Agrammatism In Jordanian –Arabic Speakers

Dissertation

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Abstract

Agrammatism is a frequent sequela of Broca's aphasia that manifests itself in omission and / or substitution of the grammatical morphemes in spontaneous and constrained speech. The hierarchical structure of syntactic trees has been proposed as an account for difficulty across grammatical morphemes (e.g., tense, agreement, and negation). Supporting data have come from different languages including Arabic. Other studies have produced different results with different accounts for the clausal functional category errors. Moreover, these studies have not produced evidence of whether the tense agreement dissociation is a sentence production phenomenon or if it may include other modalities. This study investigated question production as well as production and comprehension of grammatical morphemes corresponding to tense, agreement, and negation in Arabic-Jordanian speakers with agrammatism. Additionally, it investigated whether production of functional category in Arabic Jordanian agrammatism reflects the hierarchical structure proposed by the tree pruning hypothesis (TPH).

Control data was obtained from fifteen non-brain damaged Arabic Jordanian speakers. This control data demonstrated that the selected stimuli met testing criteria. The experimental group included fifteen patients diagnosed with Broca's aphasia and agrammatism. There were six females and nine males in each group. Their age ranged from 40 to 80 years. Their level of education ranged from zero to fourteen years. The data of this study was composed of different experiments that had separate scoring and data analysis procedures specified for each experimental task. Two expressive tasks (sentence elicitation and repetition) were used to

examine production of Wh and yes/no questions (Experiment 1). Grammatical morphemes corresponding to tense, agreement, and negation were examined through a sentence completion task (Experiments 2), and comprehension of tense and agreement through grammaticality judgments (Experiment 3).

Results of this study indicated near ceiling performance of control subjects on question production, question repetition, tense, agreement, and negation production, as well as grammaticality judgment tasks. In contrast, individuals with agrammatism demonstrated deficits across each of these tasks. Production of yes/no questions was much better preserved than Wh-questions. However, there was no statistical difference between the production of argument Wh-questions and adjunct Wh-questions. The results of the question repetition task for the agrammatic group revealed that the production of matrix questions repetition was better than that of embedded questions repetition. Sentence completion task results revealed dissociation among functional categories; that is, tense, agreement, and negation were not equally impaired in patients' production. The production of agreement inflections and negation production was much better than that of tense inflections. The results of the grammaticality judgment task revealed that participants with agrammatism had more errors than the control group. However, there was no significant difference in participants' sensitivity between tense and agreement violations. A thorough analysis of each one of these findings was discussed to conclude that TPH is an adequate explanation of the data. TPH states that the syntactic tree is pruned from the tense node and up, leaving the lower nodes such as agreement and negation nodes with less impairment. The resulting data thus provides a good addition to the controversy about the universal and language specific characteristics of agrammatism.

Dedication

This work is dedicated in memory of my parents, Mohammed and Khadija, who taught me to love learning, who taught me that the earth's heart is greater than its map and more clear than its mirror, and for that I am deeply grateful!

And also to the memory of Mahmoud Dawish who taught me that...

“When the sky appears ashen
and I see a rose that has suddenly burst
out of a crack in a wall I don't say:
The sky is ashen!
I extend my study of the rose
and say to it: What a day!”

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CHAPTER 1: INTRODUCTION

Agrammatism is a sequela of Broca's aphasia that is characterized by omission and/or substitution of grammatical morphemes in constrained tasks and in spontaneous speech (Goodglass, 1976). Numerous studies of agrammatism have been undertaken over the last decade. These have included studies in English and several other languages (German, Dutch, Japanese and others). These studies have added to our knowledge of the similarities and differences of agrammatism across languages. However, very little data with respect to Arabic-agrammatic aphasia is available. According to the author's knowledge there are only four published studies that have studied agrammatism in Arabic Broca's aphasic speech. Those studies included Arabic Palestinian (Friedmann, 1998, 2002), Algerian Arabic (Mimouni & Jarema, 1997) and Moroccan Arabic (Diouny, 2008), and none whatsoever on Jordanian Arabic. This relative poverty of studies may be related to a more general lack of research on the syntax of spoken Arabic (a combination of standard and vernacular forms of Arabic) compared to the tremendous amount of research on the syntax of Standard Arabic. Syntax remains one of the least-studied areas of spoken Arabic. It has been the subject of relatively little research (in the generative tradition) compared with other traditions such as lexicon tradition (see for example, McCarthy, 1975).

One of the main premises underlying this study is that syntactic variation across languages or language breakdown is not random, but it occurs according to syntactic, semantic, pragmatic or sociolinguistic principles. The focus of this study is on the

syntactic principle. This is also in line with recent research (see for instance Arabatzi & Edwards, 2000; Friedmann & Grodzinsky, 1997) that a syntactic account of agrammatism.

The assumption of "non-randomness" of syntactic variation means that the syntax or the syntactic breakdown of a language is far from being a random disturbance, but rather, it obeys a set of parameters. These parameters are determined by the principles of the speakers' grammar. This assumption can be extended to the syntactic performance of patients with agrammatism. For example, Friedmann and Grodzinsky (1997) explained the variability among persons with agrammatism within the selective syntactic theory framework; they proposed that "intra-syndrome variation" follows for constrained variation within each functional category. According to their classification, agrammatic features can be exhibited either by impaired tense and / or intact agreement. Hagiwara (1995) reported another pattern of variation in which both tense and agreement are intact, while the higher functional category (complementizers) is impaired.

Studies of the syntactic structure of different languages have shown that syntactic structures differ in several predictable ways and that the differences in syntactic structures create variations in agrammatic speech that differ from one language to another. For example, the nature of inflectional errors seems to depend on the patient's language (Grodzinsky, 2000). Specifically, omissions are observed in zero morphology languages, where inflection omission are observed only when the resulting form is also an item of the language such as the production of bare verbs in English language (e.g., goes→go). In contrast, substitutions occur in languages in which omissions would lead to the production of phonologically illegal words as is the case in Arabic (Grodzinsky, 2000; Mimouni & Jarema, 1997). Subsequent

linguistic investigations have shown the effect of the language specific features on agrammatism across structurally distinct languages. For example, Bates, Wulack and MacWhinney (1991) showed that similarities and differences in the symptoms of agrammatism are determined to a certain extent by the degree to which those languages differ from each other with respect to word order and inflection contrasts. They also showed that agrammatic patients demonstrate selective vulnerability of morphology. That is, the closed-class (e.g., articles, prepositions) impairments in production, comprehension and error detection vary from one language to another.

Cross-linguistic research has added tremendously to our knowledge of the universal and language-specific symptoms of agrammatism. Bates, Wulack and MacWhinney (1991) conducted a literature review of cross linguistic studies with respect to agrammatism and reported the following findings. The first observation made by the authors was the cross-linguistic variation; as demonstrated by Menn and Obler (1990), the same features of agrammatism vary from one language to another. For example, Wulack, Bates and Capasso (1991) used a grammaticality judgment task to investigate agrammatism in Italian and English speakers. They studied word order errors and agreement errors. Their study revealed that Italian speakers performed significantly better at detecting agreement errors compared with English speaking patients. However, word order errors were detected significantly better by the English speaking patients. Therefore, similarities and differences in grammatical symptoms are determined to a certain extent by the degree to which those languages differ from each other with respect to the word order and inflection contrasts (Bates, Wulack and MacWhinney, 1991). Studies of both comprehension and production revealed that patients retain the basic word order biases of their native language (Wulack, Bates and Capasso, 1991). In the same studies, use of grammatical

morphology proved to be especially vulnerable in receptive processing, and the impairment in the use of grammatical morphology was in proportion to the strength of morphology (strong inflection system) in the premorbid language (Bates, Devescovi and Wulfeck, 2001).

The second observation made by the authors was that language breakdown is performance-based rather than competence-based. Cross-linguistic studies revealed that despite the exhibited lexical and grammatical errors, agrammatic patients retained most of their language-specific knowledge. Therefore, aphasic syndromes were viewed in terms of processing deficits rather than loss of linguistic content (Bates, Devescovi and Wulfeck, 2001.) The third observation was that there were a number of contrasts that hold up across different languages. Those contrasts include differences in the production of nouns and verbs, differences in their ability to make use of grammatical redundant elements such as connectives and differences in the nature of morpheme substitution errors (Bates, Wulfack and MacWhinney, 1991).

As pointed out by Bates, Devescovi and Wulfeck (2001) besides documenting universal and language specific symptoms of agrammatism, cross-linguistic studies of grammatical and lexical symptoms help to correct the historical errors that are caused by "the hegemony of English in aphasia research" (Bates, Devescovi and Wulfeck, 2001, p. 383). Therefore, investigating agrammatic features in other languages is important to verify whether English-based findings can be generalized to other languages. This is especially true in light of the dramatic structural contrasts that characterize human language. In this context, Jordanian Arabic serves as an excellent testing ground for functional categories (e.g., verb and agreement inflections) because of the relatively free word order in Arabic versus rigid word order in English; relatively weak inflectional system in English versus strong inflectional system in

Arabic; the difference between perfective and imperfective verbal paradigms with respect to tense information and the morphological asymmetry between positive and negative imperatives. Therefore, the study of grammatical deficits in Jordanian Arabic can enhance our knowledge of similar and different agrammatic features across languages.

Although the focus of this study is on spoken Jordanian Arabic, Standard Arabic and most of the dialects of spoken Arabic (including Jordanian Arabic) all share basic morphological and syntactic properties, such as the definite article /-l/, the obligatory agreement of the noun and modifying adjectives in definiteness, the number agreement system that allows feminine singular verb and adjective agreement with plural nouns, the construct of /idafa/-also called the genitive construct and relative clause structure. Therefore, the study of grammatical deficits in Jordanian Arabic speakers may reflect similar linguistic deficits by other speakers of Arabic dialects.

This study replicates and extends Friedmann's work that proposed the Tree Pruning Hypothesis (TPH) as a selective syntactic account underlying deficits in tense inflection production, Wh-question production and production of complex sentences (Friedmann, 1998, 2002). The TPH suggested the hierarchical structure of a syntactic tree as a possible explanation for the varied patterns of impaired performance among speakers with agrammatism. According to TPH, the syntactic tree may be pruned at various structural levels; a pruned structural level necessitates impairments at all higher levels. For example, if the tense node is impaired, the higher node (complementizer phrase) must also be affected because of its higher position. Specifically, this research is based on two main studies (Friedmann, 1998, 2002) that investigated question production and tense-agreement dissociation in Arabic Palestinian speakers. Friedmann (2002) demonstrated a significant performance

difference in subjects with agrammatism in the production of Wh-questions and yes/no questions in Arabic and Hebrew. The author concluded that the impairment in agrammatic production of questions is selective and is determined by the severity of the agrammatism. The Wh-questions in the three studied languages (Hebrew, Arabic and English) were found to be impaired, whereas yes/no questions in Hebrew and Arabic were found to be intact. The author argued that the two Palestinian Arabic speakers made more tense errors than agreement errors in sentence completion task. Furthermore, she argued that the speakers with agrammatism in her study omitted verbs because they could not move them to the relevant tense node to correctly inflect them. The author (Friedmann, 1998, 2001, 2002) accounted for the observed errors in terms of the hierarchical structure of syntactic trees.

More specifically, the Tree Pruning Hypothesis (TPH) (Friedmann, 1998, 2001, 2002; Friedmann & Grodzinsky, 1997) states that the upper projections of the tree are more impaired when compared with the lower projections (Friedmann, 1998, 2001, 2002; Friedmann & Grodzinsky, 1997). The relevant reported data in the Freedman study (2002) was obtained from a total of 16 speakers with agrammatic aphasia (13 Hebrew, 2 Palestinian Arabic and 1 English speakers). Since her study was limited to two Arabic Palestinian speakers, there may have been insufficient data to explain the actual types of errors seen in these Arabic agrammatic patients. The number of agrammatic participants in the other two studies that investigated the agrammatic features in Arabic was also limited. Furthermore, the Arabic speakers in Freedmann's study participated in a sentence elicitation task but they did not participate in a repetition task which may offer a second measure of the patients' production ability.

Friedmann's study (1998) revealed tense-agreement dissociation in both Hebrew and Palestinian Arabic speaking-agrammatic patients. In her study, Friedmann

examined tense and agreement inflections in 13 (11 Hebrew and 2 Palestinian) patients with agrammatism using sentence completion and sentence repetition tasks. The results of the study revealed dissociation between tense and agreement. This dissociation was apparent in the impaired tense inflection compared to the almost intact subject-verb agreement. The Arabic speakers in this study participated in a sentence completion task but not in a sentence repetition task. The difference between tense and agreement was significant for the Palestinian Arabic speakers in the completion task. The author proposed "dissociation" between these inflectional morphemes in agrammatic speakers. This dissociation was demonstrated by the agrammatic patients' ability to preserve agreement inflection and their relative difficulty in preserving tense inflection. The syntactic account was proposed to explain impaired tense which leads to incorrect tense inflections, copula omissions and word-order errors. The word order errors may also be related to the verb form. Cross-linguistic studies of languages in which the finite (inflected verbs) and non-finite verbs (gerunds, infinitives and participles) appear in different structural positions revealed that patients with agrammatism overuse the non-finite verbs because the pruned tree prevents long-verb movement (Friedmann, 2001). This has the following implication with respect to the word order: the verb is produced in its non-finite form because it does not have finite functional categories to move to. Therefore, when the verb is non-finite, it should also appear in a low node (in a place which is preserved for non-finite verbs) and consequently affects the word order (Friedmann, 1998). Moreover, the study revealed that the complementizers, Wh-words, and embedded structures are either absent or ill-formed.

Although this reported selectivity of impairment is reported in various studies, several studies challenged Freedman's hypothesis both within and across languages

(Crawford & Howell, 1998; Arabatzi & Edwards, 2002; Lee, Milman, & Thompson, 2005). With respect to Arabic language, Diouny's study (2008) revealed that the tense/agreement dissociation was found in four Moroccan-Arabic speakers with agrammatism. The author claimed that the syntactic account as outlined in Friedmann and Grodzinsky (1997) cannot account for the tense/agreement dissociation because Moroccan Arabic has the agreement node above the tense node. However, Benmamoun (2000) and Ouhalla (1994) proposed that tense phrase in Arabic is higher than agreement subject phrase and negative phrase is lower than tense phrase. It is clear that more data needs to be analyzed to fully understand these relationships.

The current study collected data from 15 Jordanian Arabic speakers with agrammatism to examine question production, tense, agreement and negation morphemes to determine if there is evidence of tense, agreement, negation dissociation and Wh-questions-yes/no questions dissociation in these agrammatic speakers; and to examine if this dissociation is a production-specific phenomenon or if it can be extended to other modalities such as comprehension.

Specific Aims

There three primary aims (experimentally designed) and three secondary aims (not experimentally designed but evaluated on a post hoc basis) for this study.

Primary aims:

- 1- To determine if Tree Pruning Hypothesis (TPH) is a possible explanation for the deficit in production as well as in comprehension in Jordanian Arabic speakers with agrammatism by examining:
 - A- Production of complementizer phrase materials across question elicitation (Wh and yes/no questions) in Experiment 1(a) and question repetition (matrix and embedded questions) in Experiment 1 (b).
 - B- Production of other functional categories (TP, AgrP, NegP) in sentence completion tasks (Experiment 2).
 - C- Comprehension of tense and agreement categories in grammaticality judgment tasks of tense and agreement violations (Experiment 3).

Secondary aim:

- 2- To compare CP with other functional categories.
- 3- To compare production and comprehension of functional categories.
- 4- To compare the results of this study with the results of other studies that examined the predictions of TPH in Arabic and in other languages, such as Hebrew and English.

CHAPTER 2: REVIEW OF LITERATURE

Agrammatism had been described in the literature as a syndrome associated with Broca's aphasia marked by qualitative and quantitative reduction in speech output (Goodglass, 1976). This reduction pattern is characterized by the omission and substitution of grammatical morphemes and simplification of produced syntactic structures. Berndt and Caramazza (1980) defined agrammatism as "the omission of grammatical morphemes, reduced phrase length, the omission or nominalization of verbs and difficulties with word order" (p.33).

Arnold Pick (1931) was the first to use the term agrammatism. He differentiated between two forms of agrammatism. The first form was associated with nonfluent aphasia and the other form was associated with fluent aphasia. Pick (1931) characterized the nonfluent form of agrammatism as sentence complexity reduction that is coupled with occasional inflectional-morphological errors. The simplification of syntactic structure and the omission and substitution of the bound and free functional morphemes characterize agrammatic speech (Goodglass, 1976). Research findings are inconsistent as to whether agrammatism is an oral production specific phenomenon or whether it can be extended to include comprehension. Recent research on this topic showed that agrammatism occurs in both production and comprehension, but predominantly in speech production (Kean, 1995; Arabatzi & Edwards, 2002; Wenzlaff & Clashen, 2004).

Cross-linguistic descriptions of agrammatism have been reported in the literature. *Brain and Language*, *Aphasiology*, *Journal of Neurolinguistics*, *Journal of Speech-Language and Hearing Research*, and other journals provide us with an increasing number of descriptive and experimental studies. Many have examined the nature of agrammatism in Broca's aphasia. This work has yielded data of benefit to research, assessment and treatment (Thompson, Shapiro, Tait, Jacobs and Schneider, 1996). These studies can be divided into those with either linguistic or nonlinguistic hypotheses regarding the nature of agrammatism. The following section will briefly review the nonlinguistic and linguistic hypotheses that have been proposed to account for agrammatism. It is not intended to be an exhaustive discussion of all theories about agrammatism, since this would go far beyond the aims of the study. This background rather provides the foundation of the theoretical framework that will be considered in the interpretation of the data collected in this study.

Nonlinguistic hypotheses

The first nonlinguistic account of agrammatism was proposed by Pick (1931) as the "economy of effort theory" which postulated that agrammatism (as deletion of low information lexical items) represents patients' attempts to conserve effort during speech production. From this view point, agrammatism is a compensatory strategy to circumvent production deficits. Heeschen (1985) also viewed agrammatism as a compensatory strategy in what is called "avoidance theory." In this sense agrammatism is a learned behavior used as an adaptive strategy. The claim that agrammatism is an adaptation mechanism was also proposed by Kolk, Van Grunsven, and Keyser (1985) who proposed the "adaptation theory" of agrammatism. This theory proposed that agrammatism is caused by a decrease in computational resources that are necessary for sentence production. According to this theory, agrammatic

patients adapt to their reduced ability to process language within normal time constraints. Specifically, adaptation behavior results from slowing down the processing speed required to apply syntactic rules or retrieve lexical items (Kolk, Van Grunsven and Keyser, 1985).

Linguistic hypotheses

Linguistic theories of agrammatism can be traced to Roman Jakobson (1959) in his neurolinguistic work on the grammatical meaning of aphasia impairments. He referred to agrammatism as a syntagmatic rather than a paradigmatic disorder. According to Jakobson, agrammatism is "a contiguity" disorder in which there is impairment in combining words together to form grammatical sentences.

