CHAPTER 1. INTRODUCTION

Several hypotheses have been proposed to explain the nature of the underlying deficit in agrammatic aphasia. These concern (1) word order, (2) sentence position, (3) time reference, and (4) verb inflection. None of these hypotheses have been tested in Turkish. In fact, these hypotheses have never all been tested on one and the same language.

In this chapter, these hypotheses will be introduced, the relevant features of Turkish will be sketched out and an attempt will be made to capture the difficulties agrammatic speakers have with sentence production and comprehension by virtue of one deficit: an integration problem. This in turn leads to several research questions. The research questions are formulated at the end of this chapter. The next four chapters will cover experiments on Turkish agrammatism designed to test the differential research questions. In the final chapter the results will be discussed in light of the Integration Problem Hypothesis.

1.1. Agrammatic (Broca’s) Aphasia

Aphasia is a language disorder that results from damage to the language areas of the brain, which in most people are found in parts of the left hemisphere. Aphasia is most often a result of a stroke, also called a cerebro-vascular accident (CVA). It can affect language at all levels (speech, writing, reading and comprehension), and its nature and severity are dependent on the location of the damage in the brain.

Agrammatic Broca’s aphasia is usually caused by a brain lesion in Broca’s area and its vicinity (Brodmann’s area 44 and 45) in the left hemisphere, although lesions in other parts of the left hemisphere have also been noted as causing this aphasia type. Agrammatic Broca’s aphasia results in difficulties with sentence production and the comprehension of complex linguistic structures.

Agrammatic speech is non-fluent and characterized by omissions and/or substitutions of free and bound grammatical morphemes, whereas lexical words (nouns, adjectives and verbs) are retained (e.g., Goodglass, 1976). Agrammatic speech is, therefore, referred to as ‘telegraphic’. The patients speak in short, simple and meaningful phrases, which they produce with quite some effort. As the sentences the patients produce are typically reduced in length and complexity, they indicate a deficit at the grammatical level.

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\(^2\) Free morphemes are functional morphemes such as prepositions, determiners and pronouns, while bound morphemes are inflectional morphemes such as tense and agreement on verbs.
Below is a speech sample from a Turkish agrammatic speaker, explaining how his speech problems started.

‘hastalandım, elimi, bacağımı, elimi, böyle böyle, iyi iyi, elim, bak bak, bacak, bacak, bacak ta iyi değil, iyi değil, elim de, iyi değil, başım da iyi değil, burda felç felç felç oldu, anlatırım, bu, felç oldu, elim, ayağım, hastane, hastane, hastaneye …’

‘I got sick, my hand, my leg, my hand, like this like this (showing his hand/leg), fine fine, my hand, look look, leg, leg, leg as well not fine, not fine, my hand either, not fine, my head not fine either, here paralysis paralysis paralysis happened, I tell, this (showing his hand), paralysis happened, my hand, my leg, hospital, hospital, to the hospital …’

The patient’s speech reveals several general characteristics of agrammatic speech. Firstly, the patient is unable to produce a full clause, or a clause with embedding. His sentences are reduced in length and lack complexity. Secondly, the patient seems to have problems with (the retrieval of) verbs: the patient produced only two lexical verbs (anlatırım ‘I tell’ and bak ‘look’) and one auxiliary verb that was used twice (olmak ‘to happen’), limiting the diversity of the verbs he produced. Thirdly, the verbs he produced were minimally inflected. In other words, the verbs were reduced both in diversity and in the number of inflections. Interestingly, the patient negates his phrases using the adverb of negation değil, which is used to negate sentences without a verb. Finally, the rest of his speech consists of nouns and/or adjectives: when the patient produced a noun, he inflected the noun with the correct case (this is sometimes hard to evaluate in spontaneous speech when a verb is not produced). In sum, the speech of the patient lacks a proper clause structure which provides adequate morpho-syntactic relations between sentence elements. Obviously, the patient’s speech is affected at the grammatical level, but these patients are nonetheless quite good communicators.

Agrammatic speakers with Broca’s aphasia also have problems with comprehension. The patients can understand single words and simple sentences and they can follow instructions appropriately. However, when they are addressed with complex linguistic

3 Hastalandım ‘I got sick’ corresponds to a nominal predicate in Turkish.
constructions (e.g., semantically reversible object relatives: the man who the woman loves), problems arise, as first observed by Caramazza and Zurif (1976).

This thesis is about agrammatic speakers of Turkish with Broca’s aphasia. The patients included in the present study all used telegraphic speech and they were all diagnosed as suffering from Broca’s aphasia. In most production studies, the aphasia type under investigation is referred to as ‘agrammatic aphasia’, whereas in the comprehension studies, the term ‘Broca’s aphasia’ is usually used, since not all patients produce spoken language. We will mainly use the term ‘agrammatic aphasia’ in the sentence production studies and ‘Broca’s aphasia’ for the sentence comprehension study, following the usual terminology in the literature.

1.2. Linguistic Framework
According to the Minimalist Program (e.g., Chomsky, 1995), grammar consists of a lexicon that contains lexical entries and a computational system that employs structure building operations. Words are assumed to come from the lexicon fully inflected (stem + inflectional affixes) and they enter into derivation to form larger units (Chomsky, 1995).

