The role of morphology in grammatical gender assignment

A psycholinguistic study in Greek

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The aim of this study was to investigate native speakers' ability to predict gender on the basis solely of morphological information carried by the noun suffix by testing the speakers' assignment of gender to novel nouns. Results indicated that native speakers use morphology, specifically the information carried by the noun suffix to predict gender in the absence of semantic information in the noun as well as in the absence of any phrasal information that would help them to determine gender based on agreement. This result confirms both Ralli's (2002; 2003) and Anastasiadi-Symeonidi & Cheila-Markopoulou's (2003) claim that morphology plays an important role in the assignment of gender to Greek nouns. It is also compatible with findings of earlier psycholinguistic research on gender marking (Tucker, Lambert, & Rigault, 1977; Mills, 1986), suggesting that formal assignment rules determine gender marking to a great extent and are part of the native speakers' linguistic competence.

1. Gender as a grammatical feature

Gender has attracted a great deal of interest in linguistics, as it is one of the most intricate and intriguing grammatical categories. Gender is assumed to be an abstract grammatical category that marks the Noun (Corbett, 1991). It is not a feature that is present in all languages of the world; some languages grammaticalize it (e.g. Greek), while others do not (e.g. Turkish).[1] Given the complexity of gender systems in the languages of the world (see Corbett, 1991; 2007), as well as the fact that gender constitutes a grammatical feature that does not cease to puzzle second language learners even in late stages of acquisition (Andersen, 1984; Bruhn de Garavito & White, 2000; Franceschina, 2005; Tsimpli, 2003; Varlokosta & Triantafillidou, 2003; Varlokosta, 2005a, among

1. According to Nichols (1992), about one-fourth of the 174 languages she studied had gender or some other form of nominal classification system.

others), a fundamental question is how native speakers know the gender of nouns in a particular language and how this knowledge is acquired. According to Corbett (1991), it is highly unlikely that gender involves rote learning given that (a) native speakers make few or no mistakes in the use of gender; (b) loan words acquire a gender value in the language that borrows them; (c) native speakers assign novel nouns a gender value with a high degree of consistency. These facts indicate that there must be a linguistic mechanism for assigning gender to nouns. As Corbett (2007: p. 258) points out, despite the apparent arbitrariness of gender in a number of languages, there is always 'an *assignment system* behind the distribution of nouns over genders', that is, 'a model of the native speaker's ability to allot nouns to genders on the basis of information which must in any case be stored as part of the lexical entry'.

According to Corbett (1991: p. 7–8; 2007: p. 258), grammatical gender assignment depends on two basic types of information about the noun: its meaning (semantics) and its form. Information about meaning refers to features like animacy or sex, while information about form refers to word structure and phonology. Although all language systems involve a semantic core to their assignment system, language systems use different combinations of the above factors falling essentially into three categories: (a) strict semantic systems (or 'natural gender systems'), in which the meaning of the noun fully determines its gender without reference to its form (e.g. English, a pronominal gender system) (Corbett, 1991: p. 8); (b) predominantly semantic systems, in which there are semantic assignment rules which, however, appear to allow sets of exceptions or otherwise 'semantic residues' (e.g. Caucasian languages) (Corbett, 1991: p. 13); (c) formal systems, in which formal rules that depend on the form of the nouns rather than on their meaning determine gender. Formal rules are either phonological or morphological, although this distinction is not always clear-cut and very often gender systems involve both types of rules (Corbett, 1991: p. 33). Phonological rules refer to a single form of the noun. For example, French employs a gender system that has a semantic core as well as a morphological rule that concerns compound nouns formed by a verb but the major generalizations can be stated in terms of phonology; e.g., 'nouns in/ɛzɔ̃/,/sjɔ̃/,/zjɔ̃/,/ʒjɔ̃/and/tjɔ̃/are feminine, while remaining nouns in/ɔ̃/are masculine' (e.g. *la maison*/mezɔ̃/'house', *le bâton*/bɑtɔ̃/'stick') (Corbett, 1991: p. 60; Tucker, Lambert, & Rigault, 1977). Morphological rules, on the other hand, make use of more than one form of the noun, i.e. its declension type. German and Russian are examples of morphological systems. In German, there is a complex interplay of overlapping semantic, phonological and morphological rules to predict gender, and, crucially, derivational morphology determines the gender of a number of nouns; e.g., abstract nouns with the suffixes *-ung*, *-heit*, *-erei*, *-schaft* and *-keit* are feminine (e.g. *die freiheit* 'freedom'), while diminutives in *-lein* and *-chen* are neuter (e.g. *das männchen* 'little man' from the masculine *der mann* 'man') (Corbett, 1991: p. 49–50). Similarly, although semantic assignment rules operate in Russian, gender is determined by the declensional type of the noun for a great proportion of nouns (declinable nouns of

declensional type I are masculine, nouns of declensional type II and III are feminine, while the rest are neuter) (Corbett, 1991: p. 36).

To conclude, despite the distinction between semantic and formal gender systems, Corbett (1991; 2007) argues that all gender systems are based on a semantic core, and very often gender assignment involves a complex interplay of semantic and formal (phonological as well as morphological) rules.[2]

There have been some attempts to confirm hypotheses about gender assignment experimentally with native adult speakers, through the use of unfamiliar (i.e. rare) or novel words.[3] One of the first attempts to assess the role of formal rules in gender assignment was that of Tucker et al. (1977), who tested the predictions of their hypothesis about gender assignment to nouns in French. According to their hypothesis, which was based on a systematic statistical analysis of the 31.619 nouns in the *Petit Larousse*, gender in French is predictable by phonological rules that target the suffix of a given noun (see discussion above). In one of their tasks, Tucker et al. (1977) presented speakers with novel nouns and asked them to provide their gender through an oral stimulus.[4] The goal of the study was to validate the hypothesis that the phonology of the end of the noun in French was the determinant factor in gender assignment and that this was part of the speakers' linguistic competence. Results indicated that in the majority of cases, nouns ending in/ijɔ̃/were assigned masculine gender, while those in/sjɔ̃/were assigned feminine gender, confirming, thus, Tucker et al.'s (1977) hypothesis. Mills (1986) tested nine rules on gender assignment to nouns in German with 30 adult native speakers. Participants were asked to select the gender for 44 novel words and at the same time to provide a real-word association with the novel word they were presented with, if one had occurred to them at the time of selecting the gender of the novel word. The latter part was included to test the possibility that subjects assign gender by analogy with a particular lexical item rather than by a rule. Her results indicated that assignment rules can account to a great extent for the assignment of gender to novel words even though individual word associations cannot be eliminated entirely; nonetheless these associations also reflect the rule.

2. Gender is closely related to agreement since gender is realized through agreement in many languages and since gender agreement provides the basis for defining gender and for establishing the number of genders in a given language (Corbett, 1991: p. 105). Gender agreement will not be examined in this paper (but for Greek see Cheila-Markopoulou, 2003).