Another explanation of agrammatism was proposed by Goodglass (1976) in what is called "the stress-salience hypothesis". According to this hypothesis "a basic feature of Broca's aphasia is the increased threshold for mobilizing the speech output system, and the response threshold requires an emphatic or salient element in the message to overcome the elevated threshold and begin the flow of speech." (Goodglass, 1976, p. 252) The salience element may result from "informational load, affective tone, increased amplitude and intentional stress." (Goodglass, 1976, p. 253)

The stress-saliency hypothesis was modified by Goodglass and Menn (1985). They highlighted the influence of stress-salience and fluency on verbal production ability. According to them, some patients with Broca's aphasia retain grammatical morphemes and functors in part because they have intact rate, rhythm and intonation, while nonfluent subjects with Broca's aphasia lack the prosody that enable them to speak fluently (Goodglass & Menn, 1985).

Transformational generative grammar (Chomsky, 1965, 1995) has influenced subsequent work that attempted to explain aphasia impairments from

psycholinguistic, neurolinguistic and linguistic points of view. Among those psycholinguistic theories is the "central linguistic deficit theory" (Grodzinsky, 1984, 1990; Schwartz, Linebarger and Saffran, 1985), in which agrammatism is viewed as a central impairment in the syntactic parsing component of the language system (Schwartz, Linebarger and Saffran, 1985). Since this theory assumes that agrammatism results from a single central deficit to the syntactic processor, parallel deficits are predicted to be found across language modalities (Grodzinsky, 1984, 1990; Schwartz, Linebarger and Saffran, 1985). Proponents of the central syntactic hypothesis provided data that documented a receptive component to agrammatism that paralleled the expressive component (Caramazza & Zurif, 1976). Moreover, other studies demonstrated that patients with Broca's aphasia had difficulties on metalinguistic tasks that require syntactic processing (Zurif, Caramazza and Myerson, 1972). This hypothesis was challenged by data from studies that denied the receptive component of agrammatism (Kolk & Heeschen, 1992; Nespoulous & Dordain, 1988). In these studies, the patients exhibited normal sensitivity to grammatical aspects of sentences on auditory comprehension tests and judgments of the grammaticality tasks.

An alternative linguistic explanation of agrammatism was proposed by Schwartz and her colleague (Linebarger, Schwartz and Saffran, 1983; Schwartz, Linebarger and Saffran, 1985) in the "mapping hypothesis" in which agrammatism is attributed to patients' inability to map semantic roles onto sentence constituents. The source of difficulty was in the patients' inability to abstract thematic meaning from verb roles. For example, the patients were unable to identify roles (agent-action-object) from sentence constituents (subject-verb-object).

Within the linguistic account of agrammatism, many theorists suggested the syntactic impairment as an underlying cause for the symptoms of agrammatism. For example, Chomsky's Government and Binding theory was endorsed by Grodzinsky (1990) as a theoretical explanation of agrammatism. According to Grodzinsky (1990) patients with agrammatism are unable to identify the trace (t) of elements moved from their canonical (S-V-O position) to a noncanonical position. This theory would explain why individuals with agrammatism have difficulty in understanding passive sentences in which the sentential object is moved into the non-subject position. It also accounts for patients with agrammatism exhibit deficits in comprehension of non-canonical Wh-movement sentences (e.g., object relatives) and NP-movement sentences (e.g., passives). Grodzinsky (1995) also proposed the "deficit of movement account" as a selective syntactic account to explain agrammatic comprehension. This account assumes the deficit to be restricted to the movement of phrasal constituents such as noun phrases, whereas it assumes intact verb movement structures. Bastiaanse and Van Zonneveld (1998) asserted that verb movement, not verb morphology was the reason that the Dutch agrammatic speakers are not able to produce finite verbs. Bastiaanse (2001) suggested a revised version of the movement account in which movement to the noncanonical position is impaired while movement to canonical position is intact.

The application of transformational generative grammar lead to a group of theories that explain agrammatic difficulties in terms of deficits in functional categories (FCs). FCs represent a set of grammatical elements related to syntactic features. According to the current syntactic theories in the generative tradition, sentence structure can be represented as a syntactic tree. Content words and functional categories are represented in various nodes within the syntactic tree. The functional

categories include the following categories ordered from the top to the bottom of the tree as demonstrated by Pollock (1989): Complementizer phrase (CP), tense phrase (TP), negative phrase (NegP), agreement phrase (AgrP) and verb phrase (VP). The CP is located at the upper node of the syntactic tree. It hosts complementizers such as *if*, and Wh-question morphemes such as *what* (Friedmann, 2002). During question production, Wh-morphemes move from the base generated position within the VP to CP. Impairment at CP should impair the production of Wh-questions in languages that require the movement of Wh-morphemes to CP such as English, Arabic and Hebrew (Friedmann, 2002). For yes/no question production, CP is required in some languages such as English and Dutch. However, it is not required for yes/no question production in languages such as Hebrew and Arabic (Friedmann, 2002). The current linguistic theories showed the following sequence for verb movement and inflection. When the verb is inserted from the lexicon into the V in the VP, it raises to the Agr node to "collect its agreement inflection" according to Pollock and to "check the inflection features" according to Chomsky. Afterwards, it moves to the T node to "collect/check" its tense inflection node (Friedmann, 2002).

The movement pattern of the verb is determined by two factors: the language and the verb form. The inflected verb (finite verb inflection) usually moves high in the tree, whereas the non-finite verb does not need to move and stays in the low node (Friedmann, 2002).

Many researchers attributed the linguistic difficulties exhibited by agrammatic aphasics to a deficit in the functional categories of grammar and their projections. For example, Ouhalla (1991) claimed that functional categories fail to project on the syntactic tree. Ouhalla went further to suggest that structural representation of sentences in agrammatic speech is without functional projections associated with

agreement and tense morphemes. Hagiwara (1995) argued that the more "economic" a structure is the more accessible it is. Tree Pruning Hypothesis (TPH) is an extension of Ouhalla and Hagiwara's work that described language-related deficits in agrammatism in terms of functional category deficits.

The Tree Pruning Hypothesis (TPH)

More recent research suggests that the error patterns that characterize agrammatism are not only determined by different types of inflectional categories (morphology) but also by their location in the syntactic tree, which indicates that the verb forms are selected based on their syntactic properties of movement within the syntactic tree (Grodzinsky, 2000). Friedmann (1994) was the first to report data supporting this claim. She studied features of agrammatism in one Hebrew-speaking patient and found that the patient had impaired tense but intact agreement. This difference between the two inflectional features has been called tense-agreement dissociation and it has been replicated in a series of Friedmann's studies (Friedmann, 1998, 2001, 2002; Friedmann & Grodzinsky, 1997). This finding gained special importance in light of recent developments in linguistic theory, namely the split-inflection hypothesis (Pollock, 1998). According to this hypothesis there are structural differences between tense and agreement, with distinct functional categories for each. This hypothesis was the driving force for a large body of work that examined the tense-agreement dissociation as two clausal-functional categories within the syntactic tree in the Tree pruning hypothesis (TPH). These findings were first reported for one Hebrew-speaking patient (Friedmann, 1994), then replicated with 11 Hebrew and 2 Arabic-speaking patients (Friedmann, 1998), again with 13 Hebrew and 2 Arabic-speaking patients (Friedmann, 2002) and with other languages (Ruigendijk, Kouwenberg and Friedmann, 2004). TPH has made a significant

contribution to the literature. Agrammatic aphasia was described in the literature with equal impairment to all functional categories. The TPH, however, proposed the hierarchical ordering of the functional categories on the agrammatic syntactic tree (Grodzinsky, 2000). Subsequently, proponents of TPH view cross-linguistic variation in agrammatism within the syntactic framework and analyze the similarities and differences in grammatical symptoms with respect to the hierarchical ordering of the functional categories (e.g., complementizers, tense and agreement).

One of the frequently reported observations in these studies is the highly selective pattern of impairment in clausal- functional categories. For example, studies have shown that some patients with agrammatism exhibited intact case, coordination conjunctions, subject-verb agreement and negation markers, while tense inflection was impaired (Friedmann, 2001, 2002; Friedmann & Grodzinsky, 1997; Ouhalla, 1991; Wulfeck, Bates and Capasso, 1991). The general premise of TPH is that agrammatic patients in any language would produce the following three categories from the most affected to the least affected in the following consecutive order: CP, tense and agreement (Friedmann, 1998, 2001, 2002; Friedmann & Grodzinsky 1997). When the syntactic tree is impaired on a certain node the higher nodes will be impaired as well. However, the theory seems to be unable to account for some reported cases in which patients had spared upper nodes, such as CP morphology, but an impaired lower node, such as IP related morphology (Lee, Milman and Thompson, 2005). The following discussion reviews the studies that have been found in support of the TPH and those studies that provided data not in support of this hypothesis.

Proponents of TPH

Several studies investigated the ability of agrammatic individuals to form questions in Hebrew, Arabic, and English (Friedmann, 2002; Thompson, Ballard and

Shapiro, 1998; Thompson & McReynolds, 1986; Thompson et al., 1996), specifically, the difference between Wh- and yes/no questions. Other studies focused on tense and agreement dissociation in declarative sentences (Arabatzi & Edwards, 2002; Friedmann & Grodzinsky, 1997; Milman, Dickey and Thompson, 2004, 2008; Thompson, Shapiro and Schendel, 1994; Thompson & Shapiro, 1995). The overall conclusion of these studies was that question production in English speakers with agrammatism was equally impaired in both Wh-questions and yes/no questions. The ungrammatical pattern was exhibited by including the auxiliary in a position after the noun, as in the production of declarative sentences, and by not starting the questions with an auxiliary or a copula (Friedmann, 2002). However, in Hebrew and Palestinian Arabic, yes/no questions were not impaired and relatively preserved when compared with Wh-questions (Friedmann, 2002). With respect to tense and agreement dissociations, Friedmann and Grodzinsky (1997) and Friedmann (1998) reported severe impairment in verbal tense resulting mostly in tense substitutions, impaired copula resulting in tense substitution and omission errors, omission in Wh-question words and complementizers, word order deficits and impaired ability in the production of embedded structures. Hagiwara (1995) studied elements associated with the complementizer phrase (CP) such as complementizers and Wh-elements, and the inflectional phrase (IP) such as tense, negation and postposition particles in Japanese agrammatic patients and found impaired performance on CP but not with IP.

These findings have also been replicated in several other languages. For example, Ruigendijk, Kouwenberg and Friedmann (2004) examined the performance of Dutch agrammatic speakers on different types of questions and found that the Dutch agrammatic individuals were severely impaired in question production. The pattern of observed errors was similar to the English speaking individuals. Wenzlaff and

Clahsen (2004) examined agreement-tense dissociation in seven German speakers with agrammatism. The results of the study revealed that the German speakers with agrammatism did not exhibit any significant errors in subject–verb agreement, whereas the agrammatic performance on tense was considerably worse than that of the control group.

The literature on question production in agrammatic Broca's aphasic patients in the previously mentioned languages revealed the following pattern of question production deficit: in English, Hebrew, Palestinian Arabic, Japanese and Dutch languages, the production of Wh-questions was found to be severely impaired (Friedmann, 2002; Friedmann & Grodzinsky, 1997; Ruigendijk, Kouwenberg and Friedmann, 2004). Yes/no questions were also severely impaired in English and Dutch (Friedmann, 2002; Ruigendijk, Kouwenberg and Friedmann, 2004), but they were not impaired, and relatively preserved, when compared with Wh-questions in Hebrew and Palestinian Arabic. Freedman found “dissociation” between Wh- and yes/no questions (Friedmann, 2004). With respect to the matrix (where the Wh-morpheme is placed at the beginning of the sentence) and embedded (where the Wh-morpheme is embedded in the sentence) Wh-questions, both were found to be impaired in English, Hebrew and Palestinian Arabic because they require intact CP, and the CP is impaired (Friedmann, 2004). Subject and object questions were found to be equally impaired in English, Hebrew and Palestinian Arabic (Friedmann, 2004). This equal impairment is related to the fact that subject and object questions in the three languages "require deletion of either the subject or the object from the declarative sentence and creation of a dependency between the gap and the Wh-morpheme" (Friedmann, 2004, p. 174). The nature of Wh-question errors was structural-based errors, e.g., "doubling and Wh- in situ, false starts that include only the Wh- morpheme and substitution by yes/no

questions" (Friedmann, 2004, p. 177). Those structural-based errors indicated the accessibility of the lexical Wh-items but inaccessibility of CP (Friedmann, 2004).

The observed agrammatic errors within and between the previously mentioned languages reflect the hierarchical structure of syntactic trees (Friedmann, 2004). The dissociations between Wh-questions and yes/no questions in Hebrew and Palestinian Arabic is predicted and explained by the Tree Pruning Hypothesis (Friedmann, 1998, 2001, 2002; Friedmann & Grodzinsky, 1997). As a result of this hypothesis, dissociations can be explained based on the fact that the highest nodes of the tree are impaired (Friedmann, 2004). Those nodes are represented by the syntactic elements that are generated in both TP and CP (Friedmann, 2004). Therefore, question production requires the movement of the Wh-element to CP in Hebrew, Palestinian Arabic and English. Because CP is inaccessible for agrammatic individuals, Wh-questions are not accessible for them (Friedmann, 2004). On the other hand, yes/no questions in Hebrew and Arabic are produced without the need of the CP element (Friedmann, 2004). Therefore, Wh-questions are impaired, and yes/no questions are not. Freedman (1998, 2001, 2002) explains that dissociation is related to the general concept of the required movement within the syntactic tree. She claimed that questions that do not require the CP (and the TP) node to be produced are well formed in agrammatic production; however, questions that require elements in CP are impaired. Friedmann and Grodzinsky (1997) maintain that Hebrew and Arabic agreement markers are relatively unimpaired and have error rates of less than 10% because they are located lower in the tree, whereas tense is impaired because it is located in a higher node. This account was able to explain the pattern of agrammatic deficits in many languages such as German, Japanese, Spanish and Dutch (Friedmann, 2004).

Arguments against TPH

A number of studies that investigated agrammatism within the syntactic framework provided data that does not support the TPH. Arabatzi and Edwards (2002) investigated the inflectional errors in both declarative and negative sentences of eight English speakers with agrammatism. Their patients showed a tendency to "inflect the verb rather than using the bare stem" (Arabatzi & Edwards, 2002, p. 324). They proposed a different account for the observed inflection deficits that is counter to the TPH offered by Friedmann and Grodzinsky (1997). The authors proposed faulty implementation of syntactic processing, such as the inability to check the tense feature in the tense node, as an explanation of the observed errors in their data. Further evidence indicating that the TPH is not supported in explaining the selective pattern of deficits was reported by Thompson, Fix and Gitelman, (2002). Their study showed that IP elements were impaired while CP elements were preserved in their agrammatic patients. Lee and Thompson (2005) investigated three functional categories in two English-speaking patients with agrammatism. These functional categories included production of complementizers (e.g., if, whether and that) as elements that represent Complementizer Phrase (CP), and tense (-ed) and agreement (-s) as elements that represent Inflectional Phrase (IP). Although their data was limited to two agrammatic patients, the total number of analyzed tokens was relatively high in the designed tasks. The authors proposed that the impaired implementation of morphological rules explained the observed selective patterns of deficits. The results of their study showed that the TPH was not supported because the IP was found to be impaired while the CP was found to be preserved. Moreover, the results of their study showed that the agrammatic patients were able to apply inflectional rules but "had

difficulty selecting the appropriate morphemes" (Lee, Milman & Thompson, 2005, p. 119).

In Moroccan Arabic, tense/agreement dissociation has been found (Diouny, 2008); however, the author claimed that the syntactic account as outlined in Friedmann and Grodzinsky (1997) cannot explain the tense/agreement dissociation because Moroccan Arabic has the agreement node above the tense node. The author claimed that the order of functional categories in the extended projection of the Arabic verb is as follows: AgrpP > TP > V (Akkal & Gonenai, 2002) rather than TP > AgrpP > VP as reported in Friedmann's study (Pollock, 1989). However, many authors provide an alternate hierarchical order in Arabic that matches Pollock's order of the functional categories. For example, Demirdache (1988) as cited in Friedmann (2002) and Ouhalla (1994) supported the original order as advocated by Pollock (1989). The author argued that the production deficit in Moroccan Arabic agrammatism is not in agreement with the Tree-Pruning Hypothesis and cannot be described in terms of a structural account. Instead, his account posits that agrammatic errors can be explained by difficulties in the implementation of grammatical knowledge that leads to limited processing capacities. In this sense, the Moroccan subjects had difficulty accessing syntactic knowledge which leads them to an adaptation strategy that was exhibited by dropping items that are difficult to process (Diouny, 2008).

One of the most critical issues that need to be clarified is the hierarchical position of the major functional projections in Arabic. There has been a debate about whether the hierarchy of projections is subject to cross-linguistic variation. Pollock (1989) provided the following order of the functional categories in English (CP) > (TP) > (NegP) > (AGR) > (VP). Chomsky (1995) provided the following order for English

CP > AGR > Neg > TP. Shlonsky (1997) provided the following order for Hebrew and Arabic:

a- Simple tenses:

Agreement subject phrase (AgrSP) > (NegP) > TP > Aspectual phrase (AspP) > Agreement object phrase (AgroP) > VP.

b- Compound tenses:

AgrSP > (NegP) > TP > VP Aux > Agr part P > Asp P > AgroP > VP

The present study adheres to the assumption made by Benmamoun (2000) that TP in Arabic is higher than agreement subject phrase (Agrsp) and negative phrase (Negp) is lower than TP.

As reported in several studies (Arabatzis & Edwards, 2002; Bastiaanse & Van Zonneveld, 1998; Bates, Devescovi and Wulfeck, 2001; Friedmann, 1994, 2001, 2002; Grodzinsky, 1990, 2000; Hagiwara, 1995; Menn & Obler, 1990; Ouhalla, 1991; Reznik, 1995; Thompson et al., 1996; Thompson, Shapiro and Schendel, 1994; Wulfeck, Bates and Capasso, 1991) the performance of speakers with agrammatism varies from individual to individual. Because the results of these studies have been mixed in their support of TPH, Milman, Dickey and Thompson (2004, 2008) investigated the variability in the performance of speakers with agrammatism in the production of morpho-syntactic elements (functional categories) using narrative samples of 18 English speakers with agrammatism. The authors analyzed their data using Item Response Theory (Linacre & Wright, 2002). The purpose of using IRT was to determine whether the variability in the patients' performance could be explained in a probabilistic framework. The results of their study revealed that the hierarchical order of syntactic trees characterize the production patterns of the majority of participants on most functional categories. However, as illustrated by the

authors, this relationship is not deterministic or absolute but rather probabilistic. In other words, the deficit at a certain structural level does not necessarily require deficits at the higher nodes. Rather, it increases the probability of their occurrence.

Because there are differences in studies that support and do not support TPH, an explanation of these reported differences is warranted. The first explanation is that language-specific features determine the pattern of omissions and substitutions found in patients with agrammatism (Friedmann, 2002). For example, English patients with agrammatism were found to delete grammatical affixes from words which lead to another stem that was typically phonologically and morphologically well formed. However, in Arabic as well as languages such as Italian, Icelandic and Greek where stems are not typically morphologically well-formed words, patients with agrammatism are reported to substitute affixes and never produce bare stems (Grodzinsky, 2000). As reported by Freedman (2002), because omission of inflection in Hebrew is not an option, agrammatic errors are substitutions rather than omissions. However, in English, omission of verb inflection is possible and a common deficit in speakers with agrammatism.