Sentences are represented by phrase structures that are assumed to be the same across languages in the sense that they consist of a lexical domain (Verb Phrase: VP) and a functional domain. The most common functional projections are CP (Complementizer Phrase), AgrP (Agreement Phrase), and TP (Tense Phrase). The relationship between the lexical and functional domains is created by the Merge and Move operations. Merge unites two lexical elements. This is represented in Figure 1.1, which shows a binary branching tree for the VP eat the apple. The verb eat is the head of the phrase and selects a complement the apple.4

Figure 1.1. A VP Representation

4 Figure 1.1 is an X’ scheme. The complement the apple that combines with the head eat project V'.
The operation Move is responsible for moving the lexical elements from their original position to another position in the sentence, but always to a higher position in the syntactic tree since movement has to be upwards. For example, in the sentence, ‘is the man *ti* eating an apple?’ the auxiliary *is* has been overtly moved from its original position as indicated by *ti* to the clause initial position. Thus, the auxiliary *is* is pronounced clause initially, rather than at the original position – which is called the trace (*t*). Both heads and larger units (e.g., phrases that contain a head and one or more complements) can move. Therefore, it is movement that derives word order variation within and across languages (Chomsky, 1995). However, there are movements that do not affect the word order of a sentence.

Movement is always motivated by feature checking requirements. Only the elements that have lexical content can move. That is, lexical elements move to functional domains to check their inflectional features. The inflectional features of the moved lexical element are compared to those represented in the functional domain with the assumption that they match. Once features are checked, they are deleted. This is called feature checking (Chomsky, 1995). For example, the verb moves to T to check its Tense features, as indicated by the dashed arrow in Figure 1.2 that show a right-branching tree in a verb final language. If the features that are shared are not deleted, the derivation crashes. Feature checking operation is invisible at the surface level and therefore, it does not change the word order of a sentence.

![Diagram](image)

Figure 1.2. Feature checking of the verb
In the Minimalist Program, linguistic structure is a mediator between the two abstract levels of linguistic representation: the Phonetic Form (PF) – the representation of sounds – and the Logical Form (LF) – the representation of meaning (Chomsky, 1995). For example, a movement is ‘overt’ if it has a phonological (and a semantic) effect, meaning that the movement has influenced the word order of the sentence (e.g., a verb or a noun phrase (NP) is pronounced at a place other than its original position). A movement is called ‘covert’ if it has no phonological (but only a semantic) effect. We will use the theory to test our hypotheses on agrammatic performance.

1.3. Linguistic Theories of Agrammatism

In this section, six linguistic theories of agrammatism will be introduced. These theories are the following. (1) The Economy of Derivation (Hagiwara, 1995); (2) The Tree Pruning Hypothesis (Friedmann & Grodzinsky, 1997); (3) The Tense Underspecification Hypothesis (Wenzlaff & Clahsen, 2004, 2005); (4) The Tense and Agreement Underspecification Hypothesis (Burchert, Swoboda-Moll & De Bleser, 2005); (5) The Derived Order Problem Hypothesis (Bastiaanse & Van Zonneveld, 2005); and (6) The Trace Deletion Hypothesis (Grodzinsky, 1995). Some of these theories assume agrammatism to be a representational deficit (Friedmann & Grodzinsky, 1997) whereas others assume that it is a processing deficit (e.g., Bastiaanse & Van Zonneveld, 2005; Burchert et al., 2005). According to representation accounts, grammatical representations are lost in agrammatism and are therefore no longer available to the patients. Processing accounts, however, suggest that the patients have intact linguistic representations but with limited computational resources to fully exploit them. If the former approach is correct, then agrammatism is an all or nothing phenomenon – a patient can either represent a functional element or not. In contrast, if the latter approach is correct, then a patient might show some variation in his/her use of a particular functional element based on the structure of the clause (e.g., linguistically simple versus complex). In sum, whether the deficit is approached as being a representational or a processing problem results in different predictions about the syndrome.

1.3.1. The Economy of Derivation

Hagiwara (1995) was one of the first to examine the status of functional categories and their projections systematically in agrammatic speech. Within the framework of the Minimalist Program (e.g., Chomsky, 1995), Hagiwara (1995) proposed that the lower the position of a functional head and its projection in the phrase structure are, the more
accessible they are to a patient. This theory is based on the analysis of Japanese spontaneous speech and an acceptability grammaticality judgment task, both examining the availability of functional categories and their projections in agrammatism.

In Japanese, the hierarchical order of functional categories is assumed to be CP – AgrSP – TP – NegP – AgrOP – VP. Hagiwara (1995) found that lower functional projections such as TP and NegP were resistant to brain damage although functional projections higher than those, such as AgrSP and CP, were no longer available. This in effect meant that patients frequently omitted complementizers and subjects in obligatory contexts, whereas tense inflection remained available. Interestingly, none of six patients examined could handle elements in C but not those on Tense. The hypothesis – that higher nodes are less available to the patients – was supported by the grammaticality judgment data. For instance, agrammatic speakers had more difficulties in detecting the ungrammaticality of (1) incorrect use of a subject particle, compared to (2) mismatch between tense and adverb, since the functional categories in (1) are related to higher nodes – AgrSP than in (2) – TP.

(1) Saburo-*no/ga    marason-de  yuusho-sita
    Saburo-*genitive/nominative marathon-at win-past
‘Saburo won the marathon’

(2) Taro-wa     kinoo    ryokou-ni  dekake-*ru/-ta
    Taro-TOP      yesterday  a trip-to   go-*present/-past
‘Taro *go/went on a trip yesterday’

Furthermore, Hagiwara (1995) found that severely impaired patients performed poorly in all functional categories while less impaired patients had access to more functional categories. She therefore suggested that there is a relationship between the severity of the impairment and the level of accessibility of a head: the more severe the impairment is, the less accessible the functional nodes are to the patient. This results in variability in performance of the production or comprehension of a particular functional category. However, this variability should exist only among patients, since impairment has degrees, but not within a patient, because a node generating a functional category and its projection can either be available to a patient or not.
Although Hagiwara (1995) stated her hypothesis in Minimalist terms – that the top of the tree is more costly because it requires more merge than the lower parts of the tree – this does not explain why higher nodes are less accessible. It could be a problem with the phrase structure itself, implying that the top of the tree is missing and thus the phrase structure is incomplete. Alternatively, it could be that the patients can construct the full phrase structure but the heads cannot be accessed. The former makes lexical insertion impossible, whereas in the latter, it is the functional heads that are inaccessible to their elements in the lexicon. Hagiwara (1995) states that the latter is a more likely option, since one of her patients judged C related well-formed sentences as grammatical most of the time, suggesting that C was not absent in the patients’ representation; but it is quite hard to tell. In either case, it is not the concept or content of functional categories (i.e. what they express, how they function or whether they are used in linguistically simple or complex sentences) that is assumed to be difficult but their position in the phrase structure.