3. There is also abundant evidence for the validity of various gender assignment hypotheses from child language acquisition, which will not be discussed in this paper (Hawkins & Franceschina, 2004; Karmiloff-Smith, 1979; MacWhinney, 1978; Maratsos, 1988; Pérez-Pereira, 1991, among many others).

4. Speakers were also presented with French real nouns as well as with French rare nouns. Although the results obtained with these types of prompts validated Tucker et al.'s (1977) hypothesis, they are certainly less reliable than the ones with novel nouns, as they do not tell us a lot about the speakers' underlying system.

Recently, a number of studies in the neuroimaging literature investigate the neural bases of gender decisions using functional Magnetic Resonance Imaging (fMRI). Results have shown that gender decisions are faster and more accurate for nouns that are transparent compared to nouns that are opaque in terms of their gender marking (Bates, Devescovi, Pizzamiglio, D'Amico, & Hernandez, 1995; Hernandez, Kotz, Hofmann, Valentin, Dapretto, & Bookheimer, 2004). Moreover, fMRI results indicate increased activity for opaque items in specific brain areas, which are involved in phonological processing (Heim, Opitz, & Friederici, 2003; Hernandez et al., 2004) and in the processing of grammatical category information (Miceli, Turriziani, Caltagirone, Capasso, Tomaiuolo, & Caramazza, 2002), suggesting that gender decisions for opaque nouns may require additional morphological processing relative to transparent nouns (Hernandez et al., 2004). Based on these results, as well as on similar results from other studies on gender decision and studies on automatic gender processing (e.g. Hammer, Goebel, Schwarzbach, Munte, & Jansma, 2006; Levelt, Praamstra, Meyer, Helenius, & Salmelin, 1998), it is proposed by Heim (2008: p. 60) that there are different strategies for the use of gender, which in turn are associated with distinct neural processes in specific brain areas. When morphological cues are available, gender is inferred from these cues in a rather fast manner involving activation increase in the left BA 44. When no informative cues are available, gender information is retrieved from the mental lexicon, again involving activation increase in the left BA 44 but to a higher extent. An alternative route is also available whereby morphological cues are generated and evaluated by the subject, involving activation increase in the left BA 45 and BA 44 respectively (for a comprehensive review of fMRI studies on gender decision and gender processing, see Heim, 2008).[5]

It is evident that the study of gender has begun to attract much attention in the psycholinguistic research. As Corbett (2007: p. 278) notes, gender is a grammatical category that offers intriguing opportunities for collaborative research within a number of disciplines, including psycholinguistics.

The study reported in this paper is a psycholinguistic study on gender assignment in Greek. The paper is organized as follows. Section 2 provides a review of existing analyses of gender assignment to Greek nouns and puts forward the research questions and predictions of the present study. Section 3 describes the methodology used. Section 4 presents the results, while Section 5 discusses the results in light of the

5. In addition, there is abundant psycholinguistic evidence on the representation, retrieval and usage of grammatical gender from studies on gender priming, speech errors or the tip-of-the-tongue state, as well as from ERP studies (for a review, see Schriefers & Jescheniak, 1999 and Franceschina, 2005). Moreover, there are studies that assess knowledge of grammatical gender by aphasic speakers (Akhutina, Kurgansky, Kurganskaya, Polinsky, Polonskaya, Larina, Bates, & Appelbaum, 2001; Bates, Marangolo, Pizzamiglio, & Dick, 2001; Hofmann, Kotz, Marschhauser, von Cramon, & Friederici, 2007, Nerantzini, Papadopoulou, & Varlokosta, 2009, among others) as well as by L2 adult learners (Taraban & Kempe, 1999; Franceschina, 2005). These studies will not concern us here, as they go beyond the scope of the research reported in this paper.

existing analyses of gender assignment in Greek as well as in light of other psycholinguistic studies on the assignment of gender. Section 6 concludes the paper.

2. Gender assignment in Greek nouns

Gender plays a significant role in Greek because all nominal categories bear a gender feature. Greek nouns, determiners, adjectives, and a number of pronouns and numerals are marked for one of the three gender values, masculine, feminine or neuter. These values do not correspond to the division between male, female and inanimate. Although most nouns denoting humans are masculine if the person is male (e.g. *o ándras* 'man') and feminine if the person is female (e.g. *i jinéka* 'woman'), gender in a number of nouns denoting humans is unpredictable on semantic/sex grounds (e.g. *o ánθropos* 'human' is masculine, whereas *to peδí* 'child' is neuter, while both *to ayóri* 'boy' and *to korítsi* 'girl' are neuter) (Holton, Mackridge, & Philippaki-Warburton, 2004). Moreover, nouns denoting animals, inanimate objects, substances, natural phenomena or abstract concepts may be masculine (e.g. *o skílos* 'dog', *o pínakas* 'blackboard', *o aéras* 'wind', *o pólemos* 'war'), feminine (e.g. *i yáta* 'cat', *i karékla* 'chair', *i vroxí* 'rain', *i elefθería* 'freedom') or neuter (e.g. *to próvato* 'sheep', *to trapézi* 'table', *to xalázi* 'hail', *to kéfi* 'high spirits') (Holton et al., 2004). Thus, it appears that within Corbett's (1991) categorization, Greek belongs to formal systems, as gender is determined to a large extent by formal rules rather than meaning. There are three analyses of grammatical gender assignment to Greek nouns, which focus on the role of semantic and formal rules in gender determination: Ralli (2002; 2003), Anastasiadi-Symeonidi & Cheila-Markopoulou (2003) and Alexiadou (2004).

According to Ralli (2002; 2003), although semantics plays an important role in determining gender in Greek, gender assignment depends mainly on morphological information, as indicated by the systematic co-occurence between certain inflectional classes and certain gender values (although gender cannot be conflated with inflectional class). In the same spirit, Anastasiadi-Symeonidi & Cheila-Markopoulou (2003) claim that gender assignment in Greek is predicted via the notion of *prototypicality*, which is defined on the basis of two different criteria, semantic and morphological. Semantic criteria concern the distinction [±animate], while morphological criteria concern the presence of terminal consonants or vowels (i.e. suffixes) that represent an inflectional class. Alexiadou (2004), on the other hand, focuses primarily on the gender specification of human nouns and argues, along the lines of Ralli (2002; 2003), that gender assignment does not depend on the inflectional class. Alexiadou (2004) proposes that some human nouns in Greek are inherently specified for gender in the lexicon, i.e. gender is part of their intrinsic features, while others are marked as being [+human/+animate] and need to enter an agreement/concord relation with a human referent at the phrasal level to get a gender value. Given that Alexiadou (2004) focuses on human nouns and does not attribute to morphology any role in gender specification, we will not evaluate her analysis in terms of the psycholinguistic study presented here.