Another possible explanation as reported by Edwards (2000) is the variation in performance of speakers with agrammatism. Performance also varies according to the type of testing stimuli. Structured tasks found to reveal more subtle deficits than spontaneous speech; therefore, different tasks are needed to obtain unbiased data (Edwards, 2000). Inadequate statistical analysis that takes into consideration the variability in the patients' performance, and the difficulty of each syntactic projections are other possible explanations. Milman, Dickey and Thompson's (2004, 2008) perspective in addressing new statistical methods seems promising and their initial results indicated that IRT is a reliable measurement technique that can be used

accurately in identifying and analyzing the pattern of deficits of sentence production in patients with agrammatism.

Finally, lack of unified criteria for what is considered a correct response or an incorrect response is another possible explanation. For example, Friedmann (2002) reported that Goodglass et al. (1972) scored Wh-questions as correct even when they were ungrammatical because they contained all of the elements required for a positive score.

To summarize the findings of the previous mentioned studies with respect to the TPH, there are two main trends: The supporting trend is represented by a large number of studies of different languages that showed that there is tense agreement dissociation, with more impairment in tense than in agreement. The counter trend is represented by studies that showed no such dissociation was found.

Production/perception nature of agrammatism

Another related issue in support of TPH that has been inconclusive is whether the tense-agreement dissociation is production specific or can be extended to include other modalities such as comprehension. There has been a debate about whether the tense-agreement dissociation observed in patients with agrammatism is production-specific or both a production-perception phenomenon. The literature review with respect to this matter in agrammatism has not yet produced conclusive results (Wenzlaff & Clahsen, 2004). Friedmann and Grodzinsky (1997), Friedmann (2002) and Grodzinsky (2000) considered the dissociation between tense and agreement in agrammatism as a production-specific phenomenon. They studied agreement tense dissociation in Hebrew, Arabic and English languages. Supporting data for this claim has also been reported by Kolk, Grunsven and Keyser (1985). In contrast, other studies showed that patients with agrammatism were not able to judge sentences

containing inflectional errors as ungrammatical. Supporting data for this claim was reported by Arabatzi and Edwards (2002). They investigated a grammaticality judgment task comprising 30 sentences in eight English-speakers with agrammatism. The results revealed that all patients with agrammatism made errors on this task with a mean of 42.5% errors that ranged from 26.7% to 66.6%. Further support for this claim was reported by Wenzlaff and Clahsen (2004). They tested all six person and number forms of German in 7 German-speakers with agrammatism. The ungrammatical sentences contained agreement violations and/or tense violations. The German speakers with agrammatism were able to select the appropriate tense form in only 68.2% of all cases. Between group comparisons confirmed that the patients with agrammatism performed significantly worse than the control group on tense, whereas no such statistical difference was found between the two groups on agreement. The authors reported supportive data for this claim from Parisi and Pizzamiglio (1970) with 28 Italian-speakers with agrammatism. They found more impairment in error detection of the present, past and future tense morphology than in (number) agreement detection errors. Also Goodglass, Christiansen and Gallagher (1993) and Benedet, Christiansen and Goodglass (1998) reported higher error scores for number agreement than for tense in both their English and their Spanish patients. Dickey et al. (2005) examined the perception of complementizers and verb inflections by English speakers with Broca's aphasia on grammaticality judgment tasks. The study results revealed that the subjects' ability to detect agreement and tense violations was not the same and was contrary to the logic of the Tree-Pruning Hypothesis. The relative preservation of complementizers compared to verb inflection (finite auxiliaries and main verbs) was against the predictions of TPH. Therefore, more cross-linguistic research is needed to determine whether the expected agreement-tense dissociation

holds for both production and perception. The controversial issue of whether agrammatism is production specific or not was investigated in current study. There were three experimental tasks that included: Question production in sentence elicitation and repetition tasks (Experiment 1); a sentence completion task to assess verb morphology (Experiment 2) and a grammaticality judgment task for declarative sentences (Experiment 3). The ungrammatical sentences in the third experiment contained the morphology of the inflectional agreement and tense violations.

Verbal morphosyntactic features in Jordanian Arabic

In this study the term Jordanian Arabic (JA) refers to Arabic as used in Jordan both in its standard and vernacular forms. JA includes Standard Arabic (SA) which is used in the media and in the educational system, as well as a vernacular form that is used in daily life. The vernacular form is the most common type of communication in Jordan. From a sociolinguistic view, the similarity in language usage in Jordanian Arabic was a result of the spread education/mass media and teaching of classical/modern Arabic (Abdel Jawad, 1986; Codora, 1992). This lead to increased contact between Arabic vernaculars and modern Standard Arabic. Another factor that leads to this similarity was the spread of urbanization that was associated with the in-migration of Palestinians from the West bank to Jordan (Abdel Jawad, 1986). Because of sedentarization and urbanization of Bedouin groups and the in-migration of Palestinians, there has been contact between rural/urban Palestinian dialects and rural/Bedouin Jordanian dialects. This contact has lead to the incorporation of rural and urban features into the newly sedentarized speakers' usage in Amman (Abdel Jawad, 1986; Codora, 1992).

JA is characterized mainly by the absence of case markers, distinctive syntactic case of negation, free word order, absence of mood distinctions, absence of dual or

gender distinctions in the plural form, reduced type of used complementizers and affixal number agreement between the verb and the subject regardless of the word order. More detailed description of the structural properties of JA versus SA will follow in the remainder of this chapter.

Since the focus of this study was on the clausal-functional categories in Jordanian Arabic, there was a special focus on the number of categories that most human languages share. These included tense, negation and agreement. The meanings of the verbal forms that are related to the clausal-functional categories in Arabic, whether classical or modern dialects, have long been the subject of debate among Arabic linguists. For example, the question of whether the Arabic perfective and imperfective verb forms represent aspectual (completion versus non completion of the verb) or temporal forms (past versus non-past). To solve this issue, this study will adopt the position of linguists (e.g., Akkal & Gonegai, 2002; Benmoumoun, 2000) who examine these theoretical issues within the minimalist framework and provide empirical generalizations that can be applied to the Arabic dialects.

Tense, negation and agreement in Jordanian Arabic & Standard Arabic

The syntax of tense in Standard Arabic and Jordanian Arabic

The verbal paradigms in Standard Arabic and in many other Arabic dialects including-Jordanian Arabic-are divided into perfective and imperfective paradigms (Benmoumoun, 2000).

1- Perfective

Katab-tu

Write.past-1s

"I wrote"

2- Imperfective

?a-ktub-u

1s-write-ind

I write / I am writing

The perfect tense carries tense information, where the imperfective does not. Therefore, in Arabic language, the head (upper node) of TP in the present imperfect tense is specified for only one categorical feature, namely, the agreement feature. The tense category feature structure that occupies the head of the tense projection and forces the verb movement to check or collect tense is not available in the present tense. Therefore, it is not instantiated on any lexical head in Arabic, and this is why the present tense in Arabic is considered the default form of the verb in Arabic (Benmoumoun, 2000).

Verb movement within minimalism is motivated by feature checking. That is, the verb moves to the tense node to check its tense feature. Benmamoun (2000) reported that only the imperfect present tense in Arabic lacks the feature that forces it to be paired with a verbal element; however, the past tense and future tense as well as imperatives are specified for this feature. To clarify, English verbs are specified for two categorical features, the feature [+V] (tense category) and the feature [+D] (agreement category). The [+V] feature determines the interaction between tense and verb, while the [+D] feature determines its interaction with the subject. Based on that information, Benmamoun (2000) assumed that in the Arabic present tense only [+D] categorical feature is used for imperfect and therefore, there is no copula in the Arabic present tense. This is important because the copula is located in the T node. Therefore, if the T is underspecified, the copulas will be impaired too. In the case of the past tense, the presence of the copula is obligatory because the past tense is [+V] and the copula then checks the categorical [+V] feature (Benmoumoun, 2000).

Example of the copula in past tense;

Ka:n yu:sif fi-lbayit

be.past.3ms Yusuf in def- house

"Yusuf was in the house."

The feature structure of the elements that occupy the head of the tense projection was highlighted by Benmoumoun (2000) by demonstrating that the elements in tense do not have the same categorical feature specifications in the present, past and future tenses. The past tense has a [+V] feature, which must be checked by a verb, while the present tense is not specified for a [+V] feature. The following table describes features in the three tenses.

Present [deictic]	[+D]
Past	[+D, +V]
Future	[+D, +V]

In both past and future tenses, the tense feature checking mechanism is a [+V] feature that is preceded by the agreement [+D] feature, while in the present tense only agreement [+D] feature is used because the present tense is the default .

Verb morphology in Standard Arabic

The main difference between the perfective form and the imperfective form in Standard Arabic is a morphological difference; that is, the realization of their agreement features. In the imperfective form, the agreement features are realized by both prefixes and suffixes. In the perfective form, all the agreement morphology is realized by suffixes. The complete paradigm for the perfective and imperfective forms in Standard Arabic is given in Tables 2.1 and 2.2.

Person	Number	Gender	Affix	Affix+Verb
1	Singular	F/M	?a-	?a-ktub
2	Singular	M	ta-	ta-ktub
2	Singular	F	ta-ii	ta-ktub-ii
3	Singular	M	ya-	ya-ktub
3	Singular	F	ta-	ta-ktub
2	Dual	F/M	ta-aa	ta-ktub-aa
3	Dual	F/M	ya-aa	ya-ktub-aa
1	Plural	F/M	na-	na-ktub
2	Plural	M	ta-uu	ta-ktub-uu
2	Plural	F	ta-na	ta-ktub-na
3	Plural	M	ya-uu	ya-ktub-uu
3	Plural	F	ta-na	ta-ktub-na

Table 2.1: Standard Arabic Perfective

Person	Number	Gender	Affix	Verb+Affix
1	Singular	F/M	-tu	Katab-tu
2	Singular	M	-ta	Katab-ta
2	Singular	F	-ti	Katab-ti
3	Singular	M	-a	Katab-a
3	Singular	F	-at	Katab-at
2	Dual	F/M	-tumaa	Katab- tumaa
3	Dual	M	-aa	Katab-aa
3	Dual	F	-ataa	Katab-ataa
1	Plural	F/M	-naa	Katab-naa
2	Plural	M	-tum	Katab-tum
2	Plural	F	-tunna	Katab-tunna
3	Plural	M	-uu	Katab-uu
3	Plural	F	-na	Katab-na

Table 2.2: Standard Arabic Imperatives

Verb morphology in Jordanian Arabic

Jordanian Arabic is similar to Standard Arabic in the distribution of agreement features in the imperfective and the perfective. However, in Jordanian Arabic the paradigms are fewer than in Standard Arabic. Specifically, there are no mood distinctions, at least morphologically. Also in Jordanian Arabic there are no dual or gender distinctions in the plural forms. The two paradigms from Jordanian Arabic are illustrated by Tables 2.3 and 2.4.

Person	Number	Gender	Affix	Verb+Affix
1	Singular	F/M	-t	katabt
2	Singular	M	-t	katabt
2	Singular	F	-ti	katabti
3	Singular	M	-Ø	katab
3	Singular	F	-it	katabit
1	Plural	F/M	-na	katabna
2	Plural	F/M	-tu	kababt
3	Plural	F/M	-u	kababu

Table 2.3: Jordanian Arabic Perfective

Person	Number	Gender	Affix	Affix+Verb
1	Singular	F/M	?a-	?aktub
2	Singular	M	tu-	tuktub
2	Singular	F	tu-i	tukutbi
3	Singular	M	yi-	yiktub
3	Singular	F	ti-	Tiktub
1	Plural	F/M	ni-u	Niktub
2	Plural	F/M	ti-u	tiktubu
3	Plural	F/M	yi-u	Yiktubu

Table 2.4: Jordanian Arabic Imperfective

Agreement

Agreement paradigms in Standard Arabic

The word order determines the agreement between the verb and the subject in standard Arabic (Benmamoun, 2000). If the subject follows the verb, the verb carries person and gender agreement. Benmamoun (2000) referred to this as "partial agreement." However, if the subject precedes the verb, the verb carries the number, person and gender features. Benmamoun (2000) referred to this as "full agreement." Partial agreement and full agreements are illustrated in the following examples consecutively as illustrated by Benmamoun (2000).

?akal-at t- ?aalibaat-u

eat.past-3fs def-students.fp-nom

"The students ate."

t- ?aalibaat-u ?akal-na

def-students.fp-nom eat.past-3fp

"The students ate."

Number agreement is realized by an affix only in the SVO orders. In standard Arabic this particular kind of asymmetry is obtained in the context of the SVO versus VSO orders. Benmamoun (2000) added that the number agreement must be realized by an affix on the verb if the latter is not followed by an overt lexical subject.

Also as illustrated by Benmamoun (2000), in standard Arabic, when the lexical subject occurs between the auxiliary verb and the main verb, the subject partially agrees with the auxiliary and fully agrees with the main verb. The following examples are illustrated from Benmamoun (2000).

Ka:nat ʔ- ʔa:liba:t-u ya-ʔakal-na

be.past.3fs the –students.fp-nom 3-eat-fp

"The students were eating."

ʔ- ʔa:liba:t-u kun-na ya- ʔkul-na

the-students.fp-nom be.past.3fp 3-eat-fp

"The students were eating."

Please notice here that the complete versus partial agreement can't be marked in the literal translation to English. /ka:nat/ in the first sentence is the third feminine singular of verb to be in the past. It is translated into "was" in English. /kuna/ in the second sentence is the third feminine plural of verb to be in the past. It is translated into "were" in English.

Agreement paradigms in Jordanian Arabic

In Jordanian Arabic dialect number agreement between the verb and the subject is realized by an affix, regardless of word order as shown in this example:

ʔakal-w lawla:d

eat.past-3mp def-boys

"The children ate."

lawla:d ʔakal-w

def-boys eat.past-3mp

"The children ate."

Also, in Jordanian Arabic, the verb carries full agreement regardless of the position of the subject with respect to the auxiliary verb and the main verb as illustrated in the following examples:

Ka:nat	ʔ- ʔa:libaat	takul
be.past.3fs	the –students.fp	3fs-eat
ʔ- ʔa:liba:t	Ka:nat	takul
the –students.fp	Be.past.3fs	3fs-eat

"The students were eating."

Negation in Standard Arabic

As illustrated by Benmamoun (2000), sentential negatives in Standard Arabic are located between TP and VP. Sentential negative particles can be reduced to include two main negation particles: /laa/ and /maa/. The difference between /laa/ and /maa/ is due to their syntactic status. That is, /laa/ is used with the present tens as a default form of negation. /maa/ does not inflect for tense or agreement and can merge with the lexical cubject in the sentence. Apart from /maa/ and the ability of /laa/ to inflect for tense, sentential negation in Standard Arabic patterns with its counterpart in Jordanian Arabic. There are three negation particles in Standard Arabic that are considered as variants of negation particle /laa/; these include /lam/ and /lan/ that carry tense information and /laysa/ that carries agreement information. /laysa/ is a free morpheme that can be be used as anincomplete verb. It can be prefixed with feminine and masculine agreement inflections. /lam/ and /lan/ are two negation particles that support tense (past and future). /laa/ and /layssa/ do not inflect for tense; they occur in the context where no verb movement to tense takes place (present and future).

Negation in Jordanian Arabic

Sentential negation in Jordanian Arabic as well as in many modern Arabic dialects is realized by two morphemes, the proclitic /ma/ and the enclitic /š/, and in some expressions by one single element /ma/ or /š/ (Benmamoun, 2000).

The proclitic in this context means the negation morpheme that precedes the word to which it is phonologically joined, and the enclitic is the negation morpheme that is phonologically joined at the end of a preceding word to form a single unit.

Examples;

ma-...a-t- š laila

Neg-come.past.3fs-neg Laila

"Laila didn't come."

ma-bad-i

Neg-want-my

"I don't want."

badd-i- š

Want-my-neg

"I don't want."

Benmamoun's (2000) analysis of sentential negation in Arabic was that the markers *ma* and *š* in modern Arabic dialects are located in the head position of the negative projection. Also Benmamoun (2000) argued that there is a strong evidence that sentential negation in Arabic is specified for a agreement feature, which must be checked in the syntax. He provided the following evidence to support his analysis. The evidence comes from agreement. For example, standard Arabic negative *laysa* agrees with subject as in:

Laysa ?al-ṭa:lib laysat ?al-ṭa:libatu

Neg.m. def-student (masculine) neg.f. def-student (feminine)

"It is not the student (male)" "It is not the student (female)"

Also negation can merge with pronominals as in:

ma-ni:š	ma-nta:š	ma-nti:š
neg-I-neg	neg-you (masculine)-neg	neg-you (feminine)-neg
“I am not”	“You are not (male)”	“You are not (female)”

In Jordanian Arabic, the merger of the verb with negation is obligatory when tense is perfect. However, the merger of negation and verb present tense is optional; that is, both options are available.

Examples;

ma-bi-yi-ktib- š	m i š bi –yi-ktib
Neg-asp-3m-write neg	neg-neg asp-3m-write
"He isn't writing."	"He isn't writing."

Summary

Agrammatism is a frequent sequela of Broca's aphasia that manifests itself in omission and/or substitution of the grammatical morphemes in spontaneous and constrained speech. With respect to morphology impairment, varied patterns of this impairment have been documented in many languages. The hierarchical structure of functional categories in syntactic trees has been proposed as an account for this variability. Supporting data have come from different languages including Arabic. Other studies have produced different results with different accounts for the clausal functional category errors. Moreover, these studies have not produced evidence of whether the tense agreement dissociation is a sentence production phenomenon or if it may include other modalities. The current study investigates the sentence production characteristics in Jordanian Arabic speakers with agrammatism. The data of this study comprises the results of different experiments that had separate scoring and data analysis procedures specified for each experimental task. There were three

experimental tasks that included: Question production in sentence elicitation and repetition tasks (Experiment 1); a sentence completion task to assess verb morphology (Experiment 2) and a grammaticality judgment task for declarative sentences (Experiment3). The ungrammatical sentences in the third experiment contained the morphology of the inflectional agreement and tense violations.

CHAPTER 3: METHODOLOGY

Participants:

Fifteen native Arabic-speaking individuals with agrammatism (experimental group) and fifteen native Arabic non-brain-damaged speakers (control group) were examined on three sentence processing tasks. The group of individuals tested comprised cross-sectional representation of the general population of Amman, Jordan. The group of subjects included persons of various backgrounds; Jordanians of Jordanian, Palestinian, Chechnyan and Sharkas origins. Although the population was diverse with respect to ethnic background, it is important to note that the dialect differences between groups have been found to be insignificant with respect to the comprehension and production of JA (Abdel Jawad, 1986; Rashid, 1981).

The experimental group included patients diagnosed with Broca's aphasia and agrammatism. The diagnosis of agrammatism was confirmed by differential diagnosis including the speech-language pathologist's diagnosis based on speech samples and the results of an Arabic aphasia test (The Bilingual Aphasia Test Arabic, Jordanian, Paradis & Libben, 1987)

Patients who met the following inclusion-exclusion criteria were recruited as the sample for this study:

- 1- Aphasia due to single/multiple stroke identified by neurological and radiological examination (ischemic cerebrovascular accident and hemorrhagic

cerbrovascular accident). Patients were required to have a unilateral left-sided lesion with no clinical or radiographic evidence of diffuse or multifocal brain damage.