Obviously, the hypothesis brings forth an important assumption which states that not all functional categories are equally impaired in agrammatism. This is interesting in that not only do not all the languages have the same functional categories but also, the position of the functional categories in the syntactic tree could vary based on the linguistic framework followed. For example, Friedmann and Grodzinsky (1997) posited the Tree Pruning Hypothesis, again on the assumption that the top of the tree is more difficult for patients, but the authors worked within a different linguistic framework that orders functional categories differently. This is discussed in the next section.

### 1.3.2. The Tree Pruning Hypothesis

Friedmann and Grodzinsky (1997) and Friedmann (2000), contrary to the findings of Hagiwara (1995), found that their Hebrew and Arabic speaking patients produced more tense than agreement errors (see 3 and 4, respectively).

(3) Axhav ha-yeled holex. Gam etmol ha-yeled ---- (halax).
Now the boy walks. Yesterday the boy too ---- (walked).

(4) Axhav ha-yeled holex. Berega ze gam-yeladim ---- (holxim)
Now the boy walks. Right now the boys also ---- (walk).
In order to account for the dissociation between tense and agreement, the authors followed Pollock (1989) in assuming that tense and agreement are represented separately in a phrase structure and that the Tense node is located above the Agreement node. The authors then suggested in their Tree Pruning Hypothesis (TPH) that agrammatic phrase structure is pruned from the T node up, thus including CP. This is shown in Figure 1.3, in which the arc shows the pruning site. Nodes above the arc (TP and CP) are pruned from the patients’ representation whereas nodes below the arc (AgrP and below) are available to patients. Note that tree pruning is only relevant to speech production, according to Friedmann and Grodzinsky (1997).

![Figure 1.3. Pruned syntactic representations (Friedmann & Grodzinsky, 1997)](image)

The pruning causes the patients to have no representations for TP and CP nodes. This in turn explains why Hebrew patients have more difficulties in producing elements inflected for tense than for agreement inflection: the patients can project AgrP and agreement is thus intact. However, they cannot project TP and tense is therefore impaired.

One consequence of the TPH is that all finite verbs must be difficult to produce for patients because, according to linguistic theory, all finite verbs move from the V to the T node for feature checking (i.e. finite verbs check their tense and agreement features). Since the patients cannot represent the T node, they cannot move the verb to the relevant node or to a higher node when necessary. Therefore, they cannot check tense inflection. Indeed,
under the standard linguistic theories, a deficient T assumes a deficient Agr. However, this is exactly why the TPH follows Pollock (1989).

The inaccessibility of higher nodes in the syntactic tree has consequences for syntactic structures that are related to these nodes: syntactic structures that require higher nodes are impaired while those that relate to lower ones are intact. For example, in German and Dutch, the base order is Subject-Object-Verb (SOV). However, finite verbs overtly move from their clause-final positions to the second position in the main clause (Verb Second: SVO), as shown in (5), in which t shows the original position of the verb coindexed with the moved position.

(5) de man eet, de appel t

\[ \text{\textasciitilde}\text{\textasciitilde} \]

\{'the man eats the apple'\}

The finite verb in Verb Second constructions moves from V to T and C respectively. However, since TP and CP are not available, the patients cannot move the verb to the relevant nodes and leave the verb uninflected in the clause-final base position. Matrix verbs were found to appear in infinitive form in clause-final position (Bastiaanse & Van Zonneveld, 1998; Kolk & Heeschen, 1992). In sum, impairment in terms of the tree prevents finite verbs from being correctly inflected and positioned, causing problems with derived word order such as Verb Second.

It is important to realize that the TPH implies that the positions low in the syntactic tree are accessible. Therefore, no errors will be made in these lower parts. This implication has been challenged by Bastiaanse, Koekkoek & Van Zonneveld (2003), which is discussed in the next section.

1.3.3. The Derived Order Problem Hypothesis

The basic assumption of the Derived Order Problem Hypothesis (DOP-H) is that all languages have a base word order. For example, English has SVO (subject-verb-object) and Dutch has SOV (subject-object-verb) as base order and all other word orders are derived. The DOP-H assumes that all sentences with derived order are more difficult to

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5 Chomsky (2000) argues that Tense and Agreement are different syntactic elements. Tense is the interpretable feature of T, and Agr is an uninterpretable feature that does not head a separate functional category of its own. In other words, if T is deleted Agr cannot operate either because the host for verb's person and number features has been deleted.
produce and to comprehend than sentences with base word order for agrammatic speakers. For example, the base order in Dutch is visible in the embedded clause (SOV: …dat de man de appel eet, Lit: ‘… that the man the apple eats’). However, the order of the main clause (SVO) is derived by overt verb movement (de man eet, de appel, ‘the man eats the apple’), as explained earlier. Bastiaanse et al. (2002a) found that Dutch patients have more problems with (finite) verb inflection and/or word order in main clauses than in embedded clauses. The authors thus proposed that not all finite verbs are difficult but that those that are overtly moved are more difficult than those in their base positions.