Based on the main claim of Ralli's (2002; 2003) and Anastasiadi-Symeonidi & Cheila-Markopoulou's (2003) analyses regarding the role of morphology in the assignment of gender to Greek nouns, the aim of the current study was to investigate native speakers' ability to predict gender in the absence of semantic or phrasal information and on the basis solely of morphological information carried by the noun suffix by testing the speakers' assignment of gender to novel nouns. Although the two analyses share some basic insights about the role of semantics and morphology on the assignment of gender to nouns in Greek, they differ with respect to some of the specific claims they make. As a result, some of their predictions regarding native speakers' ability to assign gender on the basis of morphological information carried by the noun suffix are quite similar, while others diverge. Before we put forward the predictions that the two analyses make, we will review the most relevant aspects of these analyses for our research.

According to Ralli (2002; 2003), although semantics plays an important role in determining gender in Greek, given that in most human nouns, sex distinction is reflected as a gender opposition between masculine and feminine nouns (masculine nouns usually end in *-os*, *-as*, and *-is*, while feminine nouns end in *-a* and *-i*), in non-humans, specific gender values are generally unpredictable. Ralli (2002; 2003) considers the role of phonological rules and points out that although at first glance phonology may seem a good candidate to predict gender in a number of cases, simple phonologically-based rules relating a particular form of the nominative singular to a specific gender value proves insufficient, since there are cases that result in ambiguity; for example, nouns ending in the nominative in *-os* may be masculine, feminine or neuter, while nouns ending in *-i* may be either feminine or neuter. Alternatively, Ralli (2002; 2003) proposes that gender is determined morphologically on the basis of access to the whole inflectional paradigm.[6]

Assuming Ralli's (1994) division of Greek nouns into eight inflectional classes, illustrated in Table 1, Ralli (2002; 2003) points out that there is a close relation between gender and inflectional class: nouns of IC2 are masculine, nouns of IC3 and IC4 are feminine, while nouns of IC5, IC6, IC7 and IC8 are neuter.[7]

6. Gender is also determined by reference to the word-formation processes of derivation and compounding (Ralli, 2002; 2003). Thus, in derived nouns, the gender marker comes from the derivational affix (e.g. deverbal nouns in *-tis* (*o kléftis* 'thief') and *-mos* (*o xalazmós* 'destruction') are masculine, deverbal nouns in *-ia* (*i kaliérjia* 'cultivation') are feminine, denominal nouns in *-isa* (*i jitónisa* 'woman-neighbor') are also feminine, and nouns in *-ma* (*to fórema* 'dress') and *-aki* (*to anθropáki* 'little man') are neuter) and is inherited through headedness and percolation, which is also responsible for gender assignment in compound words (e.g. *nixokóptis*-Masc 'nail-clipper' < *nix*-Neut 'nail' + *kóptis*-Masc 'cutter', *kapnokaliérjia*-Fem 'tobacco-cultivation' < *kapn*-Masc 'tobacco' + *kaliérjia*-Fem 'cultivation', *aetopétayma*-Neut 'eagle-flying' < *aet*-Masc 'eagle' + *pétayma*-Neut 'flying').

7. As evident in Table 1, gender is marked not only on the noun but on the definite determiner too (the forms of the definite determiner in the nominative singular are: *o*-Masc, *i*-Fem, *to*-Neut) and there is gender agreement between the two (e.g. *o*-Masc *kípos*-Masc 'garden', *i*-Fem *pórta*-Fem 'door', *to*-Neut *vunó*-Neut 'mountain').

Table 1. Inflectional classes of Greek nouns based on Ralli's (1994) division

IC1 *-os* **Masc/Fem**	**IC2** *-s* **Masc**	**IC3** **Ø** **Fem**	**IC4** **Ø** **Fem**
o kípos 'garden' *i próoδos* 'progress'	*-as*: *o ximónas* 'winter' *-is*: *o maθitís* 'student' *-es*: *o kafés* 'coffee' *-us*: *o papús* 'grandpa'	*-a*: *i pórta* 'door' *-i* [pl. *-es*]: *i ayápi* 'love' *-u*: *i alepú* 'fox'	*-i* [pl. *-is*]: *i léksi* 'word'
IC5 *-o* **Neut**	**IC6** *-i* **Neut**	**IC7** *-os* **Neut**	**IC8** *-ma* **Neut**
to vunó 'mountain'	*to xartí* 'paper'	*to páθos* 'passion'	*to kíma* 'wave'

However, as Ralli (2002; 2003) points out, this correlation breaks down in nouns ending in *-os*, that belong to IC1. This inflectional class contains nouns that are masculine (e.g. *o kípos*-Masc 'garden') or feminine (e.g. *i próoδos*-Fem 'progress') and also nouns that denote a profession (e.g. *o/i ipuryós*-Masc/Fem 'minister', *o/i vuleftís*-Masc/Fem 'congressman', *o/i sigraféas*-Masc/Fem 'writer'), whose gender value is determined outside morphology. Thus, although gender and inflectional class are closely related in Greek, they do not coincide, as there is no one-to-one correspondence between the two. This is further illustrated by nouns of the same gender value that belong to different inflectional paradigms (e.g. *to vunó*-Neut 'mountain' belongs to IC5, *to xartí*-Neut 'paper' belongs to IC6, *to krátos*-Neut 'state' belongs to IC7, *to sóma*-Neut 'body' belongs to IC8). Moreover, the same inflectional morpheme can appear in more than one inflectional paradigm, as illustrated by the inflectional suffix *-os*, which characterizes two different paradigms, IC1 (e.g. *o kípos*-Masc 'garden') and IC7 (e.g. *to krátos*-Neut 'state'). If inflectional suffixes were responsible for the specification of the gender feature, we would not expect such ambiguities.

Based on the above observations about the relation between inflectional morphemes and gender, Ralli (2002; 2003) argues that gender is an inherent property of stems and not of inflectional morphemes. It is further claimed that in certain stems gender constitutes an intrinsic fully specified feature that is not motivated by semantic information or morphology (e.g. *o kípos*-Masc 'garden', *i próoδos*-Fem 'progress'). There are cases, however, where the gender value of a noun constitutes an optional underspecified feature that is predicted and can be specified by another co-occurring feature related either to semantic information (sex) (e.g. *o maθitís*-Masc 'male student', *i maθítria*-Fem 'female student') or morphology (inflectional class) (e.g. IC2: *o ximónas*-Masc 'winter', IC3: *i pórta*-Fem 'door', IC4: *i ayápi*-Fem 'love', IC5: *to vunó*-Neut 'mountain', IC6: *to xartí*-Neut 'paper',

IC7: *to páθos*-Neut 'passion', IC8: *to kíma*-Neut 'wave').[8] Last, it is argued that nouns denoting a human profession (e.g. *ipuryós* 'minister', *vuleftís* 'congressman', *sigraféas* 'writer') constitute cases of persisting underspecification, that cannot be resolved in the lexicon through the application of a feature co-occurrence rule but have to be resolved at the phrasal level, for example, through agreement between structural constituents (e.g. *o*-Masc *ipuryós*-Masc 'minister', *i*-Fem *ipuryós*-Fem 'minister', *ipéfθinos*-Masc *ipuryós*-Masc 'responsible minister', *ipéfθini*-Fem *ipuryós*-Fem 'responsible minister').