- 2- No history of speech or language disorder prior to the onset of the stroke.
- 3- For those patients with dysarthria (articulatory impairment), speech was sufficiently intelligible to determine the accuracy with which target morphemes were produced.
- 4- Medical stability (physically stable at least three months post onset).
- 5- Patients were required to produce two-word utterances.
- 6- Word-finding difficulties were required to be mild enough to allow connected conversation.
- 7- Adequate auditory comprehension and visual processing to complete the experimental tasks based on visual field testing and performance in connected speech for ordinary conversation and communication of test required.
- 8- All participants were Jordanian-Arabic native speakers (monolingual or bilingual).
- 9- At least 18-years old.
- 10- Participants included both illiterate and educated Jordanian-Arabic.

The control group included fifteen neurologically intact participants that matched the agrammatic participants in age and educational level, gender, job level and dialect. There was one-to-one matching between the two groups. The obtained data from the control group was used to obtain standardized scores that worked as "norms" or the basis to assess the production of clausal functional category in the subjects with agrammatism. The biological information (age,

gender and handedness), neurological information (etiology, number of days post onset and severity of aphasia) and demographic information (level of education) were collected for each patient and are presented in Table 4.1.

The subjects of the study were recruited from the Speech and Language Clinic at King Hussein Medical City.

Data collection

The collection of data for the tasks described below occurred at the Speech and Language Clinic at King Hussein Medical City. All data were collected by one speech language pathologist who is experienced in diagnosing and treating this group of patients. The required time to obtain the data from each individual subject ranged between three to four (one hour sessions) sessions. In the event of an incomplete gathering of data from an individual in the clinic, a follow-up visit to the subject's home occurred for the completion of the desired data gathering. All sessions were tape recorded and then transcribed by the examiner in a quiet environment.

Tasks:

Clausal functional categories including question production, verb inflections (past tense, modal verbs and Agreement) and negation were tested in three experiments. The three experiments included:

- A- Question production in sentence elicitation and repetition tasks (Experiment 1).
- B- Sentence completion task to assess verb morphology (Experiment 2).
- C- Grammaticality judgment for declarative sentences (Experiment 3).

Experiment 1: Question production

Stimuli

This experiment investigated question production in Jordanian-Arabic speakers with agrammatism, using question elicitation and repetition tasks. The focus was on comparison of Wh-questions and yes/no questions.

In order to examine the production of Wh-questions and yes/no questions, two sets of stimuli were developed. The total number of stimuli included 36 questions divided into 24 questions for the Wh-question production (12 argument questions and 12 adjunct questions) and 12 yes/no questions that were developed using the same verbs as in Wh-questions. To examine question production in the repetition task, twelve matrix and embedded questions were developed (see Appendix A for description of consonant sounds of Arabic and Appendix B for a full list of the questions.)

Design and materials

This study follows a cross-sectional design in which agrammatism was evaluated across a cohort of patients with agrammatic Broca's aphasic admitted to the Speech and Language Clinic at King Hussein Medical City.

Procedures

Task description: Question elicitation task

The question elicitation task was an adaptation of Friedmann's task (2002). A total of 36 questions were divided into the following blocks:

- 1- Twelve argument questions (subject and direct object): the argument questions included 4 questions for subject (who), 4 questions for animate object (who) and 4 questions for inanimate object (what).

Example:

çali ?akal ši

Ali.ms eat.past-3ms something

“Ali ate something.”

You want to ask about this thing, so you ask

The target response is

šu ?akal çali

What eat.past-3ms Ali.ms (subject)

“ What did Ali eat?”

For full list of stimuli please see appendix B.

- 2- Twelve adjunct questions: those questions included 4 questions for where, 4 questions for when and 4 questions for why.

Example,

?al- ?awlad bi-yurkuđu

def-boys asp-run-ind

"The boys are running."

You want to ask about the cause, so you ask

le:š ?al- ?awlad bi-yurkuđu

Why def- boys asp-running

“Why are the boys running?”

For full list of stimuli please see Appendix B.

3- Twelve yes/no questions: the same verbs were used in both Wh-questions and yes/no questions.

Example,

çali ka:n mariid
Ali.ms be.past.3ms sick (adjective)ms.

"Ali was sick."

You want to know if he went to the school, so you ask.....

The target response is

çali raħ lil- madrasi ?
Ali.ms go. past -3ms to-school ?

"Did Ali go to the school?"

For full list of stimuli please see Appendix B.

Participants were trained extensively before starting the task to ensure that they understood the task. The training session involved examples of question elicitation and lasted until participants understood the task. The participants were given the following instructions in Arabic. "Now I will present you with a sentence that is missing some details about a person, a place, a time or a cause. I will ask you to form a question asking about the nonspecific term which can be someone, something or someplace. When you ask the question, you should be careful about the time things happen (for example does it say yesterday, today or tomorrow). For example, If someone visited you yesterday and I want to ask about that person, I would ask: Who visited you yesterday? Don't worry and take your time. If you do not understand the task, ask me and I will repeat it again. Now let us do some further examples and we will start once you feel that you are ready." There were no time constraints for task completion nor was there feedback from the examiner.

Scoring for question elicitation task

I- Scoring for Wh-question elicitation task

A correct "+" score was assigned to questions that were syntactically and semantically correct and contained the minimal number of morphemes. These morphemes represent the syntactically correct sentence in Jordanian Arabic that used as the criterion for correct sentence production in this study. The minimal number of Number of morphemes included the subject, verb and inflections for tense, person, gender and number agreement. Items were still scored as correct if additional elements were added as long as these elements were still semantically and syntactically appropriate. Correct responses for the subjects included, the name provided in the example (e.g., Ali), an alternate name or the personal pronoun "you". With respect to the verb, the only accepted verb substitution was a semantically related synonym to the target verb. An incorrect "-" score was assigned if the following question production errors occurred:

Omission errors that included:

- 1- Incomplete questions (e.g., only a Wh-morpheme and nothing else).
- 2- Ill-formed Wh-questions of the form "Wh-NP" or "NP Wh- morpheme".

These included missing one or more of the minimal required morphemes that included the subject, verb and inflections for tense, person, gender and number agreement.

Substitution errors that included:

- 3- Wrong Wh-morpheme selection that is syntactically correct.
- 4- Correct Wh-morpheme with substitution errors in one or more of the minimal required morphemes that included the subject, verb and inflections for tense,

person, gender and number agreement. Some errors of this type were syntactically correct but semantically inappropriate questions.

Other errors that included:

- 5- Don't know responses.
- 6- Incorrect question type (i.e., Wh-question that is produced as a yes/no question).
- 7- Production of noun phrase statement (i.e., nominal sentence (SVO) but no Wh-word was used.). Declarative instead of interrogative.

For a full list of scoring criteria and examples on each type of error, please see Appendix E .

II- Scoring for yes/no question elicitation task

A correct "+" score was assigned to yes /no questions, that were syntactically and semantically correct and contained the minimal number of morphemes. Number of morphemes included the subject, verb and inflections for tense, person, gender and number agreement inflections. An incorrect "-" score was assigned if the following question production errors noticed:

- 1- Omission errors leading to incomplete questions with only a single word and nothing else. This includes production of the subject only, object only, the verb only or the adjective only.
- 2- Incorrect question type of the form "Wh-NP" or "NP Wh-morpheme": (i.e. using wh-morpheme to ask yes/no question).
- 3- Substitution errors leading to ill-formed yes/no question that includes errors due to inflections in (tense, person, gender and number agreement or both.). This type also included syntactically correct but semantically inappropriate alternate yes/no question.

4- Don't know responses.

For a full list of scoring criteria and examples on each type of error, please see Appendix E.

Statistical analysis

Data Transformation

The results of the collected data in the three experiments are expressed as proportions or percentages on nominal measurement. However, the data size is relatively large (15 in experimental group and 15 in control group) and the percent correct scores can be treated using scale transformation. Thus, the transformed values have approximately normal distribution which enables us to perform inferential statistics such as t-tests and ANOVA. Both t-tests and ANOVA require that the data for the dependent variables consist of numerical values measured on interval or ratio scale.

There are many different possible transformations. Here we used the “Rationalized” Arcsine Transform which transforms the raw scores into rationalized arcsine unit (rau) scores because it is widely used in speech and hearing research, more specifically, in speech sound and word identification testing. The main advantages of (rau) as described by Studebaker (1985) include the correction for the correlation between means and variances associated with percentage data, the linearization of the data in relation to the variance which makes the comparison of different pairs of the data possible because they have the same intervals, the applicability of performing t-test and ANOVA and the appropriateness of using percentage-like numbers to be used in the results interpretation and discussion.

The Studebaker (1985) Rationalized Arcsine Transform Online Program (RATARC) was used to obtain the rau scores. After obtaining the rau scores for each

level of the study variables, the scores were entered into SPSS to conduct t-tests and ANOVA. It should be noted that in all inferential statistics that included finding mean values, variance, standard deviation, t and F values, rau scores were used to obtain such values. However, in tables and graphs that showed the mean percentage of correct scores, the original (untransformed) percentages were kept to facilitate comparisons between the variables. Therefore, the mean percentage of correct scores used in this study refer to the untransformed percentages unless otherwise specified and in this case, the (rau) scores will be reported with the obtained values.

Statistical analysis for Experiment 1

Task: Sentence elicitation.

1- Question production in sentence elicitation task:

A- To determine whether agrammatic participants produce fewer grammatical questions than the control group, the independent-measures t test was used to decide whether or not there is a significant mean difference between the normal subjects (control group) and patients with agrammatism (experimental group).

All other procedures were conducted on the experimental group unless otherwise indicated.

B- To determine if there is a difference in question elicitation production among argument Wh-question, adjunct Wh-question and yes/no question productions, single factor repeated-measures analysis of variance (ANOVA) was used to test for mean differences among the three question types.

Task: Sentence repetition.

The question repetition task followed Friedmann's (2002) methodology and included both six matrix and six embedded questions. The target questions were read aloud by the examiner at normal reading speed. Patients were asked to repeat the questions. Participants were trained extensively before starting the task to ensure that they understood the task. The training session involved examples of question repetition and lasted until participants understood the task. The participants were given the following instructions in Arabic. "Now I will read some questions that include the Wh-question at the beginning of the sentence or embedded in the middle of the sentence. I will ask you to repeat the sentence exactly as you hear it from me without any additions, substitutions or omissions. For example, when I ask you to repeat "who drank the tea? you should say who drank the tea?" Don't worry and take your time. If you do not understand the task, ask me and I will repeat it again. Now repeat after me ..." There was no time constraint for task completion, nor was there feedback from the examiner. The order of tasks was randomly varied among participants. For full list of stimuli please see Appendix B.

Scoring for the repetition task

The response was scored correct "+" if the patient said the same sentence as the examiner without addition, omission or substitution of words. The response was scored incorrect "-" if the patient produced a different sentence or nonsentence.

For full examples for each type, please see Appendix E.

Statistical analysis

Data transformation:

The same data transformation procedure in elicitation task was adopted in repetition task.

Statistical analysis for question repetition task

A- To determine whether the performance of agrammatic participants repeat fewer grammatical questions than the control group, the independent-measures t-statistic was used to decide whether or not there was a significant mean difference between normal subjects (control group) and patients with agrammatism (experimental group).

B- To determine if there was a difference in question repetition production between matrix questions and repetition questions, the t-test for two related samples was used to decide whether there was a significant difference in the means.

Coding reliability for Experiment 1

An independent coder transcribed and coded 30% of the data (3 out of each group) from audio tapes and intercoder point-to point reliability was calculated. Overall agreement ranged from 95 to 100% with an overall mean of 98%.

Experiment 2: Sentence completion task for verb inflections

Stimuli

The goal of this experiment was to examine verb inflections (tense and agreement features), and negation markers using a sentence completion task. In order to examine the production of tense verb inflections, a set of stimuli (19 high frequency verbs) was developed. The same set of stimuli was used to examine subject-verb agreement inflections. To examine the production of negation, one set of stimuli was

developed. This set included 12 pictured verbs, given to the patient to produce the negative counterpart. For full list of stimuli please see Appendix C.

Task description

Sentence completion task: verb inflections

Participants were presented with action pictures that represented daily living activities. A written sentence describing the action picture but without the verb itself was placed under each picture. The required task was to supply the missing verb in the appropriate tense and gender.

Example,

huwa bi-yakul tufaḥa

Pronoun.ms asp-3m-eat an apple

"He is eating an apple."

?imbarih huwa..... tufaḥa

"Yesterday hean apple."

The target verb was /ʔakal/ ate.

For full list of stimuli please see Appendix C.

Verb negation

The participants were given 12 pairs of photographs in which one represented a performed action and the second one represented the negative version of the first photograph. The participant was asked to produce a sentence containing negation as illustrated in this example,

Example,

huwa bi-yiṣāhid tilfaaz

pronoun. ms asp-3m-watch. TV

"He is watching the TV."

huwa ma-bi- yiŠahid tilfaaz

pronoun. ms neg. asp-3m-watch TV

or

huwa ma-bi- yiŠahid-iŠ tilfaaz

pronoun. ms neg. asp-3m-watch-neg TV

"He doesn't watch the TV."

For full list of stimuli please see Appendix C.

Scoring criteria for sentence completion task and negation production

Tense inflection

The response was scored correct "+" if the patient said the required verb with the correct tense. The response was scored incorrect "-" if (1) the patient produced a different verb (the only accepted verb substitution was a semantically related synonym to the target verb), (2) produced the verb with the wrong tense or (3) produced a non verb. It should be noted that the participants' production of the other syntactic elements in the sentence were not considered in scoring; only tense inflection was considered in the scoring criteria.

For full examples for each type, please see Appendix E.

Agreement inflection

The same criteria were implemented for the agreement morphology (person, gender and number). If the subject produced the correct verb with the correct agreement inflection, the response was scored as "+", or incorrect "-" if the patient produced (1) no verb, or incorrect verb, (2) incorrect person agreement inflection, (3) incorrect gender agreement inflection or (4) incorrect number agreement inflection.

As in scoring the tense inflections, participants' production of other syntactic elements were not considered in scoring the agreement inflections; only agreement inflection was considered in the scoring criteria.

For full examples for each type, please see Appendix E.

Verb negation

The response was scored as "+" or "-". A correct "+" was scored if the patient said the correct negation form that included the correct negation particle and the correct target. An incorrect "-" was scored if the patient produced (1) no negation particle, or an incorrect negation particle, (2) only a negation particle or (3) a verb with tense and/or agreement violation/s, a different verb, or no verb to merge negation particle with.

For full examples for each type, please see Appendix E.

Statistical analysis for Experiment 2

For all tasks in this experiment, the same data transformation procedure in Experiment (1) was adopted.

Task: Sentence completion

The three categories (tense, agreement and negation) were balanced in frequency of the verbs, the length and complexity of utterances.

To investigate whether performance in the three categories was difficult between the agrammatic participants and the control group, an independent-measures t-test was used to decide whether or not there was a significant mean difference between normal subjects (control group) and patients with agrammatism (experimental group). Single-factor repeated-measures analysis of variance (ANOVA) was used to test for mean differences among tense, agreement and negation categories.

Coding reliability for Experiment 2

An independent coder coded 30% of the data (3 out of each group), and intercoder point-to point reliability was calculated. Overall agreement ranged from 97 to 100% with an overall mean of 99%.

Experiment 3

Task: Grammaticality judgment for tense and agreement violations

Stimuli

The goal of this experiment was to investigate whether a parallel pattern of deficit existed in grammaticality judgment by examining the subjects' ability to detect tense and agreement violations. To examine this, a set of stimuli consisting of 30 sentences that included agreement and tense morphological-inflectional violations was developed.

Task description

Thirty sentences containing agreement violations (17 sentences) and tense violations (13 sentences) were presented orally to the participants. They had to decide whether the sentences were grammatical or ungrammatical. Examples were given before demonstrating the task to ensure that the participants understood the tasks.

Example,

The incorrect form:

?ilwalad raḥat lil-madrasa

The-boy go.past-3fs to –the school

The boy went (go.past-3fs) to the school.

The correct form: ?ilwalad raḥ lil-madrasa

/raḥ/ is past form of go (masculine), raḥat (feminine form).

For full list of stimuli please see Appendix D.

Scoring for grammaticality judgment task

Thirty sentences containing agreement violations (17 sentences) and tense violations (13 sentences) were presented to the participants. The examiner scored the participant's response as correct "+" if the participant correctly judged the sentence as incorrect, or incorrect "-" if the participant incorrectly judged the sentence as correct, or gave no answer after 10 seconds.

For full examples for each type, please see Appendix E.

Statistical analysis for Experiment 3

The same data transformation procedure in Experiments 1 and 2 was adopted in this experiment.

To investigate if grammaticality judgment for tense and agreement violations was affected by type of participants (Agrammatic versus normal participants), the independent-measures *t* statistic was used to decide whether or not there was a significant mean difference between experimental group and control group.

To investigate if there was a statistically significant difference in grammaticality judgment between tense and agreement violations, the *t*-test for two related samples was used to decide whether or not there was a significant mean difference between them.

CHAPTER 4: RESULTS

This chapter presents an overview of the results relevant to each of the research questions. Results are presented in the following order: results for question production, question repetition, functional category production and grammaticality judgment tasks.

Thirty participants were involved in this study, fifteen native Arabic- Jordanian speaking individuals with agrammatism (experimental group) and fifteen native Arabic-Jordanian non-brain-damaged speakers (control group). The demographic information for the fifteen individuals with agrammatism is summarized in Table 4.1. Six of these participants were females, and nine were males. Age of participants ranged from 40 to 80 years old (female mean = 56.7, SD = 10.5; male mean = 62.3, SD = 13.8). Education level ranged from zero to fourteen years (female mean = 7.5, SD = 6.3; male mean = 7.9, SD = 5.5). The severity of agrammatism was determined by clinical ratings and results of the Arabic aphasia test. Of the 15 participants, five (two females and three males) were rated as mild, five (one female and four males) were rated as moderate, five (three females and two males) were rated as severe. The demographic information for the fifteen non-brain damaged controls matched the experimental individuals in age, gender and level of education. See Table 4.2.

Subject	Gender	Age	Education (years)	Hand	Months Post-onset	Hemiplegia	Severity as determined by clinical rating and Arabic Aphasia Test
1	F	47	14	R	36	Right hemiplegia	Severe
2	M	65	14	R	3	Right hemiplegia	Moderate
3	M	52	8	R	36	Right hemiplegia	Severe
4	M	45	13	R	60	Right hemiplegia	Mild
5	F	64	0	R	24	Right hemiplegia	Severe
6	M	54	14	R	108	Right hemiplegia	Mild
7	M	70	5	R	15	Right hemiplegia	Moderate
8	F	65	0	R	12	Right hemiplegia	Moderate
9	M	80	0	R	6	Right hemiplegia	Severe
10	F	61	9	R	28	Right hemiplegia	Mild
11	M	80	0	R	36	Right hemiplegia	Severe
12	F	63	8	R	84	Right hemiplegia	Severe
13	M	45	10	R	13	Right hemiplegia	Moderate
14	M	70	7	R	216	Right hemiplegia	Mild
15	F	40	14	R	12	Right hemiplegia	Severe

Table 4.1: Background Information on Agrammatic Subjects

Subject	Gender	Age	Education (years)
1	F	47	14
2	M	65	14
3	M	52	8
4	M	45	13
5	F	64	0
6	M	54	14
7	M	70	5
8	F	65	0
9	M	80	0
10	F	61	9
11	M	80	0
12	F	63	8
13	M	45	10
14	M	70	7
15	F	40	14

Table 4.2: Background Information on Control Subjects

Experiment 1(a): Question elicitation.