In a subsequent study, Bastiaanse & Thompson (2003) showed for English that (1) sentences with auxiliary movement, as in yes/no questions (e.g., Is John reading a book?) were more difficult to produce than sentences in base order and that (2) there was no difference in the production of the Verb in I (e.g., John reads the book) and Verb in V (e.g., John is reading the book) in English, although Tense is supposed to be part of the I (= Agr, T) node. The authors therefore suggested that the deficit is not related to the position in the syntactic tree but rather to movement. Sentences with moved elements, thus in derived order, are more difficult than sentences with base order for agrammatic speakers. This idea was further tested with sentences with object scrambling, low in the syntactic tree. If derived order is difficult, then sentences with a scrambled object should be impaired. For Dutch patients, object scrambling – moving the object over the adverb (e.g., Jan heeft het boek gisteren gekocht, Lit: ‘John has the book yesterday bought’) – was found to be impaired (Bastiaanse et al, 2003).

Consequently, the DOP-H is not focused on one position in the tree but simply posits that sentences with derived order (sentences in which the order is different from the base order) are more difficult to produce and to comprehend for agrammatic speakers. The DOP-H thus takes only overt movement into account and is free from other types of linguistic movements, such as covert movement that does not have an effect on the order of the surface elements (e.g., covert feature checking).

Note that the DOP-H is restricted to word order. It says nothing on verb inflection as such, recognising only that moved inflected verbs are more difficult than inflected verbs in base position. However, problems with verb inflection – specifically those related to Tense – are in fact not limited to sentences with a derived order. Wenzlaff and Clahsen (2004, 2005) present a different perspective to account for tense-related problems in agrammatic aphasia in general.
1.3.4. Tense Underspecification Hypothesis

Wenzlaff and Clahsen (2004) tested tense and agreement in production and grammaticality judgment in German-speaking patients. The patients were presented with sentences printed on cards in tense and agreement conditions. The sentences each contained a gap and the patients were asked to select a verb from a set of candidate verbs to fill in the gap. An example for the tense (6) and agreement (7) conditions is given below.

(6) Tense Condition

\[
\text{Letzten Monat} \quad \text{änderte} \quad \text{ändert} \quad \text{Du} \quad \text{ordnet} \quad \text{ordnen} \quad \text{ordnest}
\]

(7) Agreement Condition

\[
\text{Du} \quad \text{ordnet} \quad \text{ordnen} \quad \text{ordnest}
\]

For tense, there was no difference between the past and present. However, the authors found tense to be more impaired than agreement in both modalities.

The authors also tested grammatical mood (Wenzlaff & Clahsen, 2005) in if-clauses (‘If you had been reliable, you would have waited’), when-clauses (‘when I was sad, I cried’) or unreal wish clauses (‘if only she were a little more independent’). Example 8 is an example of if-clauses. The other clause types were tested with the same methodology.

(8) If-clause condition

\[
\text{Wenn du zuverlässig gewesen wärst, hätttest du gewartet.}
\]

\[
\text{hast} \quad \text{hättest}
\]
Notice that the verbs that were presented to the patients were already inflected. Interestingly, they also tested Verb-Second in German and found that some patients were impaired in this operation. However, they did not include movement impairments as such as part of their hypothesis (see below), and therefore, this will not be considered further in this section.

According to Wenzlaff and Clahsen (2005), the idea of dissociation observed between some inflectional elements such as tense and agreement can be maintained if it is assumed that T/Infl contains uninterpretable agreement features along with interpretable tense and mood features, following a feature checking model in line with Chomsky (1995). The authors suggest that among the interpretable features of T/Infl, mood distinctions are primary and tense distinctions are secondary. In other words, mood distinctions are more basic than tense oppositions. This is illustrated in Figure 1.4.

The authors (Wenzlaff & Clahsen, 2005) presented a different perspective on verb finiteness phenomena, where primary agreement and mood distinctions are maintained in agrammatic aphasia, while secondary distinctions between [+past] and [-past] are lost. This is known as the Tense Underspecification Hypothesis (TUH), based on the finding that German agrammatic speakers have selective problems with tense but not with grammatical mood (Wenzlaff & Clahsen, 2005) and agreement morphemes (Wenzlaff & Clahsen, 2004). The TUH relates problems with Tense to the T/INFL node in the syntactic tree and suggests that problems with Tense are modality independent.
However, the TUH was not supported by the German data of Burchert et al. (2005), who argued against the idea that the dissociation between tense and agreement is always unidirectional.

1.3.5. Tense and Agreement Underspecification Hypothesis

Burchert et al. (2005) tested tense and agreement in German agrammatic aphasia using a similar test design to that of Wenzlaff and Clahsen (2004, 2005). The patients were asked to select one of the inflected verbs to fill in a gap in tense (from past to present tense or from present to past tense) (see 9) and agreement (person and number agreement) (see 10) conditions.

(9) Tense Condition

\[
\begin{align*}
\text{Gestern suchte ich den Direktor.} & \quad \text{(Yesterday was looking for I the director.} \\
\text{Morgen ---- ich den director.} & \quad \text{Tomorrow ---- I the director.)}
\end{align*}
\]

\[
\begin{array}{c}
\text{suche} \\
\text{suchte} \\
\text{gesucht}
\end{array}
\]

\[
\begin{align*}
\text{(seek-1 sg. = target)} & \quad \text{(*was looking-for-1 sg.)} \\
\text{(*sought=past participle)} &
\end{align*}
\]

(10) Agreement Condition

\[
\begin{align*}
\text{Heute kaufst du das Auto.} & \quad \text{(Today buy you-2 sg. the car.} \\
\text{Heute ---- ihr das Auto.} & \quad \text{Today ---- you-2 pl. the car.)}
\end{align*}
\]

\[
\begin{array}{c}
kauft \\
kaufst \\
gekauft
\end{array}
\]

\[
\begin{align*}
\text{(buy=target)} & \quad \text{(*buy-2 sg.)} \\
\text{(*bought=participle)} &
\end{align*}
\]

There was no preference for past or present tense. However, for tense and agreement, the authors found bidirectional individual variation, although there were no differences between tense and agreement at the group level. In other words, some patients were better at Tense whereas others were better at Agreement, and some patients scored similarly for Tense and Agreement.

