WHEN IS GENDER ACCESSED? A STUDY OF PARAPHASIAS IN HEBREW ANOMIA

Naama Friedmann[1] and Michal Biran[1,2]

([1]Tel Aviv University; [2]Loewenstein Hospital Rehabilitation Center)

ABSTRACT

This study explored access to grammatical gender during naming in Hebrew. Studies of anomia and tip-of-the-tongue states (TOT) found that speakers of various languages (Italian, Spanish, German, Dutch) have information about the grammatical gender of words they fail to retrieve. In Hebrew, on the other hand, a TOT study found that Hebrew speakers could not provide gender information. To test access to gender in single words in Hebrew we used an implicit measure – the analysis of paraphasias of anomic patients with respect to whether or not they preserved the grammatical gender of the target word. The rationale behind this measure was that when a paraphasia is created, it generally conforms to the partial knowledge the speaker has on the target word. If speakers have gender knowledge when they fail to name, they should produce paraphasias that match their partial information, and thus match the gender of the target. Such gender preservation in paraphasias was found in German for individuals with anomia, and in Arabic, French and German for slips of the tongue.

Participants were 22 Hebrew-speaking aphasic patients with phonological, semantic or conceptual anomia, who produced 532 paraphasias. None of the participants showed gender preservation in their paraphasias. Even phonological anomics, who have access to semantic information, did not preserve grammatical gender in a single-word naming task. We suggest that this difference between Hebrew and previously studied languages relates to the fact that in Hebrew bare nouns are allowed, and therefore gender is not accessed in single-word naming, whereas in languages in which a noun should be produced as a full NP (with a determiner or case-marking for example) gender has to be accessed even in single-word tasks. We propose a hypothesis according to which gender is accessed if and only if the noun is incorporated into a syntactic tree (or a chunk of a tree) that includes an agreement phrase.

Key words: anomia, Hebrew, gender, phonological lexicon, semantic lexicon, lexical processing

INTRODUCTION

One of the things speakers of a language know about a noun is its grammatical gender. The main aim of the current study is to learn more about how this knowledge is encoded, when it is accessed, and whether the access to it is the same across different languages. For this purpose we used an implicit measure of grammatical gender knowledge: the errors that are made by Hebrew-speaking individuals with anomia when they fail to name. Generally, in cases of naming failure when partial information is available, a word that conforms to the partial information is used instead of the target word. For example, when trying to name a plum, partial information indicating that it is a sweet and round

summer fruit might lead to production of the word "apricot" instead. The same rationale holds for gender knowledge as well. When lexical retrieval fails, but grammatical gender information is available, a word should be retrieved that has the same gender as the target word. Thus, the analysis of gender in paraphasias can be informative with respect to grammatical gender knowledge. Such influence of gender on paraphasias was reported by Kulke and Blanken (2001) for German-speaking aphasic patients.

What is Grammatical Gender?

Grammatical gender is a lexical-syntactic property of nouns that is required for syntactic agreement. Agreement occurs within the noun phrase – between the head noun and a determiner, an adjective, etc. – and in the sentence, between the subject (and in some languages also the object) and the predicate – a verb, a copula, or an adjective. There are two distinct notions of gender: grammatical gender and natural gender (sex). In some gender systems grammatical gender is correlated with sex, but in other systems mismatches between gender and sex occur, and gender is arbitrary. For example, in German, *Mädchen,* a young woman, is in the neutral gender rather than feminine gender. In some cases synonyms for the same object may carry different genders: this is the case for example in Hebrew for *moon* which has two words, one masculine (*yare'ax*) and the other feminine (*levana*). Another point that supports the notion of arbitrariness of grammatical gender and the impossibility to deduce gender from conceptual properties is that words that refer to the same entity in various languages can be marked with different genders. For example, *train* is masculine in Italian (*treno*) and feminine in Hebrew (*rakevet*); a *house* is masculine in Hebrew (*bayit*) and feminine in Spanish and Italian (*casa*); and a *kite*, which is feminine in Arabic (*tayara*), is masculine in Hebrew (*afifon*).

The assignment of gender to a noun can follow the meaning of the word (its natural gender), as is the case in English, where the rule for gender assignment (for the pronouns *he, she* and *it)* is transparent and related to biological gender: Nouns referring to female humans are feminine, nouns referring to male humans are masculine, and all other nouns are neuter. Other languages use formal principles for gender, and they assign gender primarily based on the form of the noun, such as morphological suffix.

This is the case in Spanish, for example, where most nouns ending in *-o* are masculine and most nouns ending in *-a* are feminine (Comrie, 1999). Some studies that tested agreement of the head of subject NP to adjectival predicate found that there were fewer errors when the gender of the subject was not just grammatical but could also be determined conceptually, or when the subject was animate (Vigliocco and Zilli, 1999 for Italian; Vigliocco and Franck, 1999 for Italian and French; Deutsch et al., 1999 for Hebrew). These findings suggest that the redundant conceptual information contributes to accuracy in gender agreement. One of the questions concerning grammatical gender is whether it is stored as a syntactic property of nouns or computed on the basis of the semantic, morphological and phonological properties of the noun each time it is required (Schriefers and Jescheniak, 1999). Current psycholinguistic models of language

production assume that gender is stored as a property of nouns rather than computed and this enables fast and accurate access to gender information. If indeed grammatical gender knowledge is stored, then the question that emerges is how and where it is stored.

Where is Gender Represented According to Different Psycholinguistic Models?

Several models that referred to this question provided different answers. Levelt's (1989, 1992) model of language production (and see also Roelofs, 1992) includes three main levels: a conceptual level, a lemma level and a lexeme level. The first level, the conceptual level, provides the input for the selection of the lemmas. The lemmas are nodes at the syntactic level. In this level each lemma node connects to nodes that represent the syntactic properties of each word, such as syntactic category and grammatical gender. All nouns of the same gender are connected to one gender node. Levelt et al. (1998) also claim that the lemma is the locus of syntactic representation of the word. This syntactic representation involves syntactic category (noun, verb, etc.), gender (for nouns in languages that are gender-marked), and subcategorization (e.g., for verbs: transitive, intransitive, etc.). These syntactic properties are required for grammatical encoding and for incorporating the word in its appropriate syntactic environment (a noun projecting as a head of a noun phrase, a verb that receives its appropriate arguments, gender agreement on the article, etc.). At the next stage each lemma is connected to a lexeme node on the phonological level, which stores the phonological form of the word. Finally, there is a connection between the gender nodes and all the words that have to agree in gender with the target noun (e.g., pronouns, definite articles, etc.). According to this model, an individual who has access to the lemma stage but not to the lexeme should have access to syntactic information about the word, including grammatical gender, despite naming failure. This model is serial, and makes the assumption that phonological form is activated only after its lexical-syntactic properties have been selected (namely, the selection of a lemma always entails the selection of its lexical-syntactic features). This type of model was termed a "syntactic mediation" (SM) model by Caramazza (1997).

Another type of model is the one suggested by Caramazza (1997) and Caramazza and Miozzo (1997), which does not assume linear ordering of the stages. According to this Independent Network model (IN), semantic-conceptual representations directly activate the word-form representations and the lexical-syntactic properties in parallel, without an intervening lemma node. The crucial difference between serial access and parallel access models is that parallel access models predict a double dissociation – preserved retrieval of syntactic information with no access to phonological information, and preserved retrieval of phonological information with no access to syntactic information (which should result in a patient who can name objects but does not have access to the syntactic information). The serial model, on the other hand, permits only the first dissociation. The next sections will survey studies that examined the availability of gender information when no phonological information or only partial phonological information is available.

Is Gender Accessible when Phonological Information Is Not?

Studies in various languages tested knowledge of grammatical gender in cases of word retrieval failure. This was done both in speakers without language impairment in *tip-of-the-tongue* (TOT) states, when semantic information is available but phonological information is partial, and in individuals with anomia.