I- Results from question elicitation production

First, we investigated whether agrammatic participants produced fewer grammatical questions than the control group. Our results showed that percentage of correct questions in the agrammatic group was 57% (312/540). Compared to 95% (512/540) in the control group. An independent-measures t-test was used to analyze the results of question production elicitation task as a function of participant group (normal, agrammatic). Results of this independent measures t test, presented in Table 4.3, revealed that this difference was statistically significant, $t(20.144) = -5.876$, $p < .001$, $d = .63$

Group	Mean (rau)	SD	t	DF	Sig.
Experimental	57.56	26.63	-5.876	20.144	< .001
Control	102.39	12.81			

Table 4.3: Results of independent measures t test for question production elicitation task.

The control data demonstrated that the selected stimuli met testing criteria in terms of frequency, length and complexity of the tested linguistic structures. Given that the data on control subjects included very few errors, we did not perform a quantitative analysis of their production of different error types. The quantitative analysis focused on the experimental group only.

We investigated if there was a difference in question elicitation production for argument Wh-question, adjunct Wh-question and yes/no question productions in the experimental group. The percentages and proportions of correct argument Wh-questions, adjunct Wh-questions and yes/no questions for each participant in the experimental group are represented in Table 4.4 and depicted in Figure 4.1.

Participants with Agrammatism	Argument Questions: Untransformed Percentage Correct (Proportion)	Adjunct Questions: Untransformed Percentage Correct (Proportion)	Yes/No Questions: Untransformed Percentage Correct (Proportion)
1	33 (4/12)	8 (1/ 12)	100 (12/12)
2	33 (4/12)	67 (8 / 12)	83 (10/12)
3	0 (0/12)	0 (0/ 12)	25 (3/12)
4	92 (11/12)	83 (10 / 12)	92 (11/12)
5	0 (0/12)	0 (0 / 12)	42 (5/12)
6	92 (11/12)	67 (8/ 12)	100 (12/12)
7	33 (4/12)	17 (2/ 12)	92 (11/12)
8	75 (9/12)	58 (7 / 12)	75 (9/12)
9	17 (2/12)	17 (2 / 12)	83 (10/12)
10	92 (11/12)	92 (11 / 12)	100 (12/12)
11	17 (2/12)	33 (4 / 12)	75 (9/12)
12	17 (2/12)	33 (4 / 12)	83 (10/12)
13	67 (8/12)	75 (9 / 12)	100 (12/12)
14	83 (10/12)	33 (4 / 12)	100 (12/12)
15	50 (6/12)	58 (7 / 12)	100 (12/12)

Table 4.4: Elicitation of Wh and Yes/No Questions.

Figure 4.1: Percentages of correct argument, adjunct, and yes/no questions.

The results summarized in Figure 4.1, show a deficit in argument Wh question production (rau mean = 45.66, SD = 35.04) and adjunct Wh question production (rau mean = 41.42, SD = 31.65) in the experimental group. The production of yes/no questions (rau mean = 86.67, SD = 25.64) was higher than that of argument questions and adjunct questions. A single factor repeated-measures analysis of variance (ANOVA), presented in Table 4.5, revealed a significant mean effect for question type (Wh-argument, Wh-adjunct and yes/no question) on the question elicitation task, $F(2, 28) = 36.268, p < .001, \eta^2 = .72$

Value of Wilks' lambda	Df (numerator)	Df (denominator)	F	Sig.	Partial Eta Squared	Observed power
.197	2	28	36.268	< .001	.721	1.000

Table 4.5: Results of the repeated-measures ANOVA for question type

Sidak's post-hoc results for question type, presented in Table 4.6, indicate a significantly better production of yes/no questions but no significant difference between argument questions and adjunct questions.

	Argument	Adjunct	Yes/No
Argument		-4.245	41.011*
Adjunct	4.245		45.256*
Yes/No	-41.011*	-45.256*	

Table 4.6: Results of Sidak post hoc test for types of question type.

*. The mean difference is significant at the .05 level.

Error analysis for question elicitation production

Participants with agrammatism made 228/540 (43%) errors in the elicitation production task. These errors 199/228 (87%) were Wh-questions and 29/228 (13%) were in yes/no questions.

Error types in Wh-question (argument and adjunct) production elicitation task

The observed error types included Wh-morpheme substitutions and omissions, as well as other types of errors. These can be further divided into seven types of errors described in Table 4.7.

Type of Error	Description of error type
Omission	
Type 1	Incomplete questions (e.g., only a Wh- morpheme and nothing else).
Type 2	In complete questions (e.g., missing one or more of the minimal required morphemes that included the subject, verb, and inflections for tense, person, gender, and number agreement.
Substitution	
Type 3	Incorrect Wh-morpheme selection that is syntactically correct.
Type 4	Correct Wh-morpheme with substitution errors in one or more of the minimal required morphemes that included the subject, verb, and inflections for tense, person, gender, and number agreement. Some errors of this type were syntactically correct but semantically inappropriate questions.
Other type of errors	
Type 5	Don't know responses
Type 6	Incorrect question type (i.e., Wh-question that is produced as a yes/no question.)
Type 7	Production of noun phrase statement (i.e., nominal sentence (SVO) but no Wh-word was used.). Declarative instead of interrogative.

Table 4.7: Description of error types

As can be seen in Table 4.8 and Figure 4.2, error types produced ranged in frequency from 5% (types 5 and 7) to 34% (type 3).

Type of error	Agrammatic	
	Number of error/Total Wh-question errors	Percent of Total Errors
Type 1	18/199	9%
Type 2	24/199	12%
Type 3	67/199	34%
Type 4	48/199	24%
Type 5	10/199	5%
Type 6	21/199	11%
Type 7	11/199	5%

Table 4.8: Distribution of error types for Wh-question elicitation task.

Figure 4.2: Distribution of Wh-question error types

The most frequently observed error types were substitutions. These included both type 3 (34%) and type 4 (24%) errors. An additional 21% of the errors were omissions. These included type 1 (9%) and type 2 (12%) errors. Other types of errors included incorrect question type (11%), production of declarative NP statement (5%), and do not know responses (5%),

Type of errors in yes/no question production elicitation task

Four error types were observed for yes/no questions. Errors included omissions (type 2), substitutions (type 4 and type 6), and do not know responses or no responses (type 5). As can be seen in Table 4.9 and figure 4.3, there was a difference in the distribution of error types. Type 2 omission errors (48%) were the most frequent error type. Type 4 and 6 substitution errors (44%) included producing incorrect question type, syntactically correct but semantically inappropriate yes/no question, and tense, agreement inflection substitution errors. Type 5 was either no response or do not know responses (7%).

Type of error	Agrammatic	
	Number of error/Total Y/N-question errors	Percent of Total Errors
Type 2	14/29	48%
Type 4	6/29	20%
Type 5	2/29	7%
Type 6	7/29	24%

Table 4.9: Distribution of type of errors for yes/no question elicitation.

Figure 4.3: Distribution of Yes/No question error types

Experiment 1(b): Repetition task (Matrix and Embedded Wh-Questions production)

First, we investigated whether agrammatic participants repeated fewer grammatical questions than the control group. Our results showed that the percentage of incorrectly repeated questions in the agrammatic group was 69% (124/180) compared to 99% (179/180) in the control group.

The proportion of correctly repeated questions were transformed into rau scores and were entered into SPSS for statistical analysis. An independent-measures t- test was used to analyze the results of the question repetition task as a function of participant group (normal, agrammatic). Results of this independent measures t-test, presented in Table 4.10, revealed that the agrammatic group had more errors (rau mean = 68.30, SD = 38.98) than the control group (rau mean = 108.69, SD = 4.83). This difference was significant, $t(14.431) = -3.98$, $p < .001$, $d = .52$

Group	Mean (rau)	SD	t	df	Sig.
Experimental	68.3007	38.981	-3.982	14.431	< .001
Control	108.6913	4.836			

Table 4.10: Results of the independent measures t test for question repetition task.

Second, we investigated if there was a difference in question repetition between matrix repetition questions and embedded repetition questions in the experimental group. The percentages and proportions of correct repeated matrix and embedded questions for each participant in the experimental group are represented in Table 4.11 and depicted in Figure 4.4.

Participants with Agrammatism	Matrix : Untransformed Percentage Correct (Proportion)	Embedded : Untransformed Percentage correct (Proportion)
1	50 (3/6)	83 (5/6)
2	100 (6/6)	100 (6/6)
3	50 (3/6)	0.00(0/6)
4	83 (5/6)	83 (5/6)
5	0.00(0/6)	0.00(0/6)
6	100 (6/6)	50 (3/6)
7	67 (4/6)	50 (3/6)
8	100 (6/6)	100 (6/6)
9	83 (5/6)	83 (5/6)
10	100 (6/6)	83 (5/6)
11	16 (1/6)	0.00(0/6)
12	100 (6/6)	83 (5/6)
13	67 (4/6)	50 (3/6)
14	100 (6/6)	83 (5/6)
15	100 (6/6)	100 (6/6)

Table 4.11: Repetition of matrix and embedded Wh-Questions

Figure 4.4: Percentages of correct matrix and embedded Wh-questions

As figure 4.4 shows percent correct of matrix questions was higher than for embedded questions.

A paired samples t-test, presented in Table 4.12, revealed that matrix repetition questions were less impaired (rau mean = 73.98, SD = 38.37) than embedded repetition questions (rau mean = 61.51, SD = 38.84). The type of repetition question produced a significant effect on the rau scores of the agrammatic participants on question repetition production, $t(14) = 2.164$, $p < .05$, $d = .69$

Type of question repetition	Mean (rau)	SD.	t	df	Sig.
Matrix	73.983	38.372	2.164	14	.048
Embedded	61.512	38.845			

Table 4.12: Results of paired sample t-test for matrix and embedded repetition questions.

Error analysis of repetition task

The observed error types included omission of one or more grammatical morphemes in the repeated matrix or embedded question (types 1 and 2), substitution of one or more of the grammatical morphemes (types 3 and 4), and additions to the repeated matrix and embedded questions. The percentages and proportions of each type of errors are represented in Table 4.13 and depicted in Figure 4.5. Errors were found in both matrix and embedded questions, though there were more errors in embedded questions. The most frequent errors were omissions (20.55%), followed by substitution errors (8.33%) and addition errors (2.22%).

Type of error	Agrammatic	
	Number of error/Total repeated Wh-question errors	Percent of Total Errors
Omissions (Types 1&2)	37/56	66%
Substitutions (Types 3&4)	15/56	27%
Additions	4/56	7%

Table 4.13: Distribution of error types of question repetition task.

Figure 4.5: Question repetition type of error

Results from Experiment 2: Sentence completion task for verb inflections (tense, agreement) and negation production.

The aim of the completion task was to test the ability of agrammatic participants to produce grammatical morphemes corresponding to tense, agreement and negation. First, we investigated whether agrammatic participants produced fewer correct functional categories (tense, agreement and negation) than the control group. Our results showed that the percentage of correct functional category production in the agrammatic group was 74% (557/750), while the percentage of correct functional categories in the control group was 97% (727/750). The proportions for each subject in each one of these categories were transformed into rau scores, and entered into SPSS for further analysis. An independent-measures t test was used to compare performance of subjects on the sentence completion task. Results of this independent measures t test, presented in Table 4.14, revealed that the difference was significant, $t(18.207) = -4.184$, $p < .05$, $d = .49$.

Group	Mean (rau)	SD	t	df	Sig.
Experimental	76.7200	26.92	-4.184	18.21	<.001
Control	107.96	10.55			

Table 4.14: Results of independent measures t test for functional category sentence completion task.

Given that the data on control subjects included very few errors, we did not perform further quantitative analyses of their productions.

We investigated if there was a difference in functional category production for tense, agreement and negation productions in the experimental group. The percentages and proportions of correct tense inflections, agreement inflections and negation particles for each participant in the experimental group are represented in Table 4.15 and depicted in Figure 4.6. Percentage correct scores were 60% (171/285) for tense, 85% (241/285) for agreement and 85% (145/180) for negation production.

Participants with Agrammatism	Tense: Untransformed Percentage Correct (Proportion)	Agreement : Untransformed Percentage Correct (Proportion)	Negation : Untransformed Percentage Correct (Proportion)
1	32 (6/19)	84 (16/19)	92 (11/12)
2	74 (14/19)	100 (19/19)	100 (12/12)
3	32 (6/19)	47 (9/19)	8 (1/12)
4	84 (16/19)	84 (16/19)	92 (11/12)
5	5 (1/19)	53 (10/19)	0.00 (0/12)
6	100 (19/19)	100 (19/19)	100 (12/12)
7	89. (17/19)	95 (18/19)	92 (11/12)
8	95 (18/19)	100 (19/19)	100 (12/12)
9	47 (9/19)	68 (13/19)	83 (10/12)
10	79 (15/19)	95 (18/19)	100 (12/12)
11	47 (9/19)	89 (17/19)	42 (5/12)
12	16 (3/19)	68 (13/19)	100 (12/12)
13	47 (9/19)	100 (19/19)	100 (12/12)
14	95 (18/19)	100 (19/19)	100 (12/12)
15	47 (9/19)	89 (17/19)	100 (12/12)

Table 4.15: Sentence completion of functional category correct percentages.

Figure 4.6: Percentages of correct tense, agreement, and negation.

Results for the sentence completion task, summarized in Figure 4.6, show that there was a greater deficit in tense production (60%) percentage correct than either agreement production (85%) or negation production (85%).

A single factor repeated-measures analysis of variance (ANOVA), summarized in Table 4.16, revealed that the effects of functional category (tense, agreement, and negation) were significant, $F(2, 28) = 9.625$, $p < .001$, $\eta^2 = .41$

Value of Wilks' lambda	Df (numerator)	Df (denominator)	F	Sig.	Partial Eta Squared	Observed power
.676	2	28	9.625	< .001	.407	.969

Table 4.16: Results of the repeated measures ANOVA for functional category type.

Sidak's post-hoc results for functional category type, presented in Table 4.17, indicate significantly better production of agreement and negation as compared to tense, but revealed no statistical differences between agreement and negation production.

	Tense	Agreement	Negation
Tense		28.679*	24.659*
Agreement	-28.679*		-4.020
Negation	-24.659*	4.020	

Table 4.17: Results of Sidak post hoc test for types of functional categories.

*. The mean difference is significant at the .05 level.

Error analysis for functional category production

Error types in functional category (tense, agreement, and negation) sentence completion production task.

The percentage of errors in the three functional categories (tense, agreement, and tense) was 26% (193/750). 40% (114/285) for tense inflection, 15% (44/285) for agreement inflections and 19% (35/180) for negation particles.

The observed error types in the three functional categories included omission and substitution errors of one or more grammatical morphemes that is / are required to produce functional category. The percentages and proportions of each type of errors are represented in Table 4.18

Functional category	Type of error	Number of error/Total errors per category	Percent of Total Errors
Tense	Omission		
	Verb omission	33/114	29%
	Substitution		
	Tense substitution	60/114	53%
	Verb substitution	21/114	18%
Agreement	Omission		
	Omission of the agreement inflection	33/44	75%
	Substitution		
	Person agreement inflection	5/44	11%
	Gender agreement inflection	4/44	9%
	Number agreement inflection	2/44	6%
Negation	Omission		
	Omission of negation particle and or verb	20/35	57%
	Substitution		
	Substitution of the negation particle or verb	15/35	43%

Table 4.18: Type of errors per functional categories

Tense errors included tense substitutions 53% (60/114), verb substitutions 18% (21/114) and verb omissions 29% (33/114) as represented in Figure 4.7.

Figure 4.7: Tense type of error

Agreement errors represented in Figure 4.8, included omission of the agreement inflection 75% (33/44), substitution of the person agreement inflection 11% (5/44), substitution of gender agreement inflection 9% (4/44) and substitution of number agreement inflection 6% (2/44).

Figure 4.8: Agreement type of error

Negation errors as shown in Figure 4.9, included omission of the negation particle and or verb 57% (20/35), substitution of the negation particle or substitution of the verb 43% (15/35).

Figure 4.9: Negation type of error

Results from Experiment 3

This experiment investigated whether participants could correctly detect non-grammatical structures. Grammaticality judgments of tense and agreement were assessed in 30 sentences containing tense and agreement violations. Results on the grammaticality judgment task showed that percent correct for the agrammatic group was 88% (396/450), compared to 98% (439/450) for the control group. Figure 4.10 shows the percentage correct of the grammaticality judgment task for each group.

Figure 4.10: Percentage correct of grammaticality judgment task for each group.

An independent-measures t test was used to analyze the results of grammaticality judgment for tense and agreement violations as a function of group (normal, agrammatic). Results of this independent measures t-test, presented in Table 4.19, revealed that the agrammatic group had more errors (rau mean = 90.44, SD = 17.99) than the control group (rau mean = 107.85, SD = 8.05). This difference was significant, $t(19.392) = -3.419$, $p < .05$, $d = 0.38$

Group	Mean (rau)	SD	t	DF	Sig.
Experimental	90.44	17.99	-3.419	19.392	.003
Control	107.85	8.05			

Table 4.19: Results of independent measures t test for grammaticality judgment task.

Since the data on the control subjects included very few errors, we did not perform a quantitative analysis of their production of different error types. We conducted quantitative analysis focusing on the experimental group only.

We investigated if there was a statistical significant difference on this task between tense and agreement violations. The percentages of correct grammaticality judgment task in the agrammatic group showed that participants with agrammatism correctly identified 82 % (160/195) tense violations and correctly identified 91% (231/255) agreement violations. A paired samples t-test on the tense and agreement scores (see table 4.20) revealed that the effect of functional category was not significantly, $t(14) = -1.993$, $p = .066$.

Functional category	Mean (rau)	SD	t	DF	Sig.
Tense	84.37	22.63	-1.993	14	.066
Agreement	95.60	18.37			

Table 4.20: Results of paired sample t-test for tense and agreement violations in agrammatic group

CHAPTER 5: DISCUSSION

This study investigated agrammatism in Jordanian Arabic. Specifically, it investigated question production as well as production and comprehension of grammatical morphemes corresponding to tense, agreement and negation. Additionally, it examined whether production of functional category in Arabic Jordanian agrammatism reflects the hierarchical structure proposed by the tree pruning hypothesis (TPH). Finally, this study is unique in being the first study to examine Jordanian Arabic and to compare agrammatism in this language with its manifestations in other languages. This chapter discusses the data relevant to each of the research questions listed above.

One aim addressed in this study was to examine the performance of Arabic-Jordanian speakers on Wh- and yes/no questions. This was examined using two tasks: question elicitation and repetition. Our first finding was that the agrammatic participants performed significantly worse than the control participants on both question elicitation and repetition tasks. This finding is in agreement with several studies that investigated agrammatic question production in Hebrew, Arabic and English (Friedmann, 2002; Thompson, Ballard and Shapiro, 1998; Thompson & McReynolds, 1986; Thompson et al., 1996). Although question production in the repetition task was impaired, it was less impaired than question production in the elicitation task. Moreover, some of the agrammatic participants who couldn't produce most of the questions in the elicitation task were able to produce most of the

questions in the repetition task, this indicates that question production in the repetition task was easier than their production in the elicitation task. This finding agrees with Friedmann's study (2002) in Hebrew; Friedmann did not examine question repetition in the two Palestinian Arabic subjects in her study.