Consequently, Burchert et al. (2005) formulated their Tense and Agreement Underspecification Hypothesis (TAUH), which suggests that the representations of certain inflectional features – tense and agreement – are unsystematically underspecified (e.g., bearing no -/+ value) in agrammatic aphasia. A selective underspecification of Tense or
Agreement gives rise to impaired Tense or Agreement morphology, simultaneous underspecification of Tense and Agreement results in Tense and Agreement impairment, or alternatively both features (Tense and Agreement) could remain relatively unimpaired.

The authors relate problems to T and/or Agr, although no pruning is assumed: underspecification does not constrain the set of relevant specifications at T/INFL when there is a difficulty with Tense and/or Agreement. TAUH is meant for production.

What the TPH and TAUH have in common is that they only describe production. The DOP-H and TUH are overarching and predict problems in both production and comprehension. An influential theory that only pretends to cover the comprehension deficit at the sentence level is the Trace Deletion Hypothesis.

### 1.3.6. Trace Deletion Hypothesis

Trace Deletion Hypothesis (TDH) was formulated by Grodzinsky in 1984 and has been revised several times since then (e.g., Grodzinsky, 1995; Drai & Grodzinsky, 2006). It is based on the observation that patients have problems in understanding semantically reversible sentences such as reversible object relatives (e.g., the woman who the man rescues). When such sentences are presented orally and the patients have to choose between two pictures, as in Figure 1.5, they perform at chance level.

![Figure 1.5 Example stimuli used in comprehension tests.](image)

Traces of moved elements are crucial for the correct interpretation of a sentence. Verbs assign thematic roles to arguments in their base positions. Moved arguments receive their thematic roles through their connection to the trace position. In other words, when an element is moved, it leaves a trace (\(t\)) at the original position of that argument (see 11). This trace is coindexed (i) with its antecedent ‘the woman’. Thematic roles are assigned to the trace (this is the original position of the argument before the movement: ‘the woman’ receives the theme role) and the trace transmits the thematic role to the moved argument, which is coindexed to the trace.
(11) the woman, who, the man rescues \( t_i \)

Grodzinsky’s TDH (1995) suggests that argument traces (A-traces) are lost in the agrammatic representation. Consequently, they cannot assign the correct thematic role to a moved argument. For example, in (11) the moved argument ‘the woman’ cannot be assigned a thematic role. The patients thus use a default strategy to guess the thematic role in semantically reversible sentences, as explained below.

Now they are confronted by a sentence representation where one NP has no thematic role. According to Grodzinsky (1995) they use a ‘default strategy’. If an argument has no thematic role, it is assigned a role based on its position in the sentence. For example, in (11) ‘the woman’ has no role because its trace has been deleted, and ‘the woman’ thus receives an agent role because in English the first NP is usually an agent. Now there are two agent roles, one for ‘the man’, which receives its role from the verb, and one for ‘the woman’, which receives its role by default strategy. The patient has to guess and this results in chance level performance, which is usually observed for this kind of sentence.

Although traces remain in theta-positions in both subject-extracted (active clauses: ‘the man rescues the woman’; subject relative clauses: ‘I see the man who rescues the woman’; subject clefts: ‘it is the man who rescues the woman’) and object-extracted clauses (passives: ‘the woman is rescued by the man’; object relatives: ‘I see the woman who the man rescues’; object clefts: ‘it is the woman who the man rescues’), the patients perform better in the former sentence type than the latter. The TDH, which assumes that all argument traces are lost in agrammatic sentence representations, accounts for this pattern by virtue of the default strategy: in subject extracted clauses, the verb assigns the theme role to the object and the moved argument receives an agent role by default strategy. This strategy results in the correct interpretation of the sentences and thus in above chance performance. However, in object extracted sentences, there are two agent roles; one is assigned by the finite verb to the subject of the embedded clause and the other to the moved object by default strategy, as explained in (11). This results in chance performance as a consequence of guessing between two agents.

These are the basic ideas of the TDH (Grodzinsky, 1995) (hereafter old TDH). The latest variant of the hypothesis (new TDH: Drai & Grodzinsky, 2006) will be mentioned in Chapter 5, in relation to another relevant parameter: case information.
1.3.7. Summary
We have described six theories. These theories can be grouped differently based on which modality they focus on: production (TPH and TAUH), comprehension (TDH), or both – overarching hypotheses (Hagiwara, DOP-H and, TUH).

These theories also differ in their general approach to agrammatism, representation versus processing, and therefore, some of these hypotheses are more representation based (impaired syntactic nodes: TPH, Hagiwara; or traces: TDH) and others more processing based (DOP-H, TUH, and TAUH). That is, they assume problems in implementing grammatical knowledge resulting in difficulties with movement operations or rule applications in the face of preserved representations. Table 1.1 provides an overview of all the theories mentioned.