Tip-of-the-Tongue Studies of Individuals Without Language Impairment

Studies of TOT states have tested knowledge of grammatical gender in speakers without language deficit by examining the information they have about words they fail to retrieve. Vigliocco et al. (1997) examined 60 Italian speakers who were asked, in TOT states, to provide information about the word they failed to retrieve – gender, number of syllables, letters and their position. The results were 84% correct guesses of gender. Furthermore, 80% of the gender guesses of irregularly marked words were correct and even when participants did not report any phonological information, the performance on gender retrieval was above chance – 80% correct. This indicates that Italian speakers in TOT states do have access to syntactic features of words even when they cannot retrieve their full phonological information. Caramazza and Miozzo (1997) conducted two experiments, testing Italian speakers without a language deficit in TOT states. In the first experiment 53 participants in TOT states were asked to provide information about the gender, final phoneme, number of syllables and first phoneme of the target. In a second experiment 42 participants were asked to provide information about gender and first phoneme. In both experiments gender guessing was significantly above chance, and there was no indication of positive correlation between the retrieval of gender information and phonological information. The authors suggested that this finding indicates that the retrieval of partial phonological information does not depend on prior retrieval of correct syntactic information. Miozzo and Caramazza (1997a) examined 16 Italian speakers in TOT states. The participants were asked to retrieve the gender of the target, its final vowel and its initial phoneme, by choosing between two alternatives. Gender (71%) and initial phoneme (76%) were significantly better recognized than final phoneme (62%). No significant difference was found between gender and first phoneme. Gender was not recognized better in regular target nouns than in irregular nouns. These results indicate that the gender information was not based on the participants' ability to retrieve the final vowel of the target word, which in Italian can provide information about gender. The authors note that the similar percentage of recognition of gender and initial phoneme in TOT states raises questions regarding the two-stage models as do the Caramazza and Miozzo's (1997) findings. Two-stage models predict that the recognition of gender should be better than that of initial phoneme, since the selection of grammatical information, which is associated with the lemma level, precedes the selection of phonological information in the lexeme level. If in TOT there is access to the lemma but not to the lexeme, gender recognition should be better than initial phoneme recognition. These findings suggest that there are separate representations of lexical-syntactic properties and phonological properties of words, since speakers in TOT states can provide information about the lexical-syntactic properties (e.g.,

gender) of the word they cannot produce, without being able to provide full information about the phonological form of the word (such as final phoneme; see also Schriefers and Jescheniak, 1999).

Studies of Individuals With Anomia

Another population in which access to grammatical gender in the absence of phonological information can be tested is individuals with anomia. In this population word retrieval failure is more frequent and consistent, and studies have focused on whether information about gender is available to them when they fail to retrieve a word.

Badecker et al. (1995) examined an Italian-speaking patient, Dante, who had word-finding difficulties, in a series of experiments. They gave him different naming tasks that included irregular and regular nouns. When he failed to retrieve a word, he was asked about its gender and about its phonological and orthographic form (initial phoneme, final phoneme, length of the word, etc.). A dissociation was found: he was able to identify the gender of a word he failed to name, but he could not provide information as to its phonological or orthographic form. Regularity of the ending with respect to gender had no effect on his ability to identify gender, a further indication that the patient did not rely on phonology to access gender. A dissociation between knowledge of syntactic features and phonological form was also found with respect to another type of lexical-syntactic knowledge, auxiliary selection, which, in this patient, was found to be present when no phonological information on the verb was available (Miozzo and Caramazza, 1997b; but note the crucial role of the semantics of a verb in the auxiliary it selects, as verbs that select theme arguments take different auxiliaries than verbs that select agentive arguments, see Burzio, 1986; Levin and Rappaport-Hovav, 1995).

In a series of tasks that used explicit assessment of gender knowledge of single words in a bilingual aphasic patient (Italian-English), Scarna and Ellis (2002) could not establish knowledge of gender - the patient's performance was at chance, or above chance but impaired compared to control subjects.

In contrast, when given an implicit task in which she was asked to translate noun-adjective phrases from English to Italian, she had only two errors (67/69 correct) in adjective-noun agreement. The authors concluded that gender knowledge should be tested by implicit tasks, instead of, or in addition to, explicit tasks. (We think that it might be the incorporation of the noun in a syntactic context rather than the implicit-explicit task that made the difference. We will return to this point in the Discussion.)

The findings regarding the existence of lexical-syntactic information even in the absence of phonological information are consistent with two-stage models of lexical access in which the selection of semantic and syntactic features takes place in the first stage, and the selection of phonological forms in the second, and with models that allow for independent access to phonological and lexical-syntactic information.

Similar findings were found for French and Spanish. Henaff Gonon et al. (1989) examined a French-speaking individual (GM) who had anomia due to an

impairment at the phonological level. He had only partial phonological knowledge of target words he could not fully retrieve (length, first letter and some medial letters), but he could tell the gender of words that he could not name significantly above chance: he named 19 out of 36 pictures, and could tell the gender of 13 of the words he could not name, i.e. 17 words. (In fact, the exact numbers are somewhat unclear. Later in the article the authors say that GM had only one gender error, while in the Discussion they say that he knew the gender of 60% of the words he failed to name). Avila et al. (2001) examined FR, a Spanish-speaker with anomia due to a deficit in activating the phonology from semantics, with no substantial semantic or phonological deficit. He, too, could tell the gender of 42 words of the 66 words he could not name, a level that is significantly above chance.

Implicit Measures of Gender Knowledge: Gender Preservation in Slips of the Tongue and Paraphasias

Unlike the explicit measure used in the studies above, Kulke and Blanken (2001) used an implicit measure of gender knowledge. In two experiments in German they examined 78 aphasics in an object naming task of 37 pictures, and 13 aphasics with 118 objects. In both experiments they found that the grammatical gender of the target word was preserved in approximately 60% of the paraphasias, a level significantly above chance. (In German there are three grammatical genders: masculine, feminine and neuter, and the chance proportion of gender preservations expected would be about 36% according to the authors' calculations, taking into account gender frequency in each category.) Their analyses showed that the gender preservation was independent of phonological similarity between the target word and the produced word (in some groups of German nouns phonological form can indicate gender). This took care of the fact that distribution of genders within semantic categories or phonological neighborhoods is not always equal (e.g., in German most flowers are feminine and many bisyllabic nouns ending with schwa are feminine), and hence, semantically or phonologically based substitutions may lead to an overestimation of the gender identity effect, which may, in part, simply be a reflection of the gender distribution among the set of potential intrusion words (a point made by Schriefers and Jescheniak, 1999).

A single case study of gender preservation in the formal paraphasias of a German-speaking individual with Wernicke's aphasia was also done by Berg (1992), who analyzed data by Blanken (1990). The patient's paraphasias were collected in tasks of naming, reading aloud and writing to dictation. Gender preservation was significantly above chance in this patient's paraphasias. These data, together with the larger study by Kulke and Blanken (2001), possibly form evidence for access to gender in implicit measures of single word tasks.

Studies of slips-of-the-tongue in individuals without language deficit yielded similar data of gender preservation in speech errors. In Jordanian Arabic, Abd-el-Jawad and Abu-Salim (1987) found that the target and the error in substitution errors that occur in spontaneous speech were of the same grammatical category and agreed in number, case and gender. Above chance

preservation of grammatical category and gender in speech errors was also found for German (Berg, 1992; Marx, 1999) and for French (Arnaud, 1999). Note however the important difference between paraphasias and slips of the tongue: slips of the tongue occur within syntactic context.

Thus, results from anomic patients and from analysis of speech errors suggest that gender knowledge can be accessible even in the absence of phonological information, thus matching the results obtained in studies with speakers without language deficit in TOT states.

Neuroimaging Studies

A different approach to the study of gender information and its representation involves neuroimaging, which seeks to identify brain regions that are involved in grammatical gender processing and to compare them to areas in which processing of phonological and semantic information occur. Miceli et al. (2002) studied gender using fMRI. They investigated the processing of isolated nouns in nine Italian-speaking participants without language deficit in three different tasks: grammatical feature (explicit gender decision), semantic and phonological. Their study revealed areas that were activated in the gender condition but not in the phonological condition, which included the left inferior and middle temporal gyrus (BA 20/21 and BA 21), a large region that included the left supramarginal gyrus (BA 40) and the left posterior cingulate gyrus (BA 31). Somewhat similar areas were found to be activated in a gender decision task by Hadar et al. (2002), who suggest that activation in anteriorinferior frontal gyrus and posterior medial-inferior temporal regions was related to gender processing.