Further analysis was conducted on the question elicitation task in the agrammatic group to compare performance across argument, adjunct and yes/no questions. Results of this analysis indicated that the production of Wh-questions was significantly more impaired for argument and adjunct Wh-questions than for yes/no question production. This finding is in agreement with other studies that investigated Wh- question production and yes/no question production in Palestinian Arabic and Hebrew (Friedmann, 2002). The dissociation between the two types of questions can be explained based on the structural differences between the two. Production of Wh-questions requires the movement of the Wh-morpheme to the beginning of the sentence and therefore the involvement of CP, whereas yes/no production in Arabic does not require such movement because yes/no questions in Arabic can be formed simply by changing the intonation without the auxiliary-verb inversion.

Since previous studies have shown dissociations in the production of adjunct and argument question production (Friedmann, 2002; Thompson et al., 1996) we compared these two question types. Specifically, Friedmann (2002) reported better production of adjunct questions as compared to argument questions. Although no significant difference was found in this study between the two question types, we did find that argument question production was slightly better than adjunct question production. These findings are inconsistent with Friedmann's findings. A possible explanation for this discrepancy in findings might be related to the number of participants in the two studies; Friedmann's study included only two Palestinian

Arabic speakers in her study, whereas this study included 15 Jordanian Arabic speakers with agrammatism.

With respect to the error analysis of Wh-question production versus yes/no question production, results of this study showed more substitution errors in Wh-questions than in yes/no questions, and conversely, more omission errors in yes/no questions than in wh-questions. A possible explanation for the different error patterns observed for the two question types may lie in the relative difficulty of producing these two types of question. As indicated above, Yes/no questions based on the TPH analysis are believed to have a more basic syntactic structure than Wh-questions because they do not involve movement to CP. The reported substitution error forms in question production were always morphologically well-formed. That is, phonological illegal words were never produced by the participants. These errors were essentially characterized by omissions and substitutions of Wh-morphemes, verb affixes and omissions of verbs. This pattern is similar to the frequently reported observation in the cross-linguistic studies on agrammatism that omissions and substitutions do not operate randomly but are always produced according to a well-formed criteria imposed by the syntactic system of the language (Grodzinsky, 2000).

Since the phonological account of agrammatism (see for example, Goodglass, 1968, 1976) and (Kean, 1977, 1978, 1980) attributes question production deficits to the patients' inability to activate unstressed sentence openers, the matrix questions were expected to be more impaired than embedded questions. This study investigated if there was a difference in question repetition production between matrix repetition questions and embedded repetition questions. Results of this analysis indicated that the production of Wh-questions was significantly more impaired for embedded questions than for matrix question production. This finding follows the predictions of

TPH based on the fact that they both require a CP which is inaccessible for most of the participants with agrammatism. This finding also rules out phonological account suggested by Goodglass (1976) and Kean (1980) which claimed that Wh-morphemes are impaired when they are sentence openers. The results also showed that Wh-morphemes were impaired when they were embedded in the sentences. Furthermore, our results showed that the production of matrix questions was better than the production of embedded questions. Error analysis of question repetition revealed that omission was the most frequent type of error. The high omission rate might be related to severity of impairment that was exhibited by some participants with agrammatism. Moreover, the increased difficulty in producing embedded questions might be related to the increased length in embedded sentences compared with relatively shorter matrix questions.

The second aim addressed in this study was to examine the performance of Arabic-Jordanian speakers on the production of grammatical morphemes corresponding to tense, agreement and negation. This was examined using the sentence completion task. Our first finding was that the agrammatic participants performed significantly worse than the control participants on sentence completion task for tense, agreement and negation. This finding is in agreement with several studies that investigated the production of grammatical morphemes corresponding to tense, agreement, and negation in Arabic, Hebrew, English and other languages (Arabatzi & Edwards, 2002; Friedmann & Grodzinsky, 1997; Milman, Dickey and Thompson, 2004, 2008; Thompson, Shapiro and Schendel, 1994; Thompson & Shapiro, 1995).

Further analysis was conducted on the grammatical morphemes completion task in the agrammatic group to compare performance across tense, agreement and negation

particles. Results of this analysis indicated that the production of grammatical morphemes (inflections) was significantly more impaired for tense inflections, than for agreement inflections and negation particles. This finding is in agreement with other studies that investigated inflectional morphology in Palesinian Arabic and Hebrew (Friedmann, 1998). The dissociation across three types of functional categories (tense, agreement and negation) follows the prediction of TPH that states that functional categories associated with upper nodes in the syntactic tree (e.g, TP) are more impaired than functional categories associated with lower nodes of the tree (e.g, NegP and AgrP). The current finding that functional categories were not equally impaired has been frequently observed in agrammatism in several languages (Friedmann, 2001, 2002, Friedmann & Grodzinsky, 1997; Higiwara, 1995; Ouhalla, 1993).

The post-hoc analysis revealed no statistical differences in the agrammatic performance of negation and agreement production in the agrammatic subjects. One of the possible reasons that the error rate in negation was similar to the error rate in agreement may be related to morpho-syntactic properties of agrammatism in Jordanian Arabic. As Benmamoun (2000) argued there is strong evidence that sentential negation in Arabic is specified for the agreement feature. Therefore, negation production does not require movement to the tense node to check tense inflection. In the same context it was noted that there was a deficit in the tense substitution in the verb that is flanged with negation particle. That is; when participants were asked to negate a sentence in the past tense, they tended to produce the negation in the present tense instead of the past. In the past tense the negation is obligatory realized as a discontinuous element, however, in the present tense the negative particle may be independent of the verb. This finding can be also interpreted

in terms of TPH if we consider the fact that in Jordanian Arabic, the merger of the verb with negation is obligatory when tense is imperfect in the context of past tense; however, the merger of negation and verb “present tense” is optional. That is, both options are available. Therefore, when the subjects were asked to produce negation in the past tense that required the merger of the negation particle to the verb, they could not move the verb to the tense node to be checked, and instead they produced the present form that requires an optional merger of the negation particle. Most of the stimuli used for negation production were in the past tense, the study showed more past tense negative errors than present tense negative errors.

Error analysis of sentence completion task showed that the most frequent pattern of tense production errors was the substitution of linear suffixes and prefixes as opposed to their omissions which resulted in production of a different tense (e.g., *sa-yaruḥ* (model-go-3ms) “will go” → *ya-ruḥ* (go-past-3ms)). It was noted that most of the participants with agrammatism substituted the present tense for the past and future tenses 53% (60/114). This finding follows Benmamoun’s description of the verb movement in Arabic. Benmamoun (2000) reported that the present tense in Arabic lacks the feature that forces it to be paired with a verbal element; however, the past tense and future tense as well as imperatives are specified for this feature. Therefore, most participants preferred the present tense that can be produced by the intact agreement feature instead of the past and future tenses that require the tense feature which can not be accessed according to the TPH.

The past tense in Arabic is an inflected verb (finite verb), while the present tense is the non-finite verb (not inflected). The incorrect verb substitutions were non-finite, replacing finite verbs. This follows TPH predictions that agrammatic patients would replace verb forms that do not have to move to the pruned nodes in the tree and

replace them with verb forms that need intact nodes to be produced. Therefore, as gerunds, nomination and participles, are the most frequent substitution forms for English, German and Italian agrammatics respectively, the present tense is the used verb inflection error in Jordanian Arabic. Taken together, the finding that the past tense is more difficult to produce than the present tense is in line with other studies in Dutch (Bastiaanse, 2008), Turkish (Duman & Bastiaanse, 2009) and Greek (Stavrakaki, 2003). Although these studies explained the relative preservation of the present versus past tense in relation to semantic properties of time, the reported tense errors in Arabic-Jordanian speakers can be well-explained by the TPH. The preserved imperfective tense that does not carry tense information and the impaired perfect and future tenses that carry tense information indicate that the syntactic category itself or its position in the tree is the cause of the problem.

Another objective of this study was to investigate whether a parallel pattern of deficit existed in the comprehension of grammatical morphemes corresponding to tense and agreement. This was examined using a grammaticality judgment task for tense and agreement violations. Our first finding was that the agrammatic participants performed significantly worse than the control participants on the grammaticality judgment task. This finding is not in agreement with Friedmann's findings (Friedmann & Grodzinsky, 1997). Friedmann's claim that the deficit is only found in production is problematic. Friedmann and Grodzinsky (1997) reported data for only one of the many patients that were tested. Even for this one patient, grammaticality judgment was not completely spared. In contrast, other studies (see for example, Arabatzi & Edwards, 2002; Dickey et al, 2005; Wenzlaff and Clahsen, 2004) reported data that showed impaired comprehension.

Relative in depth data analysis of grammaticality judgment indicated that the agrammatic production deficit is related to some, but not all (often but not always) agrammatic comprehension deficits. Results of the grammaticality judgment task showed that percent correct for the agrammatic group was generally good “88%.” This percentage is much higher than what reported by Wenzlaff and Clahsen (2004) and by Arabatzi & Edwards (2002) who reported severe deficits in grammaticality judgment tasks. Further analysis was conducted on the grammaticality judgment task in the agrammatic group to compare participants’ sensitivity performance between tense and agreement violations. Results of this analysis revealed no significant difference in participants’ sensitivity between tense and agreement violations.

Even if we want to adhere to the statistical significance differences and the reported grammaticality judgment errors in other languages, we should consider that most of the studies on comprehension were carried out on native speakers of English with agrammatism. English is different from the Arabic language in terms of restricted word order compared with the flexible word order of the Arabic language. The languages that have flexible word orders are languages that have richer morphology than English. Given the fact that Jordanian Arabic has a flexible word order and given the fact that case, number or gender morphological inflections can provide explicit cues to the detection of the semantic-syntactic components (agent-subject, action-verb and object-object). This might play a role in the high rate of correct grammaticality judgments in our study. That is: the Arabic language allows more flexibility of movement of the sentence constituents at the surface level compared with English language that doesn’t allow this kind of flexibility. Moreover, the results might be different if the same syntactic constructions were tested in both comprehension and production. For these reasons it is still premature, to make, an

absolute conclusion about the modality dissociation in agrammatism. The grammaticality judgment results point to the role of the language specific features in the variability of performance of the subjects with agrammatism.

A key question concerning agrammatism is the nature of the linguistic deficit. This study is in agreement with others that support an explanation that fits with syntactic theory (see for instance Arabatzi & Edward, 2002; Friedmann, 1998, 2000, 2002). Furthermore, our data calls for a selective syntactic explanation, as suggested by Friedmann (2000, 2002) and others, versus a general syntactic explanation as suggested by Ouhalla (1993) and others. The selective syntactic explanation holds that agrammatic production of functional categories is selective and that the deficit is structurally based. This was indicated by the type of observed errors in this study. For example, all participants with agrammatism were able to produce yes/no questions better than Wh-questions. The production of Wh-questions in Arabic requires the movement of the Wh-morpheme to the beginning of the sentence, while the production of yes/no questions does not require such movements. Furthermore, in some cases, participants in this study produced Wh-morphemes at the beginning of the sentence and nothing else; in other cases the participants were able to produce a full NP statement without using the Wh-morpheme at the beginning of the sentence. Taken together, these errors indicate that the problem is structural-based rather than morphological because the participants had access to the lexical Wh-morpheme but they were not able to incorporate it into a well-formed question. Further evidence for the selective structural deficit account comes from the sentence completion task. Most of the participants in this study had more difficulties with past and future tenses than with the present tense. The production of the perfect past tense and future tenses in Arabic requires moving the verb to the tense node for tense inflection while this

movement is not required in the imperfect present tense because it is the default status (is the used verb inflection error) in Arabic (Benmoumoun, 2000). As such only a more selective syntactic account can account for such asymmetry between the tenses.

A related question of this study was to evaluate whether production of functional category reflects the TPH hierarchical structure. Here we examined whether our data from the three experiments could be explained within the framework of the TPH. We concluded that in general TPH is an adequate explanation of our data. The TPH makes the following predictions with respect to the questions of this study. It was predicted that Arabic-Jordanian speakers with agrammatism would show a dissociation between Wh-questions and yes/no questions, with decreased ability to produce well-formed Wh-questions. This prediction was born out in our study.

The results of this study also showed deficits in handling embedded structures. Both matrix and embedded Wh-morphemes were found to be impaired in the repetition task with more deficits in repeating matrix questions. This finding follows the predictions of TPH based on the fact that they both require a CP which is inaccessible for most of the participants with agrammatism.

It was also predicted to find dissociation between tense and agreement inflections, with more impairment in tense inflections than agreement inflections. This prediction was also found to fit our data. This finding follows the prediction of TPH that states that functional categories associated with upper nodes in the syntactic tree are more impaired than functional categories associated with lower nodes of the tree. Based on Friedmann's findings (1998, 2002), it was expected that subjects would demonstrate an increased difficulty in projecting the syntactic tree (i.e., that functional categories associated with upper nodes such as TP would be more difficult to be correctly

produced compared with functional categories associated with lower nodes such as AgrP. Furthermore, a deficit at any level of the syntactic tree entails deficits at all higher levels. The results of this study showed that TP is more affected than NegP and AgrP. More importantly, the TPH states that the structures at higher nodes would be more impaired than structures at lower nodes, but not vice versa. This prediction is born out in our data; none of our subjects showed less impaired CP than TP or less impaired TP than AgrP. While the TPH's prediction for production of CP and IP is born out in our data, the TPH's prediction for grammaticality judgment for tense and agreement violations seemed to depart from the predicted pattern. However, although the agrammatic group performance on grammaticality judgment was significantly different from those of normal participants, it was generally good. It should be noted that the type of the selected stimuli in the grammaticality judgment task was more vulnerable to bias "error"; all the stimuli were incorrect sentences with agreement and tense violations. Whether the task design would give different responses is one of the points that need to be empirically investigated. On the other hand, the percentage of errors was only "12%" despite the fact that all stimuli contained tense and agreement violations supports that their sensitivity to detect agrammatic errors was generally good.

With respect to tense error analysis, the results showed that the most frequent pattern of tense production errors was the substitution of the present tense for the past and future tenses. The present tense can be produced by intact agreement only while the past and future tenses require the tense feature which can't be accessed according to the TPH. The preserved imperfective tense that does not carry tense information and the impaired perfect and future tenses that carry tense information indicate that the syntactic category itself or its position in the tree is the cause of the problem.

The reported error forms were always morphologically well-formed. This finding supports the frequently reported observation in the cross-linguistic studies on agrammatism that omissions and substitutions do not operate randomly and they are always produced according to a well-formed criteria imposed by the syntactic system of the language (Grodzinsky, 2000). These findings are in agreement with what was reported in the literature that the language specific features were found to play the biggest role in determining the pattern of omission and substitution of grammatical morphemes (Bates, Wulfeck and MacWhinney, 1991). Unlike the English language, in Arabic stems are not morphologically well-formed words. Therefore, bare stems are never produced by subjects with agrammatism and instead they substituted affixes. This pattern is also reported cross linguistically in languages like Hebrew (Friedmann, 2001, 2002), Italian (Miceli & Mazzucchi, 1990), and Greek (Kehayia 1990).

A second issue addressed in literature on agrammatism is the question of whether agrammatism is competence or merely performance disorder. This question is related to how the person with agrammatism processes the syntactic elements of sentences (Duman & Bastiaanse, 2009). Considering agrammatism as a mere competence based disorder necessarily entails impairment in partial syntactic abilities and that not all functional elements are equally impaired. Earlier work on agrammatism implied impairment in all syntactic abilities and took the position that all comprehension of syntactic structures are impaired to almost the same degree as production of the same syntactic structures. The results of this study showed that the impairment in agrammatic production does not involve all grammatical morphemes or functional categories. This finding disagrees with the views that the syntactic ability is

completely lost in patients with agrammatism as incorrectly suggested by Ouhalla (1993).

Another related issue addressed in literature on agrammatism is the question of whether grammatical representation is impaired access to intact grammatical representation is impaired. The data of this study showed variability within agrammatic performance across different structured tasks, specifically, between performance on production tasks and grammaticality judgment tasks. These findings may support the processing approach to agrammatism. Regardless of the nature of the language related deficits in agrammatism (representational or processing based), the TPH provides the hierarchical structure of the syntactic tree as an explanation for the inability either to process an intact higher functional category or the inability to access an impaired functional category (Friedmann, 2002).

In this study, data are included from a good number of participants to investigate functional category production across different tasks. The results obtained supported the TPH that attributes grammatical impairment to the inability of patients to project the tree up to its highest nodes. The types of errors noted among agrammatic speakers in this study were similar to the variation of inflectional errors in agrammatic speakers in similar languages such as Hebrew. The results of the current study contribute to our understanding of agrammatism. Although we agree with Goodglass and Menn (1985) in the difficulty in seeking a unitary explanation of agrammatism, we believe, based on the reported data collected from Arabic Jordanian agrammatism, that the TPH can explain most, but not all agrammatic deficits in Jordanian Arabic. The resulting data thus provides a good addition to the controversy.

The observed variability in performance between agrammatic subjects and the observed variability within subjects on the same functional category seemed to weaken the “all or nothing” deficits that are implied by TPH. Therefore, an account that could explain more of the observed pattern of agrammatic impairments in functional category production in receptive and expressive agrammatism is needed. Employing a probabilistic approach, such as Item Response Theory (Milman, Dickey and Thompson, 2004, 2008) in explaining this graded impairment not only between subjects, but also within subjects, seems promising. This kind of analysis implies that grammatical morphemes dependent upon higher categories should be probabilistically, and perhaps not categorically more problematic than those dependent upon lower categories. This was empirically investigated in agrammatic production in English-speaking agrammatic patients. Therefore, investigating whether the performance on clausal functional categories follows a consistent pattern across patients is a recommendation of this study. Revisiting the collected data within a probabilistic framework such as Item Response Theory (IRT) could answer such a question. IRT has been proven to be a reliable measurement technique in analyzing the variable pattern of deficits of sentence production in English-speaking patients with agrammatism (Milman, Dickey and Thompson, 2004, 2008). Also, more studies are needed to explore the deficits in agrammatic Jordanian Arabic especially investigating agrammatic comprehension of functional categories by comparing the same syntactic constructions in both production and comprehension.

APPENDICES

Appendix A: Consonant sounds of Arabic

Arabic Conso- nants	Bi- labi al		Labio- Denta l		De ntal		Alve olar		Post- Alveol ar		Pal atal		Vel ar		Uv ula r		Phar yn- geal		Glo -ttal
Plosive		b			t	ṭ	d	ḍ					k		q				ʔ
Nasal		m					n												
Fricative			f		ṣ	ṣ̣	s	z	s						ħ	ʕ	h		
Affricate									...										
Lateral							l												
Rolled							r												
Semi- Vowel		w									j								

Appendix B: Eperiment one tasks' stimuli

Four questions for subject (who):

Item #		Target Response	Participant Response	Score (Rational)
1	Arabic	mi:n ?akal ?al- tufaḥa		
	Morpheme-level translation	Who eat.past-3ms def-apple		
	Literal translation	"Who ate the apple?"		
2	Arabic	mi:n Šarib ?al- ṣaṣi:r		
	Morpheme-level translation	Who drink.past-3ms def-juice		
	Literal translation	"Who drank the juice?"		
3	Arabic	mi:n ?a□ið ?al-kitab		
	Morpheme-level translation	Who take.past-3ms def-book		
	Literal translation	"Who did take the book?"		
4	Arabic	mi:n katbat ?al-risali		
	Morpheme-level translation	Who write.past-3fs def-letter		
	Literal translation	"Who wrote the letter?"		