**Table 1.1. Overview of linguistic theories of agrammatism**

<table>
<thead>
<tr>
<th>Production</th>
<th>Comprehension</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hagiwara</td>
<td>+</td>
<td>high nodes</td>
</tr>
<tr>
<td>TPH</td>
<td>+</td>
<td>high nodes</td>
</tr>
<tr>
<td>DOP-H</td>
<td>+</td>
<td>derived structure</td>
</tr>
<tr>
<td>TUH</td>
<td>+</td>
<td>tense</td>
</tr>
<tr>
<td>TAUH</td>
<td>+</td>
<td>tense and agreement</td>
</tr>
<tr>
<td>TDH</td>
<td>-</td>
<td>A-traces</td>
</tr>
</tbody>
</table>

1.4. Studies of Verb Inflection and Word Order
Several studies reported that tense inflection is impaired in structured tests or in spontaneous speech (e.g., for Spanish: Benedet, Christiansen & Goodglass, 1998; for French: Nespolous et al., 1990; for Catalan and Spanish: Ferreiro, 2003; for German: Wezlaff & Clahsen, 2004; for Greek: Tsapkini et al., 2001 and Stavrakaki & Kouvava, 2003; for Dutch: Bastiaanse, 2008).

If Tense is problematic due to its high position in the tree (Friedmann & Grodzinsky, 1997) or because Tense is underspecified (Wenzlaff & Clahsen 2004, 2005; Burchert et al., 2005), then there should be no dissociation between different tense forms – i.e. present, past and future tenses – or within the same tense form. Interestingly, in an elicitation study Tsapkini et al. (2001) found that Greek patients fail to produce the required perfective Tense form most of the time and used present and imperfect past tense forms instead. Apart from that, Stavrakaki and Kouvava (2003) found that past tense is more difficult
than present tense for Greek in spontaneous speech. It is unclear how these findings fit with theories that suggest that the T node is impaired or T is underspecified.

Recently, Bastiaanse (2008) tested time reference with finite and non-finite verbs. She found that the forms referring to the past were more difficult, both for finite verbs (third person singular past tense) and non-finite verbs (participles) compared to forms that refer to the present, both for finite verbs (third person singular present versus past tense) and non-finite verbs (infinitives versus participles). The author concluded that it is not Tense as such but time reference through verb inflection, particularly reference to the past, that is more difficult. These findings are interesting because if time reference through verb inflection is the problem, then problems with tense can neither be accounted for in terms of tree position nor by underspecification of tense features. We will discuss this study and its implications further in Chapter 4.

Several studies also showed that movements that relate to high nodes (e.g., CP) in the syntactic tree are impaired (e.g., wh-questions for Hebrew and Arabic: Friedmann, 2000; yes-no questions for English: Bastiaanse & Thompson, 2003). Agrammatic speakers also have problems with scrambled objects in Dutch and in German (Bastiaanse, Koekkoek & Van Zonneveld, 2003; Burchert, 2007 respectively). It is unclear whether these findings are due to inaccessible nodes in the tree or because of difficulties with overt movement in general.

The comprehension of sentences with traces in theta-positions are also impaired and several studies show that comprehension of subject-extracted clauses are better preserved than the object-extracted clauses (for French: Caplan et al., 1985; for Serbo-Croatian: Lukatela, Shankweiler & Crain, 1995; for Spanish: Beretta, Pinango, Patterson & Harford, 1999; for Hebrew: Friedmann & Shapiro, 2003; for German: Burchert, De Bleser & Sonntag, 2003; for Dutch: Bastiaanse & Edwards, 2004). Note that the difficulty with derived order holds regardless of whether a language has overt case marking (e.g., Hebrew, German, Serbo-Croatian) or not (Dutch). However, the relationship between movement or traces and case in sentence comprehension is not yet clear, since these studies focused only on sentences with varying word orders but not with varying case information. This will be discussed in Chapter 5.

From the findings above, we can conclude that there are two main problems in agrammatic Broca’s aphasia: derived word order and verb inflection, including for time reference. Specifically, (1) base and derived order are produced and understood differently and (2) expressing tense or time reference in general through verb inflection, particularly
reference to the past, is impaired. Accordingly, base order and present tense/time reference seem to be easier structures for patients. However, there is no neurolinguistic theory that predicts impairments in both of these factors, though it is obvious that neither derived order nor time reference through verb inflection alone can account for the data discussed earlier. Indeed, these two independent factors – derived word order and time reference through verb inflection – cannot cover the possible interactions between word order and verb inflection, and their relation to case. These issues will be addressed in this thesis and will be studied for Turkish – a language with free word order, overt case marking and a very rich verb inflection paradigm – leading to the formulation of a sentence frame that is easy to produce and to comprehend for the patients, taking both neurolinguistic findings and the characteristics of Turkish grammar into account.

1.5. Turkish Grammar
Turkish is a language with a relatively free word order and agglutinating word structure. Partially due to its typological properties, such as its basic word order (subject–object–verb: SOV), Turkish has a very rich inflectional system: tense, aspect, modality and subject agreement are marked on the predicate (see 12); number, the possessive and the morphological case that marks grammatical functions is marked overtly on nouns (see 13). There is no gender in Turkish. Turkish is also a pro-drop language, meaning that subjects and/or objects can be null, as can other nominal expressions introduced earlier in the context. These characteristics cause morphology and syntax in Turkish to interact significantly with understanding and sentence production, as will be further explained in sections 1.5.1 and 1.5.2.

(12) tanış- tir- il- ma- diğer-ımız- dan
    introduce- rec- caus- neg- part- plr poss- abbl\(^6\)
    ‘since we were not introduced to each other’

(13) rüya- lar-ımız- da- ki- ler- le
    dream- plr- plr poss- loc- rel- plr- com\(^7\)
    ‘with those who are in our dreams’

\(^6\) Rec=reciprocal; caus=causative; neg=negative; part=participle; plr poss=plural possessive.
\(^7\) Plr=plural; plr poss=plural possessive; loc=locative; rel=relative; com=commutative.
Word order is free in Turkish. Therefore, in a sense, morphology determines the phrase structure, allowing and constraining the use of base and derived word orders through syntactic processes. This is explained in section 1.5.1.