Another fMRI study in German (Heim et al., 2002) revealed activation in the anterior-superior part of Broca's area (BA 44/45) in a gender task in which the participants produced the definite determiner for pictures. Activation in the same areas (Broca's area, BA 44) was found also in a positron emission tomography (PET) study in German (Indefrey et al., 2001) in a syntactic encoding task – full sentences and NPs that included gender agreement marking on the adjectives. Note, however, that it is not clear whether the activation in these areas indicates lexical access to gender or rather the syntactic operation of agreement checking.

An Event-Related Potential (ERP) study conducted by van Turennout et al. (1998) provides evidence regarding the temporal availability of gender information and phonological information. They tested 32 Dutch speakers without language deficit and showed that gender information is available 40 milliseconds before the information about the first phoneme of the word. These results provide additional support from a novel angle for the claim that retrieval of lexical-syntactic information precedes retrieval of phonological information.

To conclude, these findings, obtained through different research methods, indicate that gender information can be available even when phonological information is not, and that gender access occurs prior to the phonological stage. Does this access to gender occur obligatorily when the word is retrieved or only in certain syntactic contexts?

Is Gender Automatically Accessed Whenever a Word is Retrieved?

Goodglass (2000) distinguished two different senses of "knowing" gender, which he termed procedural and declarative. Procedural knowledge of gender is the ability to automatically use the appropriate agreement inflections in spontaneous speech or even in experimental tasks. The declarative sense of "knowing gender" is metalinguistic knowledge. It refers to the ability to consciously and explicitly declare gender. Some studies indeed yielded different results when using implicit ("procedural") and explicit ("declarative") tasks (see, for example, Scarna and Ellis, 2002). Goodglass noted that when asked to tell the gender of a word metalinguistically, some individuals prompt themselves by producing the word with an article, thus using their automatic syntactic processing (or procedural gender knowledge) as a support. This phenomenon is reported by participants in several studies (see, for example, Miceli et al., 2002 for Italian).

If indeed individuals have to produce a phrase in order to access gender of a noun, this raises the possibility that gender is accessed in syntactic context but not necessarily in single words. The views on this question are varied.

Levelt et al. in their recent version of the model (1999) now posit that the lexical-syntactic properties of the lemma are not always selected whenever the lemma is selected. The gender of a lemma is selected only when it is needed in the syntactic environment of the noun (e.g. when producing a noun phrase as opposed to a bare noun). Similarly, Roelofs et al. (1998) do not assume obligatory access to gender in single word retrieval and suggest that during lemma retrieval (only) "task-relevant syntactic properties of a word are recovered from memory and the abstract morphosyntactic parameters that are required for grammatical encoding are made available". This is also the suggestion of the independent network model (IN; Caramazza, 1997; Caramazza and Miozzo, 1997).

Two methods that were used to study access to gender in speakers without language impairment, and which can be informative with regard to the question of obligatory access to gender, are gender priming and picture-word interference studies (i.e., interference to picture naming of a written word with incongruent gender). Because some of these studies used single word tasks and some used phrases or sentences, they allow for a comparison between access to gender in single words and access to gender in phrases or sentences. In German (Jescheniak, 1999) and in Russian (Akhutina et al., 1999), the prime required the production of phrase, a determiner or an adjective, + noun. In German incongruent determiners were inhibited, in Russian a gender priming effect was found. These results suggest that a syntactic phrase (a determiner phrase, see the Discussion for elaboration) requires access to gender. In other studies where the prime (or the simultaneous distractor) was a single word, the picture is murkier: In Dutch, a single-word distractor yielded an interference effect for a target of determiner + noun and no effect or significantly smaller effect for a target which was a single noun (La Heij et al., 1998; Schriefers, 1993; van Berkum, 1997). In Italian, Spanish and Catalan (Costa et al., 1999; Miozzo and Caramazza, 1999) a single word did not distract NP targets (determiner + noun

or determiner + noun + adjective).[1] Finally, a priming study in Greek found priming from a picture to the production of noun + adjective phrase only for masculine but not for feminine nouns, a finding that is hard to interpret (Plemmenou et al., 2002).

From the data obtained in these studies we can conclude that when there is a syntactic context (a noun accompanied by a determiner or an adjective) in the prime, gender must be accessed. However, when the prime is a single word, the findings are not completely clear, but they do generally suggest that when prime and target do not require a full NP, gender is not necessarily accessed, possibly as Levelt et al. (1999) suggest, only when the target is in a syntactic context gender must be accessed. (An interesting question that we will explore in the Discussion is what forms a syntactic context that requires gender access). Part of the reason for this ambiguity of the results may be that although it seems that only a single word is retrieved, some languages do not allow bare nouns (they require determiner phrases, see Discussion), and therefore an abstract determiner phrase is created even when no overt determiner is produced. These results are consistent with the claim that gender is selected only if it is needed in the syntactic environment of the noun, i.e., if there is an agreement target in the environment of the noun (Schriefers and Jescheniak, 1999).

Gender in Hebrew

Hebrew includes two grammatical genders – masculine and feminine. Nouns agree within the noun phrase (NP) with adjectives and numbers, and the head noun of the subject NP agrees with verb and adjectival predicates. In addition, pronouns inflect for gender. Most feminine nouns (97% according to Gollan and Frost, 2001) are marked with a suffix (*-a*, *-et* or *-it*), and most masculine nouns are morphologically unmarked. Irregular nouns exist for both genders.

In a study of gender in 25 Hebrew-English bilinguals, Gollan and Silverberg (2001) examined explicit guesses about the grammatical gender of Hebrew nouns in TOT states. The gender-guess accuracy was 55%, which on our analysis is not statistically different from chance, and there was no apparent bias for guessing masculine or feminine. Similarly, Silverberg et al. (1999) in a study of picture naming found that native Hebrew speakers in TOT states reported gender correctly only 62% of the time, a level that was not better than in "don't know" states (also 62%), indicating no knowledge of the gender of the target word in TOT states in a single word production task in Hebrew. The testing protocol produced 211 TOT states and 177 "don't know" states, thus lack of power is unlikely to have been a problem in this case. In addition, the participants in this study were Hebrew language professors, suggesting that even linguistically sophisticated participants cannot report gender explicitly during a TOT state for a Hebrew target.

---

[1] Miozzo and Caramazza (1999) and Costa et al. (1999) explain the lack of interference in Italian, Spanish and Catalan in that the critical information needed for the selection of the determiner in these languages is available only at the phonological level because phonological properties of the onset of the noun following the determiner affect the selection of the determiner. According to them, there is enough time to resolve the conflict caused by the distractor in gender selection, and this is why no interference was witnessed.

These findings are rather different from the data obtained in other languages surveyed above, in which participants guess the gender at a level above chance in Italian (Badecker et al., 1995; Vigliocco et al., 1997), German (Berg, 1992; Kulke and Blanken, 2001), Spanish (Avila et al., 2001) and French (Henaff Gonon et al., 1989). Gollan and Silverberg explained this difference in that in Hebrew, unlike in Italian, for example, the definite article, which precedes the noun, is not gender-marked. They also attribute the difference to the fact that in Hebrew the gender-marked sentential elements usually appear after the noun. Therefore, it may be unnecessary to have access to grammatical gender in Hebrew as early in the process of lexical retrieval as in Italian and German for example, and TOT states may occur at a stage of retrieval that is prior to gender access in Hebrew but is after gender access in Italian. Thus, the relative absence of prenominal gender markers in Hebrew may be the cause for the difference between languages with respect to access to gender (for a similar discussion see also Gollan and Frost, 2001). It seems that additional studies are needed to establish the reason for this cross-linguistic difference, also with monolingual speakers of Hebrew, and possibly also with implicit measures which have proven to show gender effects when explicit methods failed to show them.