Anastasiadi-Symeonidi & Cheila-Markopoulou (2003) argue that although gender assignment is a complex process that depends on a number of parameters, there is quite robust evidence from language change, loan words and language acquisition that nouns acquire gender in a very systematic way that can be predicted through default rules and prototypicality. Prototypicality is defined on the basis of semantic criteria, which concern the distinction [±animate], and morphological criteria, which concern the presence of suffixes that represent an inflectional class (Anastasiadi-Symeonidi & Cheila-Markopoulou, 2003: p. 22). More specifically, prototypically masculine nouns denote a male referent and end in *-s* (e.g. *o patéras* 'father', *o δáskalos* 'teacher'), while non-prototypically masculine nouns are, among others things, [–animate] and end in *-s* (e.g. *o ximónas* 'winter'). Prototypically feminine nouns denote a female referent and end in *-a*, *-i* and *-u* (e.g. *i mamá* 'mum', *i kóri* 'daughter', *i alepú* 'fox'). Prototypically feminine nouns are also [–animate] abstract nouns ending in *-a* and *-i* that denote an action, a property or collectivity (e.g. *i epiθimía* 'desire', *i práksi* 'action'). Non-prototypically feminine nouns are, among others things, (a) [+animate] nouns that end in *-s* and usually denote a profession (e.g. *i ipuryós* 'minister', *i vuleftís* 'congressman', *i sigraféas* 'writer') and (b) [–animate] nouns ending in *-s* (e.g. *i oδós* 'street', *i próoδos* 'progress'). Prototypically neuter nouns are [–animate] nouns that end in *-o*, *-i* and *-a*, but belong to inflectional classes distinct from those of feminine nouns in *-i* and *-a* (e.g. *to vunó* 'mountain', *to trapézi* 'table', *to kíma* 'wave'). Prototypically neuter nouns are also [+animate] nouns that denote baby humans or animals (e.g. *to vasilópulo* 'prince', *to ayóri* 'boy', *to korítsi* 'girl, *to yatí* 'kitten'). Non-prototypically neuter nouns are, among others things, [–animate] nouns ending in *-s* (e.g. *to δásos* 'forest', *to kréas* 'meat') and [+animate] non-diminutive nouns ending in *-o* and *-i* that denote animals (e.g. *to próvato* 'sheep', *to yurúni* 'pig').[9,10] To summarize, within the core of the Greek gender

8. As pointed out by Ralli (2002; 2003), when semantic information and morphology are in conflict, morphology wins. For example, although the semantic rule predicts that the noun *korítsi* 'girl' should be specified for feminine gender, it is specified for neuter gender, as grammatical gender is determined by the inflectional class it belongs to (i.e. IC6).

9. There are further cases of non-prototypically masculine, feminine and neuter nouns, not discussed here, which primarily include non-declinable nouns.

10. According to Anastasiadi-Symeonidi & Cheila-Markopoulou (2003), there is a close relation between prototypicality and frequency as well as between prototypicality and the notion of 'close class'. For example, the non-prototypical class of neuter nouns ending in *-os* includes a

Table 2. Gender assignment for Anastasiadi-Symeonidi & Cheila-Markopoulou (2003)

	Prototypical		**Non-prototypical**	
	+animate	**–animate**	**+animate**	**–animate**
Masculine	**-s**			**-s**
	o patéras 'father'	–	–	*o ximónas* 'winter'
Feminine	**-a, -i, -u**		**-s**	
	i mamá 'mum' *i kóri* 'daughter' *i alepú* 'fox'	*i epiθimía* 'desire' *i práksi* 'action'	*i ipuryós* 'minister'	*i oδós* 'street'
Neuter	**-o, -i, -a**		**-o, -i**	**-s**
	to vasilópulo 'prince' *to ayóri* 'boy' *to ɣatí* 'kitten'	*to vunó* 'mountain' *to trapézi* 'table' *to kíma* 'wave'	*to próvato* 'sheep' *to ɣurúni* 'pig'	*to δásos* 'forest'

system, *-s* is considered as a marker of masculine gender, *-a* and *-i* as markers of feminine gender, while *-o*, *-i* and *-a* as markers of neuter gender, as illustrated in Table 2.

Given the above background, let us know see the predictions the two analyses make regarding the role of inflectional suffixes in the assignment of gender to novel nouns by adult native speakers of Greek.

According to Ralli (2002; 2003), since morphology plays an important role in the assignment of gender to Greek nouns given the systematic co-occurrence between certain ICs and certain gender values, it is expected that the inflectional morpheme will constitute to a great extent a predicting factor of gender, at least in cases where gender and inflectional class seem to have a close relation. Therefore, inflectional morphemes such as, *-as*, *-is*, *-a*, *-o* and *-ma* should be sufficient gender cues for the native speaker. However, inflectional suffixes, such as *-os* and *-i*, which appear in more than one inflectional class and characterize nouns with different gender values, should constitute a problem for the native speaker and, thus, should give rise to ambiguities. Therefore, native speakers should assign feminine and neuter gender values to novel nouns ending in *-i* and similarly they should assign masculine, feminine and neuter gender values to novel nouns ending in *-os*. Nonetheless, given that feminine nouns in *-os* constitute a 'close class', since they include a small number of items that were used by the literary-style of language and are not very productive, as pointed out by Ralli (2002; 2003), it is expected that masculine responses may override feminine ones in this category. However, given that the inflectional morpheme *-os* is associated not only with IC1 (masculine and feminine nouns in *-os*) but with neuter nouns that belong to IC7 as well, a considerable proportion of neuter responses is also expected for novel nouns of this category.

rather small number of items – although not as small as other 'close classes' – that derive from Classical Greek and does not obtain new members in the modern language.

Similarly, accoding to Anastasiadi-Symeonidi & Cheila-Markopoulou (2003), inflectional suffixes can be to a great extent sufficient predictors of the gender value of nouns in Greek, given that they are associated prototypically with a particular gender value. However, Anastasiadi-Symeonidi & Cheila-Markopoulou's (2003) analysis makes different predictions with respect to specific inflectional morphemes. Thus, inflectional morphemes such as, *-as*, *-is*, and *-o*, should be sufficient cues for gender assignment, whereas inflectional morphemes such as *-i* and *-a* should give rise to both feminine and neuter responses, as these inflectional morphemes characterize nouns that are prototypically feminine and prototypically neuter. Note that the suffix *-a* characterizes both feminine and neuter nouns, under Anastasiadi-Symeonidi & Cheila-Markopoulou's (2003) analysis, albeit ones that belong to distinct inflectional classes. We come back to this difference between the two analyses in the discussion. Moreover, within Anastasiadi-Symeonidi & Cheila-Markopoulou's (2003) approach, novel nouns with the inflectional morpheme *-os* should give rise predominantly to masculine responses, as this inflectional morpheme characterizes prototypically masculine nouns and is found only in non-prototypically feminine or neuter nouns, assuming that prototypicality is indeed a determinant factor in gender assignment of Greek nouns and is part of the native speaker's linguistic competence.