Four questions for animate object (who):

Item #		Target Response	Participant Response	Score (Rational)
1	Arabic	mi:n ɟali tazwa ...		
	Morpheme-level translation	Who Ali.ms marry.past.3ms		
	Literal translation	"Who did Ali marry?"		
2	Arabic	mi:n ɟali ʔarab		
	Morpheme-level translation	Who Ali.ms beat.past.3ms		
	Literal translation	"Who did Ali beat?"		
3	Arabic	mi:n ʔal-bint ɥamlat OR mi:n ʔili ɥamlat-u ʔal-bint		
	Morpheme-level translation	Who def-girl carry.past-3mfs OR Who that (comp) carry.past-3mfs def- girl		
	Literal translation	"Who did the girl carry?"		
4	Arabic	mi:n ʔal-ʔab naʃaħ OR mi:n ʔili naʃaħ-u ʔal- -ʔab		
	Morpheme-level translation	Who def-father advice.past-3ms OR Who that (comp) advice.past-3ms def- father		
	Literal translation	"Who did the father advise?"		

Four questions for inanimate object (what):

Item #		Target Response	Participant Response	Score (Rational)
1	Arabic	šu ?akal çali ?		
	Morpheme-level translation	What eat.past-3ms Ali.ms (subject)		
	Literal translation	"What did Ali eat?"		
2	Arabic	šu Šarib çali ?		
	Morpheme-level translation	What drink.past-3ms Ali.ms (subject)		
	Literal translation	"What did Ali drink?"		
3	Arabic	šu çali kasar		
	Morpheme-level translation	What Ali.ms (subject) break.past-3ms		
	Literal translation	"What did Ali break?"		
4	Arabic	šu katab çali ?		
	Morpheme-level translation	What write.past-3ms Ali.ms (subject)		
	Literal translation	"What did Ali write?"		

Four questions for where:

Item #		Target Response	Participant Response	Score (Rational)
1	Arabic	we:n nam ali ?		
	Morpheme-level translation	Where sleep.past-3ms Ali.ms (subject)		
	Literal translation	"Where did Ali sleep?"		
2	Arabic	we:n byařta_lil ali?		
	Morpheme-level translation	Where work.-3ms Ali .ms (subject)		
	Literal translation	"Where does Ali work?"		
3	Arabic	We:n ?iřtarat fařima ?al-fusta:n OR min we:n ?iřtarat fařima?al-fusta:n		
	Morpheme-level translation	Where buy.past-3fs Fatima def-dress OR From where buy.past-3fs Fatima def-dress		
	Literal translation	"Where did Fatima buy the dress?" OR "From where did Fatima buy the dress?"		
4	Arabic	we:n qa:bal ali Ařmad		
	Morpheme-level translation	Where meet.past-3ms Ali Ařmad		
	Literal translation	Where did Ali meet Ařmad?"		

Four questions for when:

Item #		Target Response	Participant Response	Score (Rational)
1	Arabic	mata raḥ ḡali ʔal-šu_lul		
	Morpheme-level translation	When go.past-3ms Ali def-work		
	Literal translation	"When did Ali go to work?"		
2	Arabic	mata kanat faṭima ta-zu:r layla		
	Morpheme-level translation	When was Fatima visit.ind.-3ms laila		
	Literal translation	"When was Fatima visiting Laila?"		
3	Arabic	mata maraḥiṣ ḡali ʔal-madrasa		
	Morpheme-level translation	When neg.go.past.3ms-neg Ali def-school		
	Literal translation	"When didn't Ali go to school?"		
4	Arabic	mata ṣiḥi ḡali min ʔal-no:m		
	Morpheme-level translation	When wake-up.past.3ms Ali from def-sleep		
	Literal translation	"When did Ali wake up from bed?"		

Four questions for why:

Item #		Target Response	Participant Response	Score (Rational)
1	Arabic	le:š çali ma-rahiš çala ʔal-madrasi		
	Morpheme-level translation	Why Ali neg-go.past.3ms.neg to def-school		
	Literal translation	"Why didn't Ali go to school?"		
2	Arabic	le:š ʔal- ʔawla:d bi-yurku <u>ḡ</u> u		
	Morpheme-level translation	Why def- boys asp-running		
	Literal translation	"Why are the boys running?"		
3	Arabic	le:š çali bi-yabki		
	Morpheme-level translation	Why Ali asp-cry-3ms		
	Literal translation	"Why is Ali crying?"		
4	Arabic	le:š çali ma-bi- yišrab ʔal-ḥali:b		
	Morpheme-level translation	Why Ali neg-asp-drink-3ms def-milk		
	Literal translation	"Why doesn't Ali drink the milk?"		

Twelve yes no questions

Item #		Target Response	Participant Response	Score (Rational)
1	Arabic	çali ra:h ?il- madras ? OR ħal raħ çali lil-madrasi?		
	Morpheme-level translation	Ali go.past-3ms def-school OR Q go.past-3ms Ali to –school		
	Literal translation	"Did Ali go to school?"		
2	Arabic	çali mari:ǰ ? OR ħal çali mari:ǰ ?		
	Morpheme-level translation	Ali sick OR Q Ali sick		
	Literal translation	"Is Ali sick?"		
3	Arabic	çali tišrab šai ? OR bidak tišrab šai?		
	Morpheme-level translation	Ali drink-2ms tea OR Would you like drink-2ms tea		
	Literal translation	" Would you like to drink tea?"		
4	Arabic	çali □alašit ?al-wa...ib? OR ħal □alašit ?al-wa ... ib?		
	Morpheme-level translation	Ali finish.past.2ms def-homework OR Q finish.past.2ms def-homework		
	Literal			

	translation	"Did you finish the homework?"		
5	Arabic	<p>□alaṣṭi faṭur-ik?</p> <p>OR</p> <p>ḥal □alaṣṭi faṭur-ik?</p>		
	Morpheme-level translation	<p>Finish.past.2fs breakfast-yours</p> <p>OR</p> <p>Q finish-past.2fs breakfast-yours</p>		
	Literal translation	"Did you finish your breakfast?"		
6	Arabic	<p>ḥali taṣba:n?</p> <p>OR</p> <p>ḥal ḥali taṣba:n?</p>		
	Morpheme-level translation	<p>Ali.ms tired</p> <p>OR</p> <p>Is Ali-ms tired</p>		
	Literal translation	"Is Ali tired?"		
7	Arabic	<p>fi: waqit kafi ?</p> <p>OR</p> <p>ḥal fi: waqit kafi?</p>		
	Morpheme-level translation	<p>in time enough</p> <p>OR</p> <p>Q in time enough</p>		
	Literal translation	"Is the time enough?"		
8	Arabic	<p>ta:kul ḥasa ?</p> <p>OR</p> <p>bidak ta:kul ḥasa ?</p>		
	Morpheme-level translation	<p>eat.2ms now</p> <p>OR</p> <p>Would you like eat.3ms now</p>		
	Literal translation	"Do you want to eat now?"		

9	Arabic	tru:hi fil-rihli OR bidik truhi fil-rihli		
	Morpheme-level translation	go.2fs in-def-picnic OR Would you like go.2fs in-def-picnic		
	Literal translation	" Would you like to go to the picnic?"		
10	Arabic	maçak flu:s kfa:yi ? OR ħal maçak flu:s kafya?		
	Morpheme-level translation	You have money enough OR Q have money enough		
	Literal translation	"Do you have enough money?"		
11	Arabic	badat ?al-mubara ? OR ħal badat ?al-mubara ?		
	Morpheme-level translation	start.past.3fs def-match OR Q start.past.3fs def-match		
	Literal translation	"Did the match start?"		
12	Arabic	□alaş ?al-film OR ħal □alaş ?al-film		
	Morpheme-level translation	finish.past.3ms def-movie OR Q finish.past.3ms def-movie		
	Literal translation	"Is the movie over?"		

Question repetition task

Item #		Target Response	Participant Response	Score (Rational)
1	Arabic	mi:n haðar ?al-ħafli ?		
	Morpheme-level translation	who attend.3ms.past def-party		
	Literal translation	"Who attended the party?"		
2	Arabic	bidu yaçrif mi:n haðar al-ħafli		
	Morpheme-level translation	want know.3ms who attend.3ms.past def-party		
	Literal translation	"He wants to know who attended the party."		
3	Arabic	mi:n qa:bal çali?		
	Morpheme-level translation	who meet.past.3ms Ali		
	Literal translation	"Who met Ali?"		
4	Arabic	huwa yaçrif mi:n ga:bal çali?		
	Morpheme-level translation	He know.3ms who meet.past.3ms Ali		
	Literal translation	"He knows who met Ali."		
5	Arabic	we:n ra:h çali?		
	Morpheme-level translation	where go.past.3ms Ali		
	Literal translation	"Where did Ali go?"		

6	Arabic	miš ɕa:rif we:n raḥ ɕali		
	Morpheme-level translation	neg know.3ms where go.past.3ms Ali		
	Literal translation	"He doesn't know where Ali went."		
7	Arabic	mata zurt faṭima ?		
	Morpheme-level translation	When visit.3ms.past faṭima		
	Literal translation	"When did you visit faṭima?"		
8	Arabic	saʔalani mata zurt faṭima ?		
	Morpheme-level translation	ask.past.1ms when visit.1ms faṭima		
	Literal translation	"He asked me when I visited faṭima."		
9	Arabic	le:š tarakit ʔal- šuul ?		
	Morpheme-level translation	Why quit.past-1ms. def-job		
	Literal translation	"Why did you quit the job?"		
10	Arabic	ma-biɕraf-iš le:š tarakit ʔal- šuul		
	Morpheme-level translation	neg-know.3ms-neg why quit.past-1ms def-job		
	Literal translation	"He doesn't know why I quit the job."		
11	Arabic	šu: bidak tišrab?		
	Morpheme-level translation	What would.2ms.you drink.1ms		
	Literal translation	"What do you want to drink?"		

Appendix C: Experiment two tasks' stimuli:

Verb inflections in the sentence completion tasks:

Item #		Target Response	Participant Response	Score (Rational)
1	Arabic	?imbarih huwa ?akal tufaħa		
	Morpheme-level translation	yesterday he.ms ate an apple.		
	Literal translation	"Yesterday he ate an apple."		
2	Arabic	?imbarih ĉali katab risali,		
	Morpheme-level translation	yesterday Ali write.past-3ms a letter		
	Literal translation	"Yesterday Ali wrote a letter."		
3	Arabic	?imbarih huwa qara? giřa.		
	Morpheme-level translation	yesterday he.ms read a story		
	Literal translation	"Yesterday he read a story."		
4	Arabic	?imba:riħ fařima ra:ħat ?al-řu_lul.		
	Morpheme-level translation	Yesterday Fatima go.past-3fs def-work		
	Literal translation	"Yesterday Fatima went to the work."		
5	Arabic	?imbarih ĉali řarib řai.		
	Morpheme-level	Yesterday Ali drink.past-3ms tea		

	translation			
	Literal translation	“Yesterday Ali drank tea .”		
6	Arabic	?imba:riḥ faṭima naḍafat ?al-ṣuḥun		
	Morpheme-level translation	Yesterday Fatima clean.past-3fs def-dishes		
	Literal translation	“Yesterday Fatima cleaned the dishes.”		
7	Arabic	?imbariḥ ḡali na:m bara.		
	Morpheme-level translation	Yesterday Ali sleep.past- 3ms outside		
	Literal translation	“Yesterday Ali slept outside		
8	Arabic	?imba:riḥ faṭima ša:ḥadat ?al-film.		
	Morpheme-level translation	Yesterday Fatima watch.past-3fs def-movie		
	Literal translation	“Yesterday Fatima watched the movie.”		
9	Arabic	?imba:riḥ ḡali ?ištara malabis.		
	Morpheme-level translation	Yesterday Ali buy.past- 3ms clothes		
	Literal translation	“Yesterday Ali bought clothes .”		
10	Arabic	?imba:riḥ faṭima ṭabaḳat ?al-ṭaḡam		
	Morpheme-level translation	Yesterday Fatima cook.past-3fs def-food		
	Literal translation	“Yesterday Fatima cooked the food.”		
11	Arabic	?imba:riḥ ?al-?awla:d laḡibu kura		

	Morpheme-level translation	Yesterday def-boys play.past-3mp football		
	Literal translation	“Yesterday the boys played football.”		
12	Arabic	?imbarih ?al-banat sabahu		
	Morpheme-level translation	Yesterday def-girls swim.past.3ps		
	Literal translation	“Yesterday the girls swam.”		
13	Arabic	?imba:rih ?al-ra···ul sa:q ?al-saya:ra		
	Morpheme-level translation	Yesterday def-man drive.past-3ms def-car		
	Literal translation	“Yesterday the man drove the car.”		
14	Arabic	?imba:rih ?al-suya:h zaru: ?al-batra		
	Morpheme-level translation	Yesterday def- tourists visit.past-3mp def-Petra		
	Literal translation	“Yesterday the tourists visited Petra .”		
15	Arabic	?imba:rih çali şala: ?al- şubih		
	Morpheme-level translation	Yesterday Ali pray.past-3ms def. morning prayer		
	Literal translation	“Yesterday Ali prayed the morning prayer .”		
16	Arabic	bukra ?al-?a wala:d sa- yaru:hu al-madrasi		
	Morpheme-	Tomorrow def-boys		

	level translation	will go-ind to def-school		
	Literal translation	“Tomorrow the boys will go to the school.”		
17	Arabic	bukra faṭma ḥa-tudrus		
	Morpheme-level translation	Tomorrow Fatma will-study		
	Literal translation	“Tomorrow Fatma will study for the exam.”		
18	Arabic	bukra ?al-?awala:d ḥa – yusa:firu: ila- ?al-betra		
	Morpheme-level translation	Tommorrow def-boys will –travel-3pm to def-Petra		
	Literal translation	“Tomorrow the boys will travel to Petra.”		
19	Arabic	?imba :riḥ ṣali ma-daras la- ?imtiḥa:n liḏalik rasab . fi- ?almustagbal bidu yudrus ṣala al- ?imtiḥa :n		
	Morpheme-level translation	Yesterday Ali neg-study.pst.3ms for-def –exam So fail.pst.3ms In-def-future Want to study.3ms for def-exam		
	Literal translation	“Yesterday, Ali didn’t study for the exam, so he failed. In the future he wants to study for the exam.”		

Verb inflections in negative sentences

Item #		Target Response	Participant Response	Score (Rational)
1	Arabic	çali ma- rah ?al-madrasi OR çali ma- ra:h-iş ?al-madrasi		
	Morpheme-level translation	Ali neg-go.past.3ms def-school OR Ali neg-go.3ms-neg def-school		
	Literal translation	"Ali didn't go to school."		
2	Arabic	faṭma ma-?akalat ?al-tufaḥa OR faṭma ma- ?aklat--iş ?al-tufa:ḥa		
	Morpheme-level translation	Fatima neg- eat.past-3fs def-apple OR Fatima neg-eat.past3fs-neg def-apple		
	Literal translation	"Fatima didn't eat the apple."		
3	Arabic	çali ma-şarib ?al-şay OR çali ma- şirb -iş ?al-şay		
	Morpheme-level translation	Ali neg- drink.past-3ms def-tea OR Ali neg-drink.3ms-neg def-tea.		
	Literal translation	"Ali didn't drink tea."		

4	Arabic	çali ma- katab ?al-risa;li OR çali ma- katab -iš ?al-risa:li		
	Morpheme-level translation	Ali neg- write.past-3ms def-letter OR Ali neg-write.3ms-neg def-letter.		
	Literal translation	"Ali didn't write the letter."		
5	Arabic	faṭma ma-za;rat ?al-batra OR faṭma ma- -za;rat--iš ?al-batra		
	Morpheme-level translation	Fatima neg- visit.past-3fs def-Petra OR Fatima neg-visit.past3fs-neg def-Petra		
	Literal translation	"Fatima didn't visit Petra."		
6	Arabic	çali ma- λarab ?ahmad OR çali ma- λarabiš ?ahmad		
	Morpheme-level translation	Ali neg- write.past-3ms Ahmad OR Ali neg-beat.3ms-neg Ahmad.		
	Literal translation	"Ali didn't beat Ahmad."		
7	Arabic	faṭma ma- naḍafat ?al-ṣuḥu:n OR faṭma ma- - naḍafat -iš ?al-ṣuḥu:n		
	Morpheme-level translation	Fatima neg- clean.past-3fs def-dishes OR Fatima neg-clean.past3fs-		

		neg def-dishes		
	Literal translation	"Fatima didn't clean the dishes."		
8	Arabic	çali ma-qara? ?al-qişa OR çali ma- qara?-iŝ ?al-qişa		
	Morpheme-level translation	Ali neg- read.past-3ms def-story OR Ali neg-read.3ms-neg def-story.		
	Literal translation	"Ali didn't read the story."		
9	Arabic	çali ma- byalçab kura OR çali ma- byalçab -iŝ kura		
	Morpheme-level translation	Ali neg- play-3ms football OR Ali neg-play.3ms-neg football		
	Literal translation	"Ali is not playing football."		
10	Arabic	çali ma- ?a□að ?al-dawa OR çali ma- ?a□að -iŝ ?al-dawa		
	Morpheme-level translation	Ali neg- take.past-3ms def-medicine OR Ali neg-take.3ms-neg def-medicine.		
	Literal translation	"Ali didn't take medication."		
11	Arabic	faţma ma- ba:çat ?al-saya:ra OR faţma ma- - ba:çat -iŝ ?al-saya:ra faţma ma- - ba:çat -iŝ ?al-saya:ra		

	Morpheme-level translation	Fatima neg- sell.past-3fs def-car OR Fatima neg-sell.past3fs-neg def-car		
	Literal translation	"Fatima didn't sell the car."		
12	Arabic	çali ma- ?ištara mala:bis OR çali ma- ?iŠtara: -š mala:bis		
	Morpheme-level translation	Ali neg- buy.past-3ms clothes OR Ali neg-buy.3ms-neg clothes.		
	Literal translation	"Ali didn't buy clothes."		

Appendix D: Experiment three (Grammaticality Judgment)

Item #		Presented incorrect sentence	Target response	Participant Response	Score (Rational)
1	Arabic	?al- wala:d ra:hat çala ?al-madrasi	Incorrect		
	Morpheme-level translation	def-boy go.past.3fs to def-school			
	Literal translation	" The boy went (go.past.3fs) to the school."			
2	Arabic	?al- bint šarib al -ša:i	Incorrect		
	Morpheme-level translation	def-girl drink.past.3ms def- tea			
	Literal translation	"The girl drank (drink.past.3ms) the tea."			
3	Arabic	?al-?awla:d ?akal ?al-tufa:h	Incorrect		
	Morpheme-level translation	def-boys eat.past.3ms def- apples			
	Literal translation	"The boys ate (eat.past.3ms) the apples."..			
4	Arabic	çali katabu ?a-risa:li	Incorrect		
	Morpheme-level translation	Ali write.past.3mpl def-letter			
	Literal translation	"Ali write (eat.past.3mpl) the letter."			
5	Arabic	çali ya-katub	Incorrect		

		ʔal-risa:li ʔimba:rih			
	Morpheme-level translation	Ali write..3ms def-letter yesterday			
	Literal translation	"Ali writes the letter yesterday."			
6	Arabic	faṭima taqra? ʔal-risa:li ʔimba:rih	Incorrect		
	Morpheme-level translation	Faṭima read .3fs def-letter yesterday			
	Literal translation	"Fatima reads the letter yesterday."			
7	Arabic	ʔal- ʔa wla:d bi...u:-š ɟala ʔal- haflī ʔimba:rih	Incorrect		
	Morpheme-level translation	def- boys come..3pl.neg to def-party yesterday			
	Literal translation	"The boys come- .3ms-not- the party yesterday."			
8	Arabic	ʔal- bint ma-širb-iš ʔal -šai	Incorret		
	Morpheme-level translation	def-girl neg- drink.past.3ms-neg def-tea			
	Literal translation	"The girl didn't drink (drink.past.3ms) the tea.".			
9	Arabic	ʔalʔa:n ɟali miš katab ʔal-risa:li	Incorrect		
	Morpheme-level translation	Now Ali neg- write .past.ms def- letter			
	Literal translation	"Ali didn't write the letter now."			