The picture that arises from studies in various languages is that gender information can be accessed in the absence of full phonological information. Two studies of Hebrew TOT states suggest that this however is not the case in Hebrew-speaking individuals without language impairment, in explicit tasks. In this study we tried to further assess whether in Hebrew gender information can be accessible when phonological information is missing or partial, and whether gender information is accessed in a single-word naming task, using an implicit measure of gender knowledge. We examined the paraphasias produced by Hebrew-speaking anomic patients in a picture-naming task, and analysed whether they preserved the gender of the target word. Paraphasias can serve as an indication for the partial information a speaker has when naming fails, because paraphasias usually conform to the information the speaker has about the target word, such as semantic category, first phoneme, and, crucially, its gender. Hence, if the speaker knows the gender of the target word, the paraphasias are expected to be of the correct gender; if no gender information is available, the gender of the paraphasias should be randomly chosen. Thus, if paraphasias of patients who do not have access to full phonological form still preserve grammatical gender, this would indicate that gender is accessible at a stage before phonological lexicon (as predicted by the model of Levelt et al., 1999). However, if paraphasias are found not to preserve gender, this would indicate either that grammatical gender is accessed later in Hebrew, or that it is not accessed at all in a single word naming task in Hebrew.

METHOD

Participants

Twenty-two Hebrew-speaking aphasic patients with anomia due to deficits in different levels of lexical processing participated in this study. The functional

locus of their deficit was determined on the basis of the types of errors they made in naming (paraphasias: unrelated semantic formal, neologisms, circumlocutions, etc.) and by means of tests that assessed their conceptual, lexical-semantic and lexical-phonological abilities. Individuals who failed in the pyramids and palmtrees test (Howard and Patterson, 1992) and in an odd-out test of one picture out of four of the same semantic category, and also produced mainly unrelated paraphasias (paraphasias that were semantically and phonologically unrelated to the target word) were identified as having a conceptual deficit. Individuals who succeeded in these tests but failed on a spoken word-picture matching test (PALPA 47; Kay et al., 1992; Hebrew version: Gil and Edelstein, 2001) and in a semantic verbal fluency task ("Say as many names of animals as you can"), and produced mainly semantic paraphasias (within semantic category substitutions or super-ordinate category names) were identified as having a lexical-semantic deficit. Individuals who performed poorly in a phonological verbal fluency task ("Say as many words as you can that start with *m*"), but performed better on the semantic fluency task, who failed in identifying the first phoneme of a word, and who produced mainly paraphasias that were phonologically similar to the target word (formal paraphasias or nonwords), were identified as having a lexical-phonological deficit.

For two of the patients (MS and HL), the task was given in two sessions, at two different stages in recovery, and given that they showed different pattern of deficit on retesting after one to two months (moving from unrelated paraphasias to semantic paraphasias for both of them, and from a classification of conceptual to semantic impairment for MS), we could not collapse their data from the two sessions and therefore counted them separately.

On the basis of these criteria, four participants were identified with a conceptual deficit, five with a semantic deficit and eight with a phonological deficit. Seven participants had a combined deficit that could not be classified as stemming from a single deficit in one of the stages of lexical retrieval.

The participants were 15 men and 7 women, age range 20 to 72 years (mean 57.1 years). They were all proficient in Hebrew, 10 of them were monolingual native speakers of Hebrew, and the ones who were not native had spoken Hebrew for at least 46 years. Seventeen of the participants had left-hemisphere CVA, two had a tumor, two had head trauma and one was after a brain surgery. Time post-onset ranged from two weeks to 38 months (see Appendix A for detailed background information on the participants).

Materials

Two hundred colored pictures of objects were presented to each participant for naming. The target pictures and words (picture names) were screened for grammatical gender prior to the study. Thirty students who were native speakers of Hebrew participated in this preliminary screening. First, they were asked to name pictures; six pictures which were unclear to six of the students were replaced. Then, they were given the list of target words and were asked to write the gender of each of them. Words that did not yield agreement about their gender (i.e. words that more than one student judged differently from the other

students and from the normative gender) were not included in the study. For example, *gerev* (= sock), which is normatively masculine but was judged by 23 of the 30 students as feminine, was excluded from the word list. In addition, we were careful not to include two additional types of words: words that can be both feminine or masculine (for example, *sakin* (= knife)) and dual nouns such as *mishkafayim* (= eyeglasses) or *misparayim* (= scissors), whose gender is usually not very clear to native speakers of Hebrew, possibly because the dual ending is the same for masculine and feminine and they do not always have a singular noun with a known gender.

The target words also included 9 irregular nouns, i.e., feminine nouns without feminine phonological ending, and masculine nouns with a feminine ending. For example, *even* (= stone) is a feminine noun even though it is unmarked, and *macit* (= lighter) is a masculine noun that is marked with the feminine suffix *-it*. The inclusion of irregular nouns was motivated by the thought that if gender knowledge can appear without phonological knowledge, irregular and regular words should allow access to gender to the same degree, but if gender knowledge relies on the phonological form of the word, more regular than irregular words should allow access to gender knowledge.

Procedure

The 200 pictures were presented to the participants one by one, and the participants were asked to name them. No explicit questions were asked about the words they could not name, only an analysis of the paraphasias was made. In the analysis we included paraphasias that created another existing word, including unrelated paraphasias such as *aron → pil* (= closet-elephant), semantic paraphasias, namely substitution within a semantic category such as *masait → rakevet* (= truck-train) or to a super-ordinate category name, and formal paraphasias, namely a real word that is phonologically related to the target such as *vilon → milon* (= curtain-dictionary) or *xalil → xalalit* (= flute-spaceship). We examined whether the gender of the target word in these paraphasias was preserved or not. We did not include phonemic paraphasias that resulted in nonwords, and we did not include semantic associations or responses such as naming a picture of a pencil "*not* a pen".

RESULTS

A total of 532 paraphasias was produced. Fifty-two of them were discarded from the analysis because they were words that belong to both genders or words with unclear gender (as judged by 30 students, who were native speakers, without language impairment). Analysis of the paraphasias of each individual participant showed that *none of them had significant preservation of gender* in their paraphasias. This was found for each participant both using the binomial distribution, which showed that the number of gender-preserving paraphasias did not significantly differ from chance, and using chi-squared comparison (with the Bonferroni correction) between paraphasias that preserve gender and paraphasias

TABLE I
Number of gender-preserving and gender-changing paraphasias per group

Deficit	masc. → fem.	fem. → masc.	Total change	masc. → masc.	fem. → fem.	Total preservation	% preservation
Conceptual (n = 4)	19	15	34	27	10	37	52
Semantic (n = 5)	16	27	43	47	23	70	62
Phological (n = 8)	24	55	79	61	33	94	54
Combined (n = 7)	22	38	60	42	21	63	51
Total	**81**	**135**	**216**	**177**	**87**	**264**	**55**

masc. = masculine, fem. = feminine.

that do not preserve the gender of the target word (p < .002). The number of paraphasias that preserved gender and paraphasias that changed gender by anomia type is presented in Table I.

However, as most of the participants had either semantic or conceptual impairment maybe they should not be expected to have full access to the lemma level, at least according to two-stage models. An analysis of the groups by functional locus of deficit yielded the following results: the individuals with conceptual deficit did not preserve gender in their paraphasias (no significant difference between gender-preserving and gender-changing paraphasias, t (3) = 0.5, p = .64). The individuals with semantic deficit showed a gender preservation effect, t (4) = 3.04, p = .03. The combined deficit group also showed no gender preservation, t (6) = 0.32, p = .76. Then, an analysis was made which included only the participants with the phonological deficit. These patients already have full semantic information and this makes them the most interesting group when the question is whether individuals who have full access to semantic information but only partial or no phonological knowledge can have information on grammatical gender. If any group should show gender preservation, at least as predicted from Levelt's Model (Levelt et al., 1999), it should be the group of phonological anomia.

There were eight participants with preserved semantic knowledge and a selective impairment at the phonological level in our study. The pattern of gender preservation in the paraphasias of each of the individuals in this group is presented in Figure 1. The mean proportion of paraphasias that preserved gender in the phonological anomia group was 53.8%. The number of gender-preserving paraphasias in this group did not differ significantly from the number of paraphasias that did not preserve gender, t (7) = 0.86, p = .42. This number of gender-preserving paraphasias also did not differ significantly from chance, t (7) = 0.87, p = .41.