Thus, the predictions of the two approaches to gender assignment are different only with respect to the inflectional morphemes *-a* and *-os*. Under Anastasiadi-Symeonidi & Cheila-Markopoulou's (2003) approach, it is expected that *-a* should give rise to ambiguity, given that it is a marker of both feminine and neuter gender. Under Ralli's (2002; 2003) approach, it is expected that *-a* should not give rise to ambiguity, given that gender is determined morphologically by reference to the processes of derivation (see fn. 6), which dictates that nouns ending in *-ma* are neuter (most of the nouns in *-ma* are derived nouns). As for the inflectional morpheme *-os*, a predominance of masculine responses is expected under Anastasiadi-Symeonidi & Cheila-Markopoulou's (2003) approach, given that *-s* is a marker of masculine gender, whereas masculine but to some extent neuter responses as well are expected under Ralli's (2002; 2003) approach, given that *-os* is an inflectional suffix that characterizes masculine nouns that belong to IC1 and neuter nouns that belong to IC7.

An attempt to test Ralli's (2002; 2003) analysis psycholinguistically has been offered recently by Mastropavlou (2006). Mastropavlou (2006) tested sixty-two (62) native adult speakers of Greek using a test[11] that included seventy-five (75) novel words, which contained almost all possible inflectional endings of Greek nouns (*-os*, *-is*, *-as*, *-i*, *-a*, *-o*, and *-ma*). Although the study assumes Ralli's (2002) analysis,

11. The test was part of a study on the acquisition of the nominal domain (gender, number and case) by typically developing and language impaired children, and included an oral version (reported here) and a written version.

the hypotheses put forward regarding the ambiguity of inflectional endings are not always in line with Ralli (2002). Nouns ending in *-is* (masculine), *-a* (feminine) and *-o* (neuter) are considered unambiguous in terms of gender marking. Nouns ending in *-os* are regarded as ambiguous between masculine, feminine and neuter, nouns ending in *-i* as ambiguous between feminine and neuter, and nouns ending in *-as* as ambiguous between masculine and neuter; at the same time, nouns ending in *-ma* are also regarded as ambiguous between feminine and neuter, although nouns in *-ma* are derived nouns and are always assigned neuter gender, as pointed out above.[12] Besides this divergent assumption, Mastropavlou's (2006) study suffers from some methodological pitfalls as well. First, no description is offered of the procedure that was used in the creation of novel nouns, especially the phonological criteria applied in the design, given that stress and syllable number in Greek can disambiguate gender assignment (see methodology and discussion). Second, an inspection of the novel nouns used in her study reveals that there were novel nouns that included real words as one of their parts (e.g. the part *θio* of the novel noun *traθio* is a real word in Greek that means 'holy/sacred'). Third, variables such as stress or syllable number are not discussed, despite the fact they play a significant role in gender assignment (see discussion). Mastropavlou (2006) finds that unambiguous suffixes such as *-is*, *-a*, and *-o* yield statistically significant preferences for the target gender value (89%, 83%, and 98%, respectively) but at the same time ambiguous suffixes such as *-os* and *-as* yield statistically significant preferences for only one gender, namely masculine (90% and 91%, respectively). In contrast, the suffixes *-i* and *-ma* were not assigned clear gender interpretations as the rest of the suffixes, nonetheless both of them were predominantly assigned neuter gender (55% and 75%, respectively). Given the statistically significant proportion of one gender value in each noun suffix as well as the clear gender preferences even in cases of ambiguous suffixes (e.g. *-os* and *-as*), Mastropavlou (2006) concludes that although noun suffix ambiguity does not directly affect its gender predictability, suffixes constitute reliable gender indicators in Greek. On the assumption that gender is an intrinsic feature of the noun stem, along the lines of Ralli (2002), Mastropavlou (2006) presumes that a dominant gender representation for a suffix is constructed through associations with a specific value, which are determined by the frequency of their co-occurrence. This is corroborated – partly though – by a comparison between the predictive values of suffixes obtained in her study and corpus frequencies of these suffixes (based, nonetheless, on written texts). Specifically, it is observed that the preferred gender value for the suffixes *-os* and *-as* (i.e. masculine) was consistent with the most frequent gender value these suffixes assumed in the

12. There is a small number of feminine nouns (18 according to a search in Anastasiadi-Symeonidi (2002), most of which are loan words) that appear to end in *-ma*, such as *i krema* 'cream', *i vroma* 'dirt', *i firma* 'trade name', *i farma* 'farm', *i forma* 'form', *i norma* 'norm', *i suma* 'sum', *i ɣoma* 'rubber'. However, these are not derived nouns, that is, *-m* is part of their stem and not part of their suffix. These nouns end in *-a* just like other feminine nouns of IC3, e.g. *i farma* 'farm' comes from the English *farm* + the suffix *-α*.

corpus, whereas this was not the case for the suffix *-i*, which resulted in a discrepancy between the preferred value (neuter) and the most frequent value (feminine), and for the suffix *-ma*, which yielded low predictive value despite the high frequency of neuter gender in the corpus.

Despite the differences in methodology between Matropavlou's (2006) study and the present study, we will compare the results obtained by both studies to the extent that this is possible.

3. Method

3.1 Participants

Eighty-two (82) native adult speakers of Greek participated in the study, thirty-seven (37) male and forty-five (45) female. Participants were either university students or university graduates, their ages ranged from 18 to 40 years (mean age: 25.0; SD: 5.45), and came from a wide range of geographical areas in Greece. They were all monolingual speakers with no reported impairments and participated in the study on a voluntary basis.

3.2 Materials

The materials used in this study were part of a test designed to assess grammatical gender assignment of real and novel nouns in Greek by preschool and school children aged 4.0 to 8.6 (Varlokosta, 2005b). The test includes 84 real nouns and 64 novel ones.[13] Only the novel nouns were used in this study, as the aim was to investigate how native adult speakers assign grammatical gender based only on information carried by the noun suffix.

The 64 novel nouns were modeled after 64 real nouns that contained almost all possible inflectional endings of Greek nouns (*-os*, *-is*, *-as*, *-i*, *-a*, *-o*, *-ma*).[14] Some of these suffixes represent unambiguous gender marking, as discussed in the previous section

13. The 84 real nouns included nouns from all of Ralli's (1994) inflectional classes and were selected on the basis of Anastasiadi-Symeonidi & Cheila-Markopoulou's (2003) approach, including thus both prototypical and non-prototypical nouns from each category (see Varlokosta, 2005b).

