	5	CVA + left fronto parietal infarct
ms	m	37	5	CVA
ng	f	62	5	Left fronto parietal infarct

Subject	**Sex**	**Age (years)**	**Education**	**Etiology**
nk	f	58	15	Cerebral hemorrhage
st	m	31	8	CVA
sa	m	71	5	Ischemic stroke

B.2 Children

Subject	Sex	Age (months)	Education
bt	m	52	0
br	m	44	0
cb	m	48	0
cs	f	47	0
da	f	43	0
dd	f	46	0
ey	f	50	0
el	f	47	0
ga	f	50	0
gk	f	48	0
gu	f	50	0
ot	m	42	0
oc	m	47	0
rg	f	41	0
so	m	48	0
to	f	47	0
tg	m	42	0

B.3 Normal Subjects

Subject	Sex	Age (years)	Education
sz	m	58	15
ni	m	61	13
rp	f	49	11
ym	m	36	5
ic	m	34	8
hg	m	39	5
ny	f	31	15
fo	f	61	5
tg	m	68	5
mp	m	57	5
ao	f	83	5
mz	f	55	5
ho	m	48	17
ns	f	39	11
ek	m	35	13

Appendix C

Pictures