In order to determine where gender information resides, it is interesting to compare the semantic and phonological groups. The comparison of gender-preserving paraphasias in the two groups showed no significant difference between the groups (t (11) = 0.38, p = .70). Thus, it seems that neither of the groups had gender knowledge and, if anything, the semantic group, who had only partial semantic information, had (non-significantly) more gender knowledge.
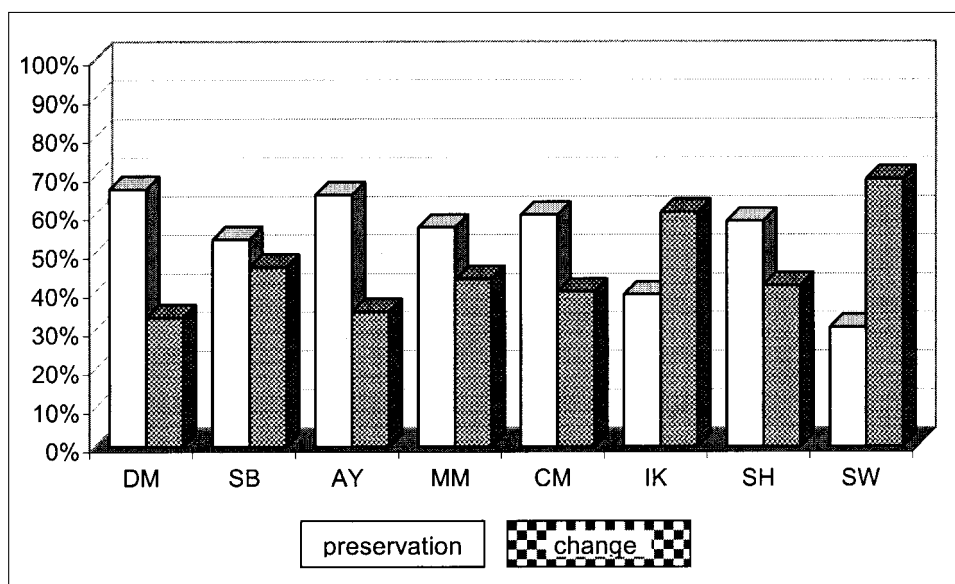
Fig. 1 – *Gender-preserving and gender-changing paraphasias of the individuals with phonological anomia.*

Another important analysis regards the type of paraphasia rather than the type of deficit: it might be claimed that while formal paraphasias should preserve gender, semantic paraphasias and semantic associations should not, because more weight is given in semantic paraphasias to close association in meaning than to gender and other syntactic features. For this reason, we did not include associations in the analysis, but it is necessary to compare gender preservation in the different types of paraphasias, to see whether unrelated, formal and mixed paraphasias did preserve gender while semantic paraphasias did not. This analysis did not yield significant difference between the different types of paraphasias with respect to gender preservations. The comparison of semantic and formal paraphasias showed no significant difference, $\chi^2 = 1.47$, p = .22; semantic and mixed paraphasias did not differ, $\chi^2 = 0.67$, p = .41; neither did the semantic and unrelated paraphasias, $\chi^2 = 0.01$, p = .92, indicating that formal paraphasias and semantically unrelated paraphasias also did not show significant gender preservations.[2]

Another analysis, which was targeted at assessing how much of the gender preservation was due to phonological similarity between the target and the paraphasia, compared gender preservation in target words with regular phonological form and target words with irregular endings (i.e., feminine nouns are usually marked with a suffix and masculine nouns are usually unmarked).

---

[2] The formal paraphasias that we analyzed did not result from a post-lexical deficit, namely they were not neologisms that accidentally formed an existing word. This can be learned from the fact that for all of the participants who had formal paraphasias there were more formal paraphasias than neologisms, and no more than 4 neologisms. Three other participants produced 18-30 neologisms, two of them had no formal paraphasias, and one of them had one formal paraphasia, which was not included in the analysis because it was suspected to be a neologism in disguise. Patients that had only neologisms were not included in the study at all.

Chi-squared analysis revealed that preservation of gender was significantly higher in regular than in irregular words (χ^2 = 12.62, p = .003). This indicates that although gender was not significantly preserved in paraphasias, it might be that even the small and non-significant difference between gender-preserving and gender-changing paraphasias should be attributed to the production of a word very similar in phonological properties, a similarity that made the paraphasia also similar in gender, even when gender information was not available. (Moreover, the finding suggests that if the study had included more irregular words we would have found an even lower number of gender preserving paraphasias). An additional analysis that can be instrumental in assessing whether gender preservation, when it occurred, was a result of mere phonological similarity (which caused the paraphasia to share the gender with the target even though gender knowledge was not available) or of genuine gender knowledge is the analysis of the different feminine suffixes which were produced. Given that more than one suffix marks feminine gender in Hebrew (*-a*, *-et*, *-it*), we can analyze how many of the gender-preserving feminine paraphasias had the same suffix and how many had a different suffix but still kept the same gender. This analysis yielded twice as many same-suffix than different-suffix paraphasias (60 vs. 27, which differ significantly, χ^2 = 25.03, p < .0001), pointing in the same direction as the results from the irregular nouns: some of the gender-preserving paraphasias might be accounted for by phonological similarity which happened to cause gender preservation.

A final interesting finding is that out of the total of 532 paraphasias only two consisted of a change from noun to adjective, *ogen* → *adom* (= anchor → red) and *beica* → *adom* (= egg → red). This finding indicates that even though grammatical gender information was not available to the participants, another type of lexical-syntactic information – grammatical category – was.

DISCUSSION

This study used an implicit measure: gender preservation in paraphasias in a picture-naming task to explore access to grammatical gender. The participants were Hebrew-speaking individuals with anomia due to deficits in different levels of lexical processing: conceptual, semantic, or phonological. The results indicate that Hebrew-speaking patients with anomia do not have information about the gender of the word they cannot retrieve. None of the participants showed gender preservation in their paraphasias. Even patients with phonological anomia, who have full semantic information and partial phonological information, did not show an indication of gender knowledge in their paraphasias. Importantly, this finding is different from those in many other languages (e.g. Italian, French, German), where anomic patients were reported to have information about the gender of words they cannot retrieve in explicit tasks (i.e., Badecker et al., 1995; Henaff Gonon et al., 1989), and even different from studies that used the same methodology of analysis of paraphasias that was used here, which found gender preservation in paraphasias in German (Berg, 1992; Kulke and Blanken, 2001). Gender preservation was also reported in speech errors in Jordanian Arabic, French and German.

The question is, of course, why. What is the cause for this difference between Hebrew and other languages regarding gender information? Two types of answers are possible here. We will consider them in detail one by one, but the general gist is the following: one answer would be to say that access to gender is obligatory and that different languages code or access grammatical gender in different stages of the lexical process. Another type of answer would be that only certain syntactic contexts, which include agreement phrase, require access to gender, and different languages have different requirements in naming: some require the production of a syntactic phrase with agreement even in single words, and this entails gender access in naming, whereas other languages, like Hebrew, do not require access to grammatical gender during naming, and this is why we did not observe gender knowledge in Hebrew.

Late Access to Gender in Hebrew

Under a serial model of lexical access, and specifically access to grammatical gender, and under an assumption that gender is obligatorily accessed whenever a word is retrieved, then our results, which showed that Hebrew-speaking individuals who had full semantic information and partial phonological information still did not have gender information, should indicate that gender in Hebrew is accessed at a very late stage of lexical retrieval, at the phonological level or even at a stage following it. This would require a parameter with cross-linguistic variation for the location of gender information in the lexical retrieval process.

A similar suggestion could be made maintaining that grammatical gender is always accessed during lexical retrieval, but assuming that the access can be parallel, rather than serially incorporated in a certain position in the lexical retrieval process. Such an account could suggest that gender information is stored in a similar way across languages, but speakers of Hebrew access this store of gender information later in the process of retrieval. A possible reason for a difference between languages with respect to when gender is accessed can be related to the nature and direction of the agreement system in a language. Possibly, languages that include mainly pre-nominal agreement would need early access to grammatical gender, while languages that include mainly post-nominal agreement would allow later access (See Gollan and Frost, 2001; Gollan and Silverberg, 2001).

Examining some of the languages in which grammatical gender has been studied, languages that include agreement with adjectives or determiners that appear before the noun, such as Dutch, German, Italian, French and Spanish, require early agreement and therefore early access to grammatical gender. Hebrew, on the other hand, exhibits mainly post-nominal agreement (the determiner, which precedes the noun, is not inflected, adjectives follow the nouns, and verbs follow the noun phrases). This might make Hebrew a late-access language with respect to grammatical gender.