14. Nouns with the suffixes *-es* (masc), *-us* (masc), and *-u* (fem) were not included in the study, as we had to keep down the size of the test, and inclusion of these inflectional morphemes would not contribute any further results to our study, given that these inflectional morphemes are unambiguous.

(*-is*: masculine, *-as*: masculine,[15] *-a*: feminine, *-o*: neuter,[16] *-ma*: neuter[17]), while others reflect ambiguous gender marking (*-os*: masculine/feminine/neuter, *-i*: feminine/neuter). In order to ensure that the test measured the effect of the morphological information carried by the suffix, one further parameter was taken into account in the design of the novel nouns, namely stress. In some instances of ambiguous gender marking, stress is a factor that could potentially facilitate the speaker to assign grammatical gender to the noun. Therefore, such cases were excluded from the test. For example, nouns with the suffix *-i* that are stressed on the antepenultimate syllable, are predominantly feminine (e.g. *i záxari*), although the suffix itself is ambiguous between feminine and neuter gender. These nouns were excluded from the test, as stress could potentially be a parameter that determines the speaker's assignment of grammatical gender.[18]

Based on the above criteria, the set of novel nouns in the test included the following categories:

i. nouns with unambiguous gender marking, which were distributed to: eight (8) nouns with the suffix *-is*, which is unambiguously masculine (4 tri-syllabic, half stressed on the penultimate and half on the ultimate; 4 bi-syllabic, half stressed on the penultimate and half on the ultimate; e.g. *xepetís* from *fititís* 'student'; *lóxtis* from *ráftis* 'tailor');[19] eight (8) nouns with the suffix *-as*, which is unambiguously masculine (6 tri-syllabic, two stressed on the antepenultimate, two on the penultimate and two on the ultimate; 2 bi-syllabic stressed on the penultimate;[20] e.g. *θérokas* from *fílakas* 'guard'; *yéxas* from *víxas* 'cough'); ten (10) nouns with the suffix *-a*, which is unambiguously feminine (6 tri-syllabic, two stressed on the antepenultimate, two on the penultimate and two on the ultimate; 4 bi-syllabic, half stressed on the penultimate and half on the ultimate; e.g. *klóteza* from *trápeza* 'bank'; *ðrása* from *ylósa* 'tongue'); eight (8) nouns with the suffix *-o*, which is

15. Unlike Mastropavlou (2006), we take the suffix *-as* to represent unambiguous gender marking, since neuter nouns ending in *-as* constitute a 'close class' of bi-syllabic nouns stressed on the penultimate and are very few (e.g. *to kréas* 'meat', *to téras* 'monster') (cf. Anastasiadi-Symeonidi & Cheila-Markopoulou, 2003).

16. Feminine nouns with the suffix *-o* stressed on the ultimate or penultimate are common names, except from the noun *i ixó* 'echo'.

17. In line with Ralli (1994; 2002; 2003), we consider the suffix *-ma* to represent unambiguous gender marking (see discussion in the previous section).

18. There is only one neuter noun in this category, the noun *to fíldisi* 'ivory', which is a loan word from Turkish.

19. Nouns ending in *-is* stressed on the antepenultimate are rare (e.g. *o fúrnaris* 'baker') and were not included in the test.

20. Recall from fn. 15 that there are some bi-syllabic nouns stressed on the penultimate that are neuter (e.g. *to kréas* 'meat', *to téras* 'monster'). Inclusion of the two bi-syllabic nouns will allow us to check the effect of syllable number in the assignment of gender to nouns ending in *-as* (see discussion).

unambiguously neuter (4 tri-syllabic, half stressed on the antepenultimate and half on the penultimate; 4 bi-syllabic, half stressed on the penultimate and half on the ultimate; e.g. *tákelo* from *kókalo* 'bone'; *farjó* from *xorjó* 'village'); six (6) nouns with the suffix *-ma*, which is again unambiguously neuter (3 tri-syllabic, stressed on the antepenultimate; 3 bi-syllabic, stressed on the penultimate; e.g. *tékoma* from *pátoma* 'floor'; *fláma* from *γráma* 'letter').[21]

ii. nouns with ambiguous gender marking, which were distributed to: twelve (12) nouns with the suffix *-os*, which is ambiguous between masculine, feminine and neuter gender (6 tri-syllabic, half stressed on the antepenultimate and half on the ultimate;[22] 6 bi-syllabic, half stressed on the penultimate and half on the ultimate; e.g. *yétruxos* from *vátraxos* 'frog'; *revós* from *layós* 'hare'); twelve (12) nouns with the suffix *-i*, which is ambiguous between feminine and neuter (6 tri-syllabic, half stressed on the penultimate and half on the ultimate; 6 bi-syllabic, half stressed on the penultimate and half on the ultimate; e.g. *doláni* from *balóni* 'balloon'; *pekí* from *kutí* 'box').

The number of novel nouns per suffix and the distribution of syllables and stress in the novel nouns are summarized in Table 3.

Each novel noun had to be sufficiently dissimilar to the real noun it was derived from and not similar to another real noun in the language. The underlying idea was that if a novel noun resembled the real noun it was constructed from or another real noun in the language enough to activate its lexical entry, then gender assignment could be a result of assignment by analogy to a real word and not due to the effect of the suffix.

Table 3. Number of novel words per suffix and distribution according to number of syllables and stress position

Suffix	Gender	Number of items	Number of syllables		Stress position		
			2	3	ultimate	penultimate	antepenultimate
-is	Masc	8	4	4	4	4	0
-as	Masc	8	2	6	2	4	2
-a	Fem	10	4	6	4	4	2
-o	Neut	8	4	4	2	4	2
-ma	Neut	6	3	3	*	3	3
-os	M/F/N	12	6	6	6	3	3
-i	F/N	12	6	6	6	6	0 [Neut*]

21. Tri-syllabic nouns in *-ma* are stressed on the antepenultimate, while bi-syllabic nouns in *-ma* are stressed on the penultimate.

22. Tri-syllabic nouns with the suffix *-os* that are stressed on the penultimate syllable were not included because, there are no neuter nouns in this category, and there are very few masculine and feminine nouns, which consist though of more than three syllables (e.g. *o taxiδrómos* 'post-man', *i leofóros* 'avenue').

Each real noun was turned into a novel noun by changing two to four phonemes (depending on whether the word had two or three syllables) so that the result remained phonotactically acceptable. As far as consonants are concerned, changes were made on place of articulation (or manner of articulation when a change in place of articulation was not possible). As far as vowels are concerned, changes were made along the height axis. Thus, changes from back vowels to front vowels and the reverse were avoided, while changes from high vowels to mid vowels or the reverse were preferred.