1.5.1. Word Order
The base word order in Turkish is SOV (Erguvanlı, 1984); all other word orders being derived (see 14a–e) by syntactic processes such as object scrambling (see 14a). A simple sentence following subject-object-verb can have six different surface orders, as shown below.

(14) adam elma-(y)ı yi-yor
    man-nom apple-acc eat-aspect/agr
‘the man eats the apple’

    a. elmayı adam yi-yor OSV
    b. adam yi-yor elmayı SVO
    c. elmayı yi-yor adam OVS
    d. yi-yor adam elmayı VSO
    e. yi-yor elmayı adam VOS

According to Erguvanlı (1984) there are three argument positions in a Turkish sentence: sentence initial, immediate preverbal and postverbal. These argument positions have pragmatic consequences for topic, focus\(^8\) and background respectively, based on syntactic processes such as object scrambling, also known as topicalization (see 14a). Turkish has a rich case paradigm. Word order and case inflection are closely bound in Turkish: it is the presence of overt case marking that allows for word order flexibility.

1.5.2. Case Marking
There are six cases in Turkish (nominative: -∅; accusative: -I; genitive: -In; dative -E; locative: -DE; ablative: -DAn). Case is marked by a specific suffix on the noun (as well as on adjectives and pronouns) except for the nominative (nom), which is inflected as a zero morpheme. In main clauses, the subject is generally inflected in the nominative case and

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\(^8\) The immediate preverbal position is the default Focus position but not the only focus position. Göksel and Özsoy (2000, 2003) shows that Turkish has a focus field in the preverbal area rather than a single focus in the immediate preverbal position.
the object is inflected in the accusative case. Accusative case marks definiteness in Turkish since Turkish does not have a definite article. Constituents can easily be scrambled when there is overt case marking.

However, when constituents are not overtly marked for case, not all word orders are allowed. For example, if the object is not inflected in the accusative, only (base) SOV and (derived) OVS orders are grammatical, while the rest of the derived orders (OSV, SVO, VSO and VOS) are ungrammatical (see 15, *=ungrammatical). This is because the object, which is not overtly case marked (= the indefinite object) has to be placed immediately left of the verb (Erguvanlı, 1984). Obviously, word order and case interact significantly in Turkish.

(15) adam elma yi-yor
    man-nom apple eat-aspect/agr
    ‘the man eats an apple’

   a. *elma adam yiyor *OSV
   b. *adam yiyor elma *SVO
   c. elma yiyor adam OVS
   d. *yiyor adam elma *VSO
   e. *yiyor elma adam *VOS

An interaction between word order and case is also seen in subordinate relative clauses. For example, in both subject (16) and object (17) relative clauses, word order within the NP is derived due to the relativization process (NP OVS and NP SVO) through rightward movement. However, the nominative case on subjects and the

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9 Null (unmarked) case is also used to mark indefinite/non-referential objects (e.g., çocuklar elma yedi, children-nom-plural apple eat-past, ‘the children ate an apple’).
10 When the case on the object is null, this is sometimes analyzed as noun incorporation.
11 Word order variation is also allowed in embedded clauses (e.g., gerunds or complements). Apart from that, sentential adjuncts and adverbials can also scramble. However, these will not be covered in the present study.
12 In his 1994 monograph ‘The Antisymmetry of Syntax’, Kayne argues that all phrases whose surface order is not specifier-head-complement, that is SVO, have undergone movements which disrupt this underlying order. Head final languages such as Turkish, Korean and Japanese, however, provide ample evidence contrary to this claim. In such languages, relative clauses precede their head, for instance. Deriving such a word order requires unmotivated complex movements. Consequently, few linguists working on verb final languages adopt Kayne (1994). For arguments from Korean and Japanese against Kayne (1994), see Whitman (2001).
accusative case on objects are not strict in Turkish.\textsuperscript{13} Note that Turkish uses participle (part) verbs in relative clauses, as shown in (16) and (17). Participles are formed by specific suffixes added to the verb stem (e.g., –DIK for the past, –EcEK for non-past i.e. future). Similar morphemes, particularly –DIK and –ECEK are also used to nominalize predicates in complement clauses (see 18). In a complement clause, however, word order is not derived (i.e. SOV). The uppercase letters in the participle morphemes represent underspecified phonemes subject to vowel harmony and other morpho-phonemic rules in Turkish.

\begin{verbatim}
(16) resim çizen Ali
   picture draw-part Ali
   ‘Ali who draws the picture’

(17) Ali’nin çizdiği\textsuperscript{14} resim
   Ali-gen draw-part-agr picture
   ‘the picture that Ali has drawn’

(18) Ali’nin resim çizdiğini biliyorum
   Ali-gen picture draw-part-agr-acc know-prog-1sg
   ‘I know that Ali draws the picture’
\end{verbatim}

The function of inflections in Turkish is not limited to grammatical characterizations. For example, verb inflection and case marking on nouns (Aygen, 1999; Aygen, 2007) can convey semantic information as well. For instance, verbs in Turkish are inflected for time reference reasons.

1.5.3. Time Reference
In Turkish, time reference is expressed through verb inflection. Both finite verbs and participles can express a time frame. Finite verbs\textsuperscript{15} express time through tense/aspect

\textsuperscript{13} In object relatives and complement clauses, the subject is in the genitive case. These variations will be discussed in the relevant research chapters.