Interestingly, not all cases of agreement in Hebrew are post-nominal. There are syntactic environments in which gender agreement is required prenominally in Hebrew: *count numbers* which agree with the noun, for example: *shlosha banim = three*-masc *boys*-masc vs. *shalosh banot = three*-fem *girls*-fem, and

unaccusative verbs, (like fall, arrive, vanish) which can precede or follow the subject, and which should agree with the subject, like every predicate verb, in person, number and gender. Modern Hebrew is changing, and exactly these environments in which gender agreement should precede the noun are gradually losing agreement, and default forms are beginning to appear, regardless of the gender of the noun. In numbers, during the last two decades or so, the feminine number form (the form that is unmarked morphologically) is used more and more as the default form, with both masculine and feminine nouns. So, for example, although *banim,* boys, is clearly a masculine noun, it frequently appears with the feminine count number, *shalosh banim* (= three-fem boys). Interestingly, the only count number that is used post-nominally, one, is never used incorrectly [*ben exad* (= boy one-masc) but *bat axat* (= girl one-fem)]. Similarly, when the unaccusative verb precedes the subject, agreement in gender (and number) is frequently violated, and a default masculine form is used. So, although *na'al* (shoe) is a feminine noun, the verb *nafal* (fell) frequently appears with it in the masculine form as in (1) instead of the traditional, and normative (2). A similar phenomenon is exemplified with "hurt" in (3) and (4).

(1) *nafal li ha-naal*
fell$_{[masc.]}$ to-me the-shoe$_{[fem.]}$
My shoe fell.

(2) *nafala li ha-naal*
fell$_{[fem.]}$ to-me the-shoe$_{[fem.]}$
My shoe fell.

(3) *koev li ha-regel*
hurt$_{[masc.]}$ to-me the-leg$_{[fem.]}$
My leg hurts.

(4) *koevet li ha-regel*
hurt$_{[fem.]}$ to-me the-leg$_{[fem.]}$
My leg hurts.

Importantly, none of the Hebrew speakers who accept and produce sentences (1) and (3) instead of (2) and (4), would accept (or produce) (5) instead of (6), or (7) instead of (8), where the subject precedes the verb. Why? We suggest that the reason is that in this case the agreeing element follows the noun, and post-nominal agreement is very carefully kept.[3] (This occurs also in other cases of

---

[3] A different case in Hebrew in which the agreeing element precedes the noun is the Triggered Inversion structure, which is derived by verb movement to a position before the subject (TI, Shlonsky, 1997). In these cases, gender agreement is as robust as in the cases in which the verb follows the noun, and thus the verb always agrees with the subject and (9) is not produced instead of (10).
(9) * *etmol likek hayalda glida* (*Yesterday licked-masc the girl ice cream)
(10) *etmol likka hayalda glida* (Yesterday licked-fem the girl ice cream)
The difference between unaccusative VS sentences (1)-(2) and Triggered Inversion VS sentences (9)-(10) lies in the fact that TI, but not unaccusative VS, is created from a base-generated order of SV and a verb movement through Agr to C. Given that in TI sentences agreement checking occurs in AgrP in an SV configuration, before the verb moves to C, the agreement in TI structures is not violated.

pronominal agreement such as *ze harakevet sheli* = this-masc is my train-fem, but *harakevet hazot sheli* = the train- fem this-fem is mine.)

(5) * *ha-naal nafal li*
the-shoe$_{[fem.]}$fell$_{[masc.]}$ to-me
My shoe fell.

(6) *ha-naal nafla li*
the-shoe$_{[fem.]}$fell$_{[fem.]}$ to-me
My shoe fell.

(7) * *ha-regel koev li*
the-leg$_{[fem.]}$hurts$_{[masc.]}$ to-me
My leg hurts.

(8) *ha-regel koevet li*
the-leg$_{[fem.]}$hurts$_{[fem.]}$ to-me
My leg hurts.

These observations are important to our point because in both cases when agreement is not kept, the agreeing element precedes the noun, but when it follows the noun the agreement is kept. Thus, it seems that Modern Hebrew is in the process of gradually losing prenominal agreement, but keeps post-nominal agreement.

However, it remains to be seen exactly what the relations are between the direction of agreement in a language, which is a syntactic phenomenon, and access to gender in single words, which is a lexical process. Another possibility, which can also account for the pre- and post-nominal agreement phenomena in Hebrew, is that access to gender is not obligatory whenever lexical access occurs, but is rather constrained by syntactic considerations.

Gender is Accessed only if it is Required by AgrP

The approach that we suggest to bear on our findings is that grammatical gender is only accessed when it is relevant, and that it is relevant specifically when a syntactic tree that includes an Agreement Phrase (AgrP) for the relevant noun is constructed.

When a sentence is constructed it includes an agreement phrase, which is responsible for the agreement between the noun and its predicate (either as part of the Inflectional Phrase (IP), or as a separate AgrP; Chomsky, 1995; Pollock, 1989). Therefore, when a noun is produced as the subject of a sentence for example, its gender should be accessed to construct the agreement between the subject and the verb. This is why sentential contexts in the studies that explored access to gender (such as slips of the tongue in spontaneous speech) show gender effects. But why was gender accessed also in some studies in naming tasks? According to syntactic analyses not only full sentences include agreement. According to influential syntactic analyses, when a noun appears with a

determiner, it constructs a determiner phrase (DP; Abney, 1987). This DP includes a mechanism for agreement. According to some analyses the DP includes three layers: the noun phrase (NP) layer, a determiner layer (DP), and an intermediate agreement layer, AgrP (or nP or NumP), which dominates NP. According to other analyses the DP includes two layers, NP and DP, and agreement is checked within the Determiner layer itself (Fassi Fehri, 1993; Kihm, 2001; Ritter, 1988, 1991; Siloni, 1997). Given that the determiner layer is built above the agreement layer (or that agreement is part of the determiner layer), whenever a determiner slot is created in the DP (by the determiner or case marking for example), agreement should be there too, and subsequently gender should be accessed. In some languages, a determiner (either definite or indefinite) is obligatory, and bare NP is illicit (namely nouns without the DP layer are not allowed by the grammar, and DP is required even if it is empty). This is the case for example in Italian and Spanish arguments, where bare NP arguments are illicit, and DP is obligatorily constructed (Longobardi, 1994). In these languages, whenever a noun is retrieved, a Determiner Phrase should be constructed, and this entails also the construction of agreement, which in turn requires access to gender. In Hebrew, on the other hand, bare noun phrases are possible (Danon, 2002; Dobrovie-Sorin, 2000, 2001; Engelhardt, 2000), and bare indefinite nouns do not include a DP level, so that production of a noun does not require access to grammatical gender. In a way, it seems that the question is not why gender was not accessed in single word naming in Hebrew, but why was gender accessed at all in some single word contexts in other languages. And the answer we suggest here is that when a language requires DP rather than NP, the agreement in the DP requires access to gender.

Importantly, this suggestion entails that it is not whether or not a noun is produced within a sentence that determines whether its gender will be accessed or not. Neither is it the production of a determiner. It is the existence of an agreement phrase for this specific noun (or the movement to it[4]) that determines whether or not gender will be accessed. The immediate implication of this suggestion is that a noun might be incorporated in a tree smaller than a sentence (such as a noun with a determiner, or a noun with case, which both form Determiner Phrase) and require access to gender, and conversely it might be incorporated in a full sentence and still not require gender, if the agreement phrase in the sentence does not relate to it. For example, in languages like Hebrew in which there is no agreement between the object and the verb (and hence no agreement-object-phrase), and noun phrases can be bare in object

---

[4] This can be syntactically accounted for by saying that in the prenominal cases the agreeing constituents do not move to the agreement node while in the post-nominal cases they are in agreement node or higher. In *shalosh banim* (= three-fem boys) for example, the noun does not raise to Agr and therefore does not agree with the count number, and is represented [$_{DP}$ [$_{AgrP}$ [$_{Agr}$] [$_{NP}$ shalosh [$_{N}$ banim]]]], whereas in *ben exad* (=boy one-masc) the noun moves to Agr and therefore agrees with the count number: [$_{DP}$ [$_{AgrP}$ [$_{Agr}$ ben$_i$] [$_{NP}$exad [$_{N}$ t$_i$]]]]; Similarly, in the unaccusative case, when the verb and the subject remain in the VP, they do not agree, but when the subject raises to, or through, AgrP, they agree, so in *nigmar hagranola* (= ended-masc the-granola-fem) the subject remains in the VP: [$_{AgrP}$ [$_{Agr}$] [$_{VP}$ nigmar hagranola]], whereas in *hagranola nigmera (=the-granola-fem ended-fem)* the subject moves to [$_{AgrP}$ hagranola$_i$ [$_{Agr}$ nigmera$_v$] [$_{VP}$ t$_v$ t$_i$]]. Such an analysis will suggest that what determines whether or not gender is accessed is not only whether or not a relevant agreement node is present but rather whether or not there is movement to agreement node, assuming that gender is accessed when the constituent moves to the agreement node.