Before the test was administered to the participants of the main study, a pretest that included 92 novel nouns was given to 10 native adult speakers of Greek. The participants of the pretest were told to provide the appropriate definite determiner for each novel noun they heard and at the same time to state whether the novel noun reminded them of an existing one in the language. The pretest included a greater number of novel nouns compared to the test of the main study, as the aim was to arrive at a set of novel nouns that would not resemble existing nouns sufficiently to activate them. The additional 28 novel items of the pretest were: (a) alternative novel nouns derived from the same real noun (e.g. *nepóra* and *nepéra* from the real noun *mitéra* 'mother'; *kupéras* and *kupóras* from the real noun *patéras* 'father'; *péfisma* and *pévisma* from the real noun *káθisma* 'seat') that were included to try out the speakers' preferences in terms of the gender assigned to one item or the other; (b) novel nouns based on additional real nouns that were eventually not included in the final test, as they turned out to be problematic for a number of reasons (e.g. *anorfjá* from the real noun *omorfjá* 'beauty'). Novel nouns were discarded if two or more speakers managed to trace them back to the real noun they were derived from or if they were reminiscent of another real noun. For example, the novel nouns *anorfjá* (from *omorfjá* 'beauty'), *faleθóni* (from *xeliδóni* 'swallow'), *poθráftis* (from *kaθréftis* 'mirror') and *klóδato* (from *próvato* 'sheep') were excluded from the final test, as more than two speakers were able to trace them back to the real nouns they were based on.

3.3 Procedure

The test items were presented auditorily to the participants, who were tested on an individual basis by the author and two research assistants. Participants were told to provide orally the singular nominative form of the definite determiner for each novel noun they heard, indicating thus the gender value of the novel noun. Testing took place either at the Laboratory of Linguistics in the Department of Mediterranean Studies of the University of the Aegean or at the participants' homes in the academic year 2005–2006.

4. Results

Table 4 illustrates the means, standard deviations and ranges of the speakers' responses for each inflectional morpheme (the target gender is indicated in bold letters).

Table 4. Means, standard deviations (SD) and ranges for each inflectional morpheme

Suffix	N of items	Masc			Fem			Neut		
		Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
-as	8	**7.68**	**0.67**	**3.00**	0.13	0.38	2.00	0.19	0.51	2.00
-is	8	**7.55**	**0.79**	**3.00**	0.44	0.75	3.00	0.01	0.11	1.00
-a	10	0.14	0.42	2.00	**9.10**	**1.16**	**7.00**	0.76	1.02	6.00
-o	8	0.16	0.40	2.00	0.28	0.57	3.00	**7.56**	**0.63**	**3.00**
-ma	6	0.00	0.00	0.00	1.54	1.11	5.00	**4.46**	**1.11**	**5.00**
-os	12	**10.30**	**1.38**	**7.00**	**0.52**	**0.93**	**5.00**	**1.18**	**0.89**	**3.00**
-i	12	0.06	0.24	1.00	**5.29**	**2.37**	**10.00**	**6.65**	**2.40**	**10.00**

We observe that novel nouns with an inflectional suffix that unambiguously indicates a specific gender value were assigned that particular gender value. In particular, novel nouns ending in *-as* and *-is* were predominantly assigned masculine gender, novel nouns ending in *-a* were predominantly assigned feminine gender, whereas novel nouns ending in *-o* and *-ma* were predominantly assigned neuter gender. With respect to novel nouns with inflectional morphemes that can be assigned more than one gender value, we observe the following. Nouns ending in *-os* were predominantly assigned masculine gender, whereas nouns ending in *-i* were assigned both feminine and neuter gender.

Statistical analyses were carried out to assess the overall performance according to suffix (*-as*, *-is*, *-a*, *-o*, *-ma*, *-os*, *-i*) based on the type of answer (masculine, feminine, neuter). The proportions of masculine, feminine and neuter answers were compared for each suffix separately. For the suffixes *-os* and *-i*, which are ambiguous in terms of their gender value, and for the suffix *-ma*, which triggered some feminine responses as well, despite the fact it represents unambiguous neuter gender marking (within Ralli's, 1994; 2002; 2003 approach), additional statistical analyses were carried out regarding the relationship between the scores according to suffix (*-os*, *-i*, *-ma*) and syllable number of the novel nouns (2-syllables, 3-syllables). The relationship between the scores according to suffix (*-os*, *-i*, *-ma*) and stress position in the novel noun (ultimate, penultimate, antepenultimate syllable) was also evaluated.

Overall performance

A repeated measures ANOVA was conducted to investigate the effect of gender responses (masculine, feminine and neuter) for each suffix separately. Regarding novel nouns ending in *-as*, *-is* and *-os*, a significant main effect of gender type was revealed ($F(1, 81) = 3623.05$, $p < 0.001$; $F(1, 81) = 6690.28$, $p < 0.001$; $F(1.81) = 1497.79$, $p < 0.001$, respectively), indicating that masculine responses were significantly more compared to feminine and neuter responses. Feminine responses were the least popular for the categories *-as* and *-os*, while neuter responses were the least popular for the

category *-is*. With respect to novel nouns ending in *-o*, *-i* and *-ma*, a significant main effect of gender type was also revealed ($F(1, 81) = 5711.84$, $p < 0.001$; $F(1, 81) = 587.96$, $p < 0.001$; $F(1, 81) = 1318.08$, $p < 0.001$, respectively), indicating that neuter responses were significantly more compared to masculine and feminine responses. Masculine responses were the least popular among participants. Last, a significant main effect of gender type was also revealed for novel nouns ending in *-a* ($F(1, 81) = 27.59$, $p < 0.001$), indicating that feminine responses were significantly more compared to the other two types of responses. Masculine responses were the least popular among participants for this category as well.

Additional Analyses

Response type and syllable number

Analyses were done on the relationship between responses (masculine, feminine and neuter) and syllable number (3-syllables, 2-syllables) of the novel noun. Analyses were carried out separately for the categories *-os*, *-i* and *-ma*.

Table 5 demonstrates the means and standard deviations of the responses of the participants for novel nouns ending in *-os*.

An Analysis of Variance was conducted to investigate the effects of *response type* and *syllable number* of novel nouns ending in *-os* on group performance. The effect of two factors was investigated: *syllable number* as the first within-participants factor with 2 levels: (1) two syllables and (2) three syllables; *response type* as the second within-participants factor with three levels: (1) masculine, (2) feminine and (3) neuter. The analysis revealed that there is a significant effect of *response type* ($F(1, 81) = 1497.79$, $p < 0.001$). Masculine responses were produced more often than other responses. Feminine responses were produced less often than other responses. Moreover, the interaction between *response type* and *syllable number* was significant ($F(1, 81) = 94.95$, $p < 0.001$). Post-hoc t-tests confirmed that the effect of syllable was significant for all gender responses. For both masculine and feminine responses, 3-syllable responses were

Table 5. Response type and syllable number for novel nouns ending in *-os*

2-syllables *-os*	
Masculine	4.73 (0.96)
Feminine	0.16 (0.43)
Neuter	1.11 (0.82)
3-syllables *-os*	
Masculine	5.56 (0.72)
Feminine	0.36 (0.66)
Neuter	0.08 (0.30)

Table 6. Response type and syllable number for novel nouns ending in *-i*

2-syllables *-i*	
Masculine	0.02 (0.15)
Feminine	1.94 (1.44)
Neuter	4.04 (1.43)
3-syllables *-i*	
Masculine	0.04 (0.19)
Feminine	3.35 (1.28)
Neuter	2.61 (1.30)

significantly greater than 2-syllable responses ($t(81) = 7.67$, $p < 0.001$; $t(81) = 3.11$, $p < 0.005$, respectively), whereas for neuter responses, 2-syllable responses were significantly greater than 3-syllable responses ($t(81) = -11.01$, $p < 0.001$).