\textsuperscript{14} The finite predicate in declarative and conditional sentences is inflected for specific agreement paradigm (1sg: -Im, 2sg: -sIn, 3sg (-∅), 1pl: -lIz, 2pl: -slnlz, 3pl: -lAr). The participle suffix –DIK agrees in person and number (1sg: - Im, 2sg: -In, 3sg: -sln, 1pl: -lmlz, 2pl: -lnlz, 3pl: -lArln) (see Aygen, 2004; 2005 for agreement paradigms).
inflection in the declarative mood (e.g., for past –DI, for non-past –EcEK) (see 19 for past). Participles express time by specific nominalizer inflections (e.g., for past –DIK; for non-past i.e. future –EcEK) (see 20 for past). Time reference in Turkish is thus a morphological process.

(19) finite verb [+ tense ]
    arkadaş-im-ı çağır-di-m
    friend-lsg-acc call-perfect-1sg
    ‘I called my friend’

(20) participle [ − tense ]
    çağır-diğ-im arkadaş-im
    call-perfect-1sg friend-lsg
    ‘the friend who I have called’

The notions of tense and time reference are closely related to the grammatical aspect in which the characteristic of an event (e.g., being progressive, completed or iterative) is expressed. For example, the sentences ‘I called my friend’ and ‘I was calling my friend’ differ in aspect: the former is in the perfect (completed) while the latter is in the imperfect (incomplete and progressive) aspect, although both use past tenses. In many languages including Turkish, tense and aspect are fused or only one is used overtly.¹⁶

A speaker should use tense/aspect on any verb form with a time reference to express modality – his/her subjective attitude to the speaker’s commitment to the truth of the event (Lyons, 1977). Epistemic modality determines how much confidence or certainty the speaker has about his/her proposition. ‘Certainty’ has degrees expressed both grammatically by modal verbs (e.g., ‘he must be at home’ versus ‘he might be at home’) or lexically by adverbials (e.g., ‘he is certainly happy’ versus ‘he is possibly happy’). For example, the past tense is also a kind of epistemic modality (Aygen, 2004; following Lyons, 1977) since it indicates the ‘certainty’ of the speaker towards the proposition expressed (e.g., ‘he was at home’) as opposed to the future that can never be certain (e.g.,

¹⁵ Substantive predicates (nouns, adjectives) can also be inflected for time (e.g., hasta-(y)d-i-m, sick-past-1sg., ‘I was sick’). However, in this thesis, only finite verbs inflected for tense and participles that are not inflected for tense will be discussed.

¹⁶ In Turkish, -Iyor (e.g. gel-iyor, ‘come-aspect/3 sg’: ‘he comes’) is only an aspect with null tense, implying the present. –DI is perfect and past (e.g. gel-di, come-perfect/3 sg: ‘he came’).
‘he will be at home’), since the future is a predication. Accordingly, past time encoded in verb forms (with certainty of past) makes the situation remote in contrast to the present and the future, which are non-remote (Lyons, 1977).\(^{17}\) Note that all verb forms are non-periphrastic in Turkish.

In sum, time reference is expressed through verb inflection in Turkish. Tense and/or aspect and modality are closely related topics: the past expresses the perfect aspect – as opposed to the future, which expresses the imperfect aspect – with a finite verb or a participle, based on how much certainty a speaker has about his/her proposition. Only the past is remote.

1.6. Towards a new theory
Turkish has many interesting characteristics for testing neurolinguistic theories: Turkish is (1) a free word order language – there is a base SOV order and other possible orders can be derived. Turkish is (2) a morphologically rich language, for example reflected by a rich verb inflection paradigm and overt case-marking. Turkish expresses (3) time reference by verb inflection for both finite verbs, inflected for tense and aspect, and participles that lack tense. These morpho-syntactic properties make Turkish an excellent language for studying theories of agrammatic production and comprehension: Turkish provides a rich laboratory for investigating the availability of movement and lack thereof, and grammatical and agrammatical structures in aphasia data.

According to the literature, derived order and time reference through verb inflection are difficult for patients. This could be due to an integration problem and both are determined by pragmatics rather than syntax. These issues will be examined in Turkish, a free word order language, where reference to past and future is expressed by verbs with and without tense inflection and with an overt case system that presents subject case alternations in object relative clauses (e.g., from nominative to genitive). The characteristics of Turkish and the current controversies in neurolinguistic theories and studies call for evaluation at several levels: (1) word order; (2) time reference through verb inflection; (3) interaction between word order and time reference as such; and (4) interaction between word order and case. The question is whether the neurolinguistic findings already reported hold for Turkish. Therefore, the aim is to capture different

\(^{17}\) Chapter 4 discusses why the past is remote as opposed to the present and the future, which are non-remote, through Lyons’ remoteness model.
findings on word order and time reference under one hypothesis, and to simultaneously take case marking into account. Accordingly, the following questions need to be answered.

1.7. Research Questions
The general research questions are the following:

*Word Order*
(1) Is derived word order more difficult than base order in a free word order language like Turkish?

*Verb Inflection, for Time Reference*
(2) Do Turkish agrammatic speakers have problems using verb inflections for time reference?
   (a) Is reference to remote structures with certainty of past more difficult than reference to non-remote structures (e.g., the future)?
   (b) Do the time reference problems get more severe in a derived word order sentence?

*Word Order, Case*
(3) Is there an interaction between the effects of derived word order and the non-base case in sentence comprehension in Turkish?
   In other words, do deviations from both base order and case make sentences more difficult to comprehend than sentences in which only one of these factors is deviant?

In the following chapters these questions are addressed. In Chapter 2, an experiment on word order is discussed. In Chapter 3, the focus is on the combination of word order and verb inflection. In Chapter 4, word order and time reference through verb inflection experiment is discussed. These three chapters concern sentence production. The interaction between word order and case is the topic of Chapter 5, a discussion of a sentence comprehension experiment. Finally, the results will be discussed in Chapter 6.