position, the gender of an indefinite object, even within a sentence, might be underspecified (in a sentence like *ha-balshanit axla xumus*: "The linguist-fem ate-fem hummus"). This means that even in a sentence context, gender information will not be available for the object (in this example *hummus*). Given that other languages do have agreement both with the subject and with the object (Italian, for example), it is expected that in languages that do not allow for bare Ns, or in languages and sentences that include verb-object agreement, the gender of the object would be accessible. Thus, a testable prediction of this hypothesis, with differential prediction both within and between languages, is that in Hebrew slips of the tongue in bare NP objects will not preserve gender, while slips of the tongue of the subject of these sentences, or of definite objects will preserve gender. Slips that relate to objects of participle verbs that agree with the object in Italian are predicted to preserve gender.

Note also that according to this hypothesis it is not important whether the determiner agrees with the noun or not or even if there is a determiner at all (such as in Russian). This hypothesis predicts that even in languages in which the determiners are required but do not inflect for gender, and in languages in which there are no determiners but case markers are required, a syntactic tree for the phrase is constructed that includes agreement, and the gender of the noun should be accessed.

To conclude, the suggestion that gender is accessed only in the syntactic context of a relevant agreement node can account for most of the results surveyed in the Introduction. In single word tasks the crucial factor is whether or not the syntax of the language allows for bare NPs, or whether a DP should be constructed. Thus, Hebrew, which allows for bare NPs, does not show gender preservations in paraphasias, as this study has found, and does not show gender knowledge in TOT states (Gollan and Silverberg, 2001). Languages that require DPs would require agreement, and therefore access to gender also in naming tasks that superficially require only single words. When the task or the context of production requires the production of a phrase or a sentence that include agreement, gender will necessarily be accessed in the nouns that relate to the agreement node, in every language. This is probably the reason why participant HL in our study had a high, though not significant statistically, number of gender-preserving paraphasias that made the semantic deficit group show gender preservation effect – even in the naming task he tended to include the target word within a sentence. This is also why slips of the tongue, which occur in sentential contexts, preserve gender (Abd-el-Jawad and Abu- Salim, 1987 in Arabic; Berg, 1992 in German; Arnaud, 1999 in French; and our very preliminary analysis of slips of the tongue in Hebrew that preserve gender in 11 of 13 sentences), and this is why when the production requires a determiner, gender is preserved. This hypothesis has a large number of testable predictions in sentence and phrase context, and we are currently exploring these predictions empirically.

REFERENCES

ABD-EL-JAWAD H and ABU-SALIM I. Slips of the tongue in Arabic and their theoretical implications. *Language Sciences, 9:* 145-171, 1987.

ABNEY SP. *The English noun phrase in its sentential aspect*. Doctoral dissertation, MIT, 1987.

AKHUTINA T, KURGANSKY A, POLINSKY M and BATES E. Processing of grammatical gender in a three-gender system: Experimental evidence from Russian. *Journal of Psycholinguistic Research, 28:* 695-713, 1999.

ARNAUD PJL. Target-error resemblance in French word substitutions speech errors and the mental lexicon. *Applied Psycholinguistics, 20:* 269-287, 1999.

AVILA C, LAMBON RALPH MA, PARCET MA, GEFFNER D and GONZALES-DARDER JM. Implicit word cues facilitate impaired naming performance: Evidence from a case of anomia. *Brain and Language, 79:* 185-200, 2001.

BADECKER W, MIOZZO M and ZANNUTTINI R. The two-stage model of lexical retrieval: Evidence from a case of anomia with selective preservation of grammatical gender. *Cognition, 57:* 193-216, 1995.

BERG T. Prelexical and postlexical features in language production. *Applied Psycholinguistics, 13:* 199-235, 1992.

BLANKEN G. Formal paraphasias: A single case study. *Brain and Language, 38:* 534-554, 1990.

BURZIO L. *Italian Syntax: A Government-Binding Approach.* Dordrecht: Reidel, 1986.

CARAMAZZA A. How many levels of processing are there in lexical access? *Cognitive Neuropsychology, 14:* 177-208, 1997.

CARAMAZZA A and MIOZZO M. The relation between syntactic and phonological knowledge in lexical access: Evidence from the 'tip-of-the-tongue' phenomenon. *Cognition, 64:* 309-343, 1997.

CHOMSKY N. *The Minimalist Program.* Cambridge: MIT Press, 1995.

COMRIE B. Grammatical gender systems: A linguist's assessment. *Journal of Psycholinguistic Research, 28:* 457-466, 1999.

COSTA A, SEBASTIAN-GALLES N, MIOZZO M and CARAMAZZA A. The gender congruity effect: Evidence from Spanish and Catalan. *Language and Cognitive Processes, 14:* 381-391, 1999.

DANON G. Case and formal definiteness: The licensing of definite and indefinite noun phrases in Hebrew. Unpublished PhD dissertation, Tel Aviv University, Tel Aviv, 2002.

DEUTSCH A, BENTIN S and KATZ L. Semantic influence on processing gender agreement: Evidence from Hebrew. *Journal of Psycholinguistic Research, 28:* 515-536, 1999.

DOBROVIE-SORIN C. (In)definiteness spread: From Romanian genitives to Hebrew construct state nominals. In V. Motapanyane (Ed), *Comparative Studies in Romanian Syntax*, Amsterdam: Elsevier, 2000.

DOBROVIE-SORIN C. From DPs to NPs: A Bare Phrase Structure Account of Genitives. In *Proceedings of the Antwerps Conference on from NPs to DPs*. Antwerps, 2001.

ENGELHARDT M. The projection of argument-taking nominals. *Natural Language and Linguistic Theory, 18:* 41-88, 2000.

FASSI-FEHRI A. *Issues in the structure of Arabic clauses and words*. Dordrecht: Kluwer, 1993.

GIL M and EDELSTEIN C. *Hebrew version of the PALPA*. Ra'anana, Israel: Loewenstein Hospital Rehabilitation Center, 2001.

GOLLAN TH and FROST R. Two routes to grammatical gender: Evidence from Hebrew. *Journal of Psycholinguistic Research, 30:* 627-651, 2001.

GOLLAN TH and SILVERBERG NB. Tip-of-the-tongue states in Hebrew-English bilinguals. *Bilingualism: Language and Cognition, 4:* 63-83, 2001.

GOODGLASS H. Grammatical gender is not always syntactic. In Y Grodzinsky, LP Shapiro and D Swinney (Eds), *Language and the brain: Representation and processing*. San Diego: Academic Press, 2000.

HADAR U, PALTI D and HENDLER T. The cortical correlates of verb processing: Recent neuroimaging studies. *Brain and Language, 83:* 175-176, 2002.

HEIM ST., OPITZ B and FRIEDERICI AD. Broca's area in the human brain is involved in the selection of grammatical gender for language production: Evidence from event-related functional magnetic resonance imaging. *Neuroscience Letters, 328:* 101-104, 2002.

HENAFF GONON MA, BRUCKERT R and MICHEL F. Lexicalization in an anomic patient. *Neuropsychologia, 27:* 391-407, 1989.

HOWARD D and PATTERSON KE. *Pyramids and Palmtrees: A test of semantic access from words and pictures*. Bury St. Edmunds, Suffolk: Thames Valley Test Company, 1992.

INDEFREY P, BROWN CM, HELLWIG F, AMUNTS K, HERZOG H, SEITZ RJ and HAGOORT P. A neural correlate of syntactic encoding during speech production. *Proceedings of the National Academy of Sciences of the United States of America, 98:* 5933-5936, 2001.