10	Arabic	?akal ?al-bana:t	Incorret	
	Morpheme-level translation	Eat.past.3ms def-girls		
	Literal translation	"The girls ate."		
11	Arabic	?imba:rih ?ali yaqra? ?al-kita:b	Incorrect	
	Morpheme-level translation	Yesterday Ali read..3ms def-book		
	Literal translation	"Ali reads the book yesterday."		
12	Arabic	ka:na ?al-bint tal?ab	Incorrect	
	Morpheme-level translation	be.past-3ms def-girl play.3fs		
	Literal translation	"The girl was laying."		
13	Arabic	kita:b ?al-walad ?a lati kan huna	Incorrect	
	Morpheme-level translation	Book def-boy that (f) be.past-3ms here		
	Literal translation	"The boy's book that was here. "		
14	Arabic	ka:nat ?al walad yakul	Incorrect	
	Morpheme-level translation	Be.past-3fs def-boy eat.3ms		
	Literal translation	"The boy was (Fs) eating"		
15	Arabic	?al-?awala:d ?al – ?arib ?al – ?a:i	Incorrect	
	Morpheme-level translation	Def-boys drink.past-3ms def-tea		
	Literal translation	"The boys drank (MS) the tea"		
16	Arabic	bukra ?al- bint qar?at ?al-kita:b	Incorrect	

	Morpheme-level translation	Tomorrow def-girl read.past.3fs def-book			
	Literal translation	"Tomorrow the girl read (Past) the book"			
17	Arabic	?imbarih ?al-walad sa-yaqra? ?al- kita:b	Incorrect		
	Morpheme-level translation	Yesterday def-boy will-read.3ms def-book			
	Literal translation	"Yesterday the boy will read the book."			
18	Arabic	?al-bint yakul tufa:ha	Incorrect		
	Morpheme-level translation	Def-girl eat.3ms apple			
	Literal translation	"The girl eats(Masculine) apple			
19	Arabic	?al-walad tarkuḏ fil malḡab	Incorrect		
	Morpheme-level translation	Def-boy run.3fs in def- playground			
	Literal translation	"The boy (is, feminine) running at the playground."			
20	Arabic	?al-?awla:d yarkuḏ fil malḡab	Incorrect		
	Morpheme-level translation	Def-boys run.3ms in def- playground			
	Literal translation	"The boys is at the play ground."			
21	Arabic	haḏa ?al-walad ?alati kasar ?al-zo ...a:d3	Incorrect		
	Morpheme-level translation	This is def-boy comp(who)fs break.past.3ms def- glass			
	Literal translation	"This is the boy that (feminine) broke the window."			

22	Arabic	faṭīma yaqraʔu: ʔal-risa:li	Incorrect	
	Morpheme-level translation	Faṭīma read .3mp def-letter		
	Literal translation	"Fatima reads (masculine) the letter."		
23	Arabic	faṭīma yaqraʔ fi kita:b	Incorrect	
	Morpheme-level translation	Faṭīma read .3ms in def-book		
	Literal translation	"Fatima reads(masculine) in the book."		
24	Arabic	fatima tagraʔ ʔal-risala ʔimbarih	Incorrect	
	Morpheme-level translation	Fatma read.3fs def-letter yesterday		
	Literal translation	"Fatima reads the letter yesterday."		
25	Arabic	ka:n ʔal -ʔawla:d ya:kul	Incorrect	
	Morpheme-level translation	Be.past-3ms def- boys eat.3ms		
	Literal translation	"The boys (was) eating."		
26	Arabic	Ka:nat ʔal-bint yalṣab	Incorrect	
	Morpheme-level translation	Be.past-3fs def- girl play.3ms		
	Literal translation	"The girl was (feminine) playing (masculine)"		
27	Arabic	ʔakalat ʔal- ʔawala:d	Incorrect	
	Morpheme-level translation	Eat.past-3fs def- boys		
	Literal translation	"The boys ate (feminine plural)."		
28	Arabic	ʔal-ʔawla:d ma- tišrab-iš ʔal -šai	Incorrect	

	Morpheme-level translation	def-boys neg-drink.3mp-neg def-tea			
	Literal translation	The boys doesn't drink the tea.			
29	Arabic	?al- walad sa-yaqra? ?imbarih	Incorrect		
	Morpheme-level translation	Def-boy will-study yesterday			
	Literal translation	"The boy will read yesterday."			
30	Arabic	bukra Fatima za:rt laila	Incorrect		
	Morpheme-level translation	Tomorrow Fatima visit.past.3fs laila			
	Literal translation	"Tomorrow Fatima visited laila."			

APPENDIX E: Scoring Criteria

Experiment 1

Scoring for question elicitation task

I- Scoring for wh-question elicitation task

A "+" score was assigned to questions that were syntactically and semantically correct and contained the minimal number of morphemes. Minimal morphemes included the subject, verb, and inflections for tense, person, gender and number agreement. In the case of optional additions to syntactic structure of the questions, the score was still correct as long as the syntactic structure and the semantic meaning were still intact. With respect to the subject, the name of the subject used in the stimuli was "Ali" or replaced by a familiar name to the participant. The score was still correct if the participant used the alternate name or the personal pronoun "you" instead of "Ali" to form the question. With respect to the verb, the only accepted verb substitution was the counterpart synonym (semantically related) to the targeted verb, otherwise all productions were all scored as incorrect. A "-" score was assigned if the following question production errors occurred:

Omission errors:

1- Incomplete questions (e.g., only a Wh morpheme and nothing else).

	Target Response	Participant Response	Score (Rational)
Arabic	mata maraḥiṣ ḡali ʔal-madrasa	ʔay sa:ḡa....ʔ	Incorrect: Incomplete questions (e.g., only a Wh morpheme and nothing else).
Morpheme-level translation	When neg.go.past.3ms- neg Ali def- school	Which hour ʔ	
Literal translation	"When didn't Ali go to school?"	"At what time..?"	

2- Ill-formed Wh-questions of the form "Wh-NP" or "NP Wh- morpheme".

These included missing one or more of the minimal required morphemes that included the subject, verb and inflections for tense, person, gender and number agreement.

	Target Response	Participant Response	Score (Rational)
Arabic	we:n ʔiṣtar fatim ʔal-fusta:n OR min we:n ʔiṣtarat faṭima ʔal-fusta:n	mine:n ʔiṣtare:ti	Incorrect: Missing one or more of the minimal required morphemes (Object)
Morpheme-level translation	Where buy.past- 3fs Fatima def- dress From where buy.past-3fs Fatima def-dress	From where buy.past-3fs	
Literal translation	"Where did Fatima buy the dress?" OR "From where did Fatima buy the dress?"	"From where did you buy ʔ"	

Substitution errors:

3- Wrong Wh-morpheme selection that is syntactically correct.

	Target Response	Participant Response	Score (Rational)
Arabic	šu katab ɟali	man huwa ɟali ʔili katab kaðaʔaw ..kaða	Incorrect: Wrong Wh-morpheme selection(who instead of what).
Morpheme-level translation	What write.past-3ms Ali.ms (subject)	Who he Ali that write.past-3ms this...or...that	
Literal translation	"What did Ali write?"	"Who is he Ali that wrote this and that?"	

4- Correct Wh-morpheme with substitution errors in one or more of the minimal required morphemes that included the subject, verb and inflections for tense, person, gender and number agreement. Some errors of this type were syntactically correct but semantically inappropriate questions.

	Target Response	Participant Response	Score (Rational)
Arabic	mi:n ʔakal ʔal- tufaħa	mi:n ʔa□að ʔal- tufaħa	Incorrect: Correct Wh-morpheme followed by another noun phrase including using a different verb (take.past-3ms instead of eat.past-3ms).
Morpheme-level translation	Who eat.past-3ms def-apple	Who take.past-3ms def-apple	
Literal translation	"Who ate the pple?"	"Who took the apple?"	

Other errors that included:

- 5- Incorrect question type (i.e., Wh-question that is produced as a yes/no question.)

	Target Response	Participant Response	Score (Rational)
Arabic	mi:n ?al-?ab naṣaḥ OR mi:n ?ili naṣaḥ-u ?al- -?ab	ma: baḡrif.....	Incorrect : Don't know response
Morpheme-level translation	Who def-father advice.past-3ms OR Who that (comp) advice.past-3ms def- father	Neg.know.3ms...	
Literal translation	"Who did the father advice?" OR "Who was advised by the father?"	"I don't know..."	

- 6- Don't know responses.

	Target Response	Participant Response	Score (Rational)
Arabic	we:n na:m ɟali	hal fi: fra:š...(pause).....widak tna:m ?	Incorrect: Wh-question is produced as a yes/no question
Morpheme-level translation	Where sleep.past- 3ms Ali.ms (subject)	Do in bed...(pause).....want- 3ms sleep-1ms ?	
Literal translation	"Where did Ali sleep?"	"Is it in bed?...(pause).. would you like to sleep ?"	

- 7- Ill formed Wh-question of the form NP statement (i.e., the subject produced nominal sentence (SVO) but no Wh-word was used.)

	Target Response	Participant Response	Score (Rational)
Arabic	mi:n ?akal ?al-tufaha	haða kalha.....he:dar...yaçni maøalan ...?a□aðha ..	Incorrect : Ill formed Wh-question of the form NP statement (i.e., the subject produced nominal sentence (SVO) but no Wh-word was used.)
Morpheme-level translation	Who eat.past-3ms def-apple	this....eat.past-3ms Haider...mean-1ms for example take.past-3ms	
Literal translation	"Who ate the apple?"	"This is... for exampleHaidertook it ?"	

- 8- Production of noun phrase statement (i.e., nominal sentence (SVO) but no Wh-word was used.). Declarative instead of interrogative.

	Target Response	Participant Response	Score (Rational)
Arabic	we:n na:m hani ?	we:n ?inti na:ym ?	Incorrect: Tense and agreement violations (use of active participle-2ms instead of past tense-3ms)
Morpheme-level translation	Where sleep.past-3ms Hani.ms (subject)	Where you sleeping. active participle-3ms	
Literal translation	"Where did Hani sleep?"	"Where are you sleeping?"	

II- Scoring for yes/no question elicitation task

A "+" score was assigned to yes /no questions, that were syntactically and semantically correct and contained the minimal number of morphemes. Minimal morphemes included the subject, verb and inflections for tense, person, gender and number agreement. A "-" score was assigned if the following question production errors noticed:

- 1- **Omission errors leading to incomplete questions with only a single word and nothing else. This includes production of the subject only, object only, the verb only or the adjective only. This was coded as type 2.**

	Target Response	Participant Response	Score (Rational)
Arabic	ta:kul ħasa ? OR bidak ta:kul ħasa ?	kul?	Incorrect (Incomplete questions with only a single word and nothing else)
Morpheme-level translation	eat.2ms now OR Want-2ms eat.3ms now	eat-2ms?.	
Literal translation	"Would you like to eat now?"	"Eat...? "	

3- Incorrect question type of the form "Wh-NP" or "NP Wh-morpheme":

(i. e. using Wh-morpheme to ask yes/no question.). This was coded as type 6.

	Target Response	Participant Response	Score (Rational)
Arabic	maçak flu:s kfyɑ:yi ? OR ħal maçak flu:s kafya?	çali...?inta kaif Šu_lak ?al- yuo:m..hal ?inta mi...awib maça:na wala la? ?	Incorrect (Ill- formed yes/no question of the form "Wh NP"
Morpheme-level translation	You have money enough OR Q have money enough	Ali....you how work-yours def- today..Are you responding with us or not?	
Literal translation	"Do you have enough money?"	" How is your work Ali? are you following us?"	

4- Substitution errors leading to ill-formed yes/no question that includes errors due to inflections in (tense, person, gender and number agreement or both.). This type also included syntactically correct but semantically inappropriate alternate yes/no question. This was coded as type 4.

	Target Response	Participant Response	Score (Rational)
Arabic	hani tišrab šai ? OR bidak tišrab šai?	širibit šai wala la? ?	Incorrect: Ill-formed yes/no question with tense error (Participant asked Hani if he drank tea instead of whether he likes to drink tea now.)
Morpheme-level translation	Hani drink- present-2ms tea OR Want-2ms drink- present-2ms tea	Drink.past-2ms tea or not	
Literal translation	“ Would you like to drink tea?”	“ Did you drink tea or not ?”	

5- Don't know response. This was coded as type 5

	Target Response	Participant Response	Score (Rational)
Arabic	maçak flu:s kfyā:yi ? OR hal maçak flu:s kafya?	mi:n ?abşar....?	Incorrect: I don't know response
Morpheme-level translation	You have money enough OR Q have money enough	Who..I don't know ?	
Literal translation	"Do you have enough money?"	"Who...I don't know ?"	

II- Question repetition task

The response is scored "+" if the patient says the same sentence as the examiner without addition, omission or substitution of words. The response is scored "-" if the patient produces a different sentence or nonsense.

	Target Response	Participant Response	Score (Rational)
Arabic	neg-know.3ms-neg why quit.past-1ms def-job	ma-biçrif-iş le:ş tarak ?al- şu _ ul	Incorrect (agreement error). Type of error (substitution) , patient used (tarak) instead of (tarakit)) Embedded Wh-question repetition.
Morpheme-level translation	ma-biçrif-iş le:ş tarakit ?al-şu _ ul	neg-know.3ms-neg why quit.past-3ms def-job	
Literal translation	"He doesn't know why I quit the job."	"He doesn't know why he quit the job."	

Experiment 2: Sentence completion task: verb inflections

I- Tense inflection

The response is scored "+" if the patient says the required verb with the correct tense. The response is scored "-" if (1) the patient produces a different verb, (2) produces the verb with the wrong tense or (3) non verb. The criterion for acceptability is that of ordinary spoken language, not prescriptive grammar books.

- Patient produces different verb , code (1)

	Target Response	Participant Response	Score (Rational)
Arabic	?imbarih huwa qara? giša.	?imbarih ša:r yuxtub çale: ha	Incorrect tense (different verb),
Morpheme-level translation	yesterday he.ms read a story	yesterday become.past-3ms speak.3ms on-her	
Literal translation	"Yesterday he read a story."	"Yesterday he was giving her speech ."	

- Patient produces the verb with the wrong tense, code (2).

	Target Response	Participant Response	Score (Rational)
Arabic	bukra ?al-?a wala:d sa-yaru:hu al-madrasi	bukra ?al-?a wala:d bi-yiru:hu çala ?al-madrasi	Incorrect tense : patient uses (present continuous) instead of future model (will) + present verb.
Morpheme-level translation	Tomorrow def-boys will go-3mp (simple present) to def-school	Tomorrow def-boys asp-- go-ind (present continuous) to def-school	
Literal translation	" Tomorrow the boys will go to the school."	" Tomorrow the boys are going to the school."	

- Patient produces no verb , code (3)

	Target Response	Participant Response	Score (Rational)
Arabic	?imba:riḥ faṭima ša:ḥadat ?al- film .	?ams	Incorrect tense (no verb)
Morpheme-level translation	Yesterday Fatima watch.past-3fs def-movie	Yesterday.....	
Literal translation	"Yesterday Fatima watched the movie."	"Yesterday...."	

II- Agreement inflection

The same criteria will be implemented for the agreement morphology (person, gender and number). If the subject produces the correct verb with the correct agreement inflections, the response is scored as "+", or "-" if the patient produces (1) no verb or incorrect verb, or (2) incorrect person agreement inflection, or (3) incorrect gender agreement inflection or (4) incorrect number agreement inflection.

	Target Response	Participant Response	Score (Rational)
Arabic	?imbarih huwa qara? giša.	?imbarih huwa qar?at giša.	correct tense but incorrect agreement (use of feminine instead of masculine inflection)
Morpheme-level translation	yesterday he.ms read-3ms a story	yesterday he.ms read-3fs a story	
Literal translation	"Yesterday he read (3ms) a story."	"Yesterday he read (3fs) a story ."	

I- Verb negation

The response is scored as "+" or "-". A "+" was assigned if the patient says the correct negation form that includes the correct negation particle and the correct targeted verb. A "-" was assigned if the patient produced (1), no negation particle, incorrect negation particle, (2) only negation particle, (3) incorrect verb, a different verb or no verb to merge negation particle with.

	Target Response	Participant Response	Score (Rational)
Arabic	çali ma- katab ?al-risa;li OR çali ma- katab -iš ?al-risa:li	katab ?al-risa;li	Incorrect , Patients didn't use negation particle.
Morpheme-level translation	Ali neg- write.past-3ms def-letter OR Ali neg-write.3ms- neg def-letter.	write.past-3ms def-letter	
Literal translation	"Ali didn't write the letter."	"He wrote the letter."	

Experiment 3: Grammaticality Judgment of tense and agreement violations

Thirty incorrect sentences contained agreement violations (17 sentences) and tense violations (13 sentences) were presented to the participants. The examiner scores the participant's response as "+" if the participant correctly judged the sentence as incorrect, or "-" if the participant incorrectly judged the sentence as correct or gives no answer after 10 seconds.

Item #		Presented incorrect sentence	Target response	Participant Response	Score (Rational)
1	Arabic	ka:na ʔal-bint talʕab	Incorrect	Correct	Incorrect (Agreement violation) The participant judged the use of the masculine-gender agreement instead of the feminine- gender agreement as correct.
	Morpheme-level translation	be.past-3ms def-girl play.3fs			
	Literal translation	"The girl was (3MS) playing (3FS)."			

Example of agreement grammaticality judgment:

Item #		Presented incorrect sentence	Target response	Participant Response	Score (Rational)
1	Arabic	ʔimba:riħ ʕali yaqraʔ ʔal- kita:b	Incorrect	Correct	Incorrect (Tense violation) The participant judged the use of the present tense instead of the past tense as correct.
	Morpheme-level translation	Yesterday Ali read-present- 3ms def-book			
	Literal translation	"Ali reads the book yesterday."			

Appendix F: IRB Approval

Behavi

April 16, 2009

Dr. Fox,

In order to facilitate IRB review, our office prescreened your application, "**A IN JORDANIAN-ARABIC SPEAKERS**". The data collection was conducted by the Investigator arrived at Ohio State and was covered by the review of the Human Subjects Committee at the Directorate Royal Medical Services. The data set contains random unlinked code numbers. As such, no IRB or exempt application need be submitted for the analysis of this data.

Please contact me with any questions. Best wishes with the research.

A handwritten signature in cursive script that reads "Michael Donovan".

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