JESCHENIAK JD. Gender priming in picture naming: Modality and baseline effects. *Journal of Psycholinguistic Research, 28:* 729-737, 1999.

KAY J, LESSER R and COLTHEART M. *Psycholinguistic assessments of language processing in aphasia (PALPA)*. Hove: Erlbaum, 1992.

KIHM A. *Agreement in noun phrases in Semitic: Its nature and some consequences for morphosyntactic representations*. Ms., Laboratoire de Linguistique Formelle, 2001.

KULKE F and BLANKEN G. Phonological and syntactic influences on semantic misnaming in aphasia. *Aphasiology, 15:* 3-15, 2001.

LA HEIJ W, MAK P, SANDER J and WILLEBOORDSE E. The gender-congruency effect in picture-word tasks. *Psychological Research, 61:* 209-219, 1998.

LEVELT WJM. *Speaking: From intention to articulation*. Cambridge: MIT Press, 1989.

LEVELT WJM. Accessing words in speech production: Stages, processes and representations. *Cognition, 42:* 1-22, 1992.

LEVELT WJM, PRAAMSTRA P, MEYER AS, HELENIUS P and SALMELIN R. An MEG study of picture naming. *Journal of Cognitive Neuroscience, 10:* 553-567, 1998.

LEVELT WJM, ROELOFS A and MEYER AS. A theory of lexical access in speech production. *Behavioral and Brain Sciences, 22:* 1-75, 1999.

LEVIN B and RAPPAPORT-HOVAV M. *Unaccusativity*. Cambridge: MIT Press, 1995.

LONGOBARDI G. Reference and Proper Names: A theory of N-movement in syntax and logical form. *Linguistic Inquiry, 25:* 609-665, 1994.

MARX E. Gender processing in speech production: Evidence from German speech errors. *Journal of Psycholinguistic Research, 28:* 601–622, 1999.

MICELI G, TURRIZIANI P, CALTAGIRONE C, CAPPASO R, TOMAIUOLO F and CARAMAZZA A. The neural correlates of grammatical gender: An fMRI investigation. *Journal of Cognitive Neuroscience, 14:* 618-628, 2002.

MIOZZO M and CARAMAZZA A. Retrieval of lexical-syntactic features in tip-of-the-tongue states. *Journal of Experimental Psychology: Language, Memory, and Cognition, 23:* 1410-1423, 1997a.

MIOZZO M and CARAMAZZA A. On knowing the auxiliary of a verb that cannot be named: Evidence for the independence of grammatical and phonological aspects of lexical knowledge. *Journal of Cognitive Neuroscience, 9:* 160-166, 1997b.

MIOZZO M and CARAMAZZA A. The selection of determiners in noun phrase production. *Journal of Experimental Psychology: Learning, Memory and Cognition, 25:* 907-922, 1999.

PLEMMENOU E, BARD EG and BRANIGAN HP. Grammatical gender in the production of single words: Some evidence from Greek. *Brain and Language, 81:* 236-241, 2002.

POLLOCK JY. Verb movement, Universal Grammar and the structure of IP. *Linguistic Inquiry, 20:* 365-424, 1989.

RITTER EA. Head-movement approach to construct-state noun phrases. *Linguistics, 26:* 909-929, 1988.

RITTER E. Two functional categories in noun phrases: Evidence from Modern Hebrew. *Syntax and Semantics, 25:* 37-62, 1991.

ROELOFS A. A Spreading-activation theory of lemma retrieval in speaking. *Cognition, 42:* 107-142, 1992.

ROELOFS A, MEYER AS and LEVELT WJM. A case for the lemma/lexeme distinction in models of speaking: Comment on Caramazza and Miozzo (1997). *Cognition, 69:* 219–230, 1998.

SCARNA A and ELLIS AW. On the assessment of grammatical gender knowledge in aphasia: The danger of relying on explicit, metalinguistic tasks. *Language and Cognitive Processes, 17:* 185-201, 2002.

SCHRIEFERS H. Syntactic processes in the production of noun phrases. *Journal of Experimental Psychology: Language, Memory, and Cognition, 19:* 841-850, 1993.

SCHRIEFERS H and JESCHENIAK JD. Representation and processing of grammatical gender in language production: A review. *Journal of Psycholinguistic Research, 28:* 575-600, 1999.

SHLONSKY U. *Clause structure and word order in Hebrew and Arabic*. New York: Oxford University Press, 1997.

SILONI T. *Noun Phrases and Nominalizations: The Syntax of DP*s. Dordrecht: Kluwer, 1997.

SILVERBERG N, GOLLAN TH and GARRETT MF. *TOTs: In and out of the language machine.* Presented at the 3rd annual meeting of the conference on Architectures and Mechanisms for Language Processing, Edinburgh, Scotland, 1999.

VAN BERKUM JJA. Syntactic processes in speech production: The retrieval of grammatical gender. *Cognition, 64:* 115-152, 1997.

VAN TURENNOUT M, HAGOORT P and BROWN CM. Brain activity during speaking: From syntax to phonology in 40 milliseconds. *Science, 280:* 572- 574, 1998.

VIGLIOCCO G and FRANCK J. When sex and syntax go hand in hand: Gender agreement in language production. *Journal of Memory and Language, 40:* 455-478, 1999.

VIGLIOCCO G and ZILLI T. Syntactic accuracy in sentence production: The case of gender disagreement in Italian language-impaired and unimpaired speakers. *Journal of Psycholinguistic Research, 28:* 623-648, 1999.

VIGLIOCCO G, ANTONINI T and GARRETT MF. Grammatical gender is on the tip of Italian tongues. *Psychological Report, 8:* 314- 317, 1997.

Naama Friedmann, School of Education, Tel Aviv University, Tel Aviv 69978, Israel. E-mail: naamafr@post.tau.ac.il. Homepage: http://www.tau.ac.il/~naamafr/

APPENDIX A

Background information on the participants

Participant	Age	Sex	Hand	Plegia/ paresis	Etiology	Time post onset (months)	Lesion site	Functional locus of anomic deficit	Education
YA	70	M	right	–	CVA	2.5	L temporo-parietal infarct	conceptual	8
AO	56	M	right	R pleg.	CVA	1.5	L frontal and occipital infarct	conceptual	12
BM	58	F	right	R pleg.	thalamic surgery	2	no information	conceptual	15
MS	48	M	right	R pleg.	CVA	1.5	L basal ganglia hermorrhage	conceptual	14
MS2						3.5	bilat. temporo-occipital hypodensic areas	semantic	
HL	60	M	right	R pleg.	CVA	1	L temporo-occipital infarct	semantic	12
HL2						2		semantic	
RH	72	F	right	R par.	CVA	0.5	L occipito-parietal and L thalamus hypodensic areas	semantic	15
EC	25	F	right	R pleg.	tumor	4	brain stem edema following tumor removal surgery	semantic	10
DM	64	M	right	R par.	CVA	1	L temporo-parietal infarct	phonological	8
SW	71	M	right	R par.	CVA	1	L temporo-parietal hemorrhage	phonological	17
SH	68	M	right	R par.	CVA	1.5	L parietal infarct	phonological	8
IK	62	M	right	R par.	CVA	0.5	L parietal infarct	phonological	14
CM	54	F	right	–	tumour	1	L temporal meningioma	phonological	12
MM	34	M	right	R pleg.	TBI	38	L frontal, temporal and basal ganglia hypodensic areas	phonological	12
AY	64	M	right	R par.	CVA	2	bilat. lacunar infarcts in the basal ganglia	phonological	6
SB	20	F	right	R pleg.	TBI	6	L fronto-parieto-temporal hemorrhage	phonological	12
HM	63	F	right	R pleg.	CVA	2	basal ganglia infarct	combined	12
EO	70	M	right	R par.	CVA	4	L paraventricular hypodensic area	combined	12
SF	51	M	right	R par.	CVA	1.5	L basal ganglia and thalamus infarct	combined	14
YM	70	M	right	R pleg.	CVA	1	L frontal infarct in the internal capsule	combined	12
YV	68	M	right	R par.	CVA	1	L parieto-occipital hemorrhage	combined	10
AF	58	M	right	R par.	CVA	1	L temporo-parietal hemorrhage	combined	16
YD	56	F	right	R par.	CVA	1	L basal ganglia	combined	11