Table 6 demonstrates the means and standard deviations of the responses of the participants for novel nouns ending in *-i*.

An Analysis of Variance was conducted to investigate the effects of *response type* and *syllable number* of novel words ending in *-i* on group performance. The effect of two factors was investigated: *syllable number* as the first within–participants factor with 2 levels: (1) two syllables and (2) three syllables; *response type* as the second within-participants factor with three levels: (1) masculine, (2) feminine and (3) neuter. The analysis revealed that there is a significant effect of *response type* ($F(1, 81) = 587.96$, $p < 0.001$). Neuter responses were produced more often than other responses, while masculine responses were the least produced compared to other responses. The interaction between *response type* and *syllable number* was also significant ($F(1, 81) = 95.39$, $p < 0.001$). Post-hoc t-tests confirmed that the effect of syllable was significant for feminine and neuter gender responses. For feminine responses, 3-syllable responses were significantly greater than 2-syllable responses ($t(81) = 9.54$, $p < 0.001$), while for neuter responses, 2-syllable responses were significantly greater than 3-syllable responses ($t(81) = -9.83$, $p < 0.001$).

Table 7 demonstrates the means and standard deviations of the responses of the participants for novel nouns ending in *-ma*.

An Analysis of Variance was conducted to investigate the effects of *response type* and *syllable number* of novel words ending in *-ma* on group performance. The effect of two factors was investigated: *syllable number* as the first within–participants factor with 2 levels: (1) two syllables and (2) three syllables; *response type* as the second within-participants factor with three levels: (1) masculine, (2) feminine and (3) neuter. The analysis revealed that there is a significant effect of *response type* ($F(1, 81) = 1318.08$, $p < 0.001$). Neuter responses were produced more often than other responses. Masculine responses were the least produced compared to other responses. The interaction between *response type* and *syllable number* was also significant ($F(1, 81) = 142.24$,

Table 7. Response type and syllable number for novel nouns ending in *-ma*

	2-syllables *-ma*
Masculine	0.00 (0.00)
Feminine	1.33 (0.89)
Neuter	1.67 (0.89)
	3-syllables *-ma*
Masculine	0.00 (0.00)
Feminine	0.21 (0.44)
Neuter	2.79 (0.44)

$p < 0.001$). Post–hoc t-tests confirmed that the syllable effect was significant for feminine responses ($t(81) = -11.93$, $p < 0.001$), whereby responses were higher for 2-syllable nouns than 3-syllable nouns. The syllable effect was also significant for neuter responses ($t(81) = 11.93$, $p < 0.001$), whereby responses were higher for 3-syllable nouns than 2-syllable nouns.

Response type and stress position

Further analyses to define the relationship between responses (masculine, feminine and neuter) and stress position (ultimate, penultimate, antepenultimate syllable) were conducted. Analyses were carried out separately for the category *-os* and *-i*. For the category *-ma*, there was no need to perform additional analyses, as the number of syllables and stress position coincide; 2-syllable nouns are stressed on the penultimate, while 3-syllable nouns are stressed on the antepenultimate (see fn. 21). Thus, the effect of stress position was significant for feminine responses ($t(81) = -11.93$, $p < 0.001$), whereby responses were higher for nouns stressed on the penultimate than nouns stressed on the antepenultimate. The effect of stress position was also significant for neuter responses ($t(81) = 11.93$, $p < 0.001$), whereby responses were higher for nouns stressed on the antepenultimate than nouns stressed on the penultimate.

Table 8 demonstrates the means and standard deviations of the responses of the participants for novel words ending in *-os* according to stress position.

An Analysis of Variance was conducted to investigate the effects of stress of novel nouns ending in *-os* on participants' performance. The effect of two factors was investigated: *stress position* as the first within–participants factor with 3 levels: (1) ultimate, (2) penultimate and (3) antepenultimate; *response type* as the second within-participants factor with three levels: (1) masculine, (2) feminine and (3) neuter. The interaction between *response type* and *stress position* was significant ($F(1, 81) = 1051.09$, $p < 0.001$). Post–hoc t-tests confirmed that the stress position was significant for masculine responses (antepenultimate vs. penultimate: $t(81) = 8.96$, $p< 0.001$;

Table 8. Response type and stress position for novel words ending in *-os*

Ultimate *-os*	
Masculine	5.72 (0.65)
Feminine	0.18 (0.59)
Neuter	0.10 (0.34)
Penultimate *-os*	
Masculine	1.85 (0.75)
Feminine	0.10 (0.30)
Neuter	1.05 (0.77)
Antepenultimate *-os*	
Masculine	2.71 (0.53)
Feminine	0.24 (0.51)
Neuter	0.05 (0.22)

antepenultimate vs. ultimate: t (81) = –37.18, p < 0.001; penultimate vs. ultimate: t (81) = –44.35, p < 0.001), whereby responses were higher for nouns stressed on the ultimate than nouns stressed on the antepenultimate and penultimate. The stress position was also significant for feminine responses (antepenultimate vs. penultimate: t (81) = 2.33, p < 0.05), whereby responses were higher for nouns stressed on the antepenultimate than nouns stressed on the penultimate. The stress position was significant for neuter responses as well (antepenultimate vs. penultimate: t (81) = –11.30, p < 0.001; penultimate vs. ultimate: t (81) = 10.57, p < 0.001), whereby responses were higher for nouns stressed on the penultimate than nouns stressed on the antepenultimate and ultimate.

Table 9 demonstrates the means and standard deviations of the responses of the participants for novel words ending in *-i* according to stress position.

An Analysis of Variance was conducted to investigate the effects of stress of novel words ending in *-i* on participants' performance. The effect of two factors was investigated: *stress position* as the first within–participants factor with 2 levels: (1) ultimate and (2) penultimate; *response type* as the second within-participants factor with three levels: (1) masculine, (2) feminine and (3) neuter. The interaction between *response type* and *stress position* was significant (F (1, 81) = 56.84, p < 0.001). Post–hoc t-tests confirmed that the stress position was significant for feminine responses (penultimate vs. ultimate: t (81) = –8.32, p < 0.001), whereby responses were higher for nouns stressed on the ultimate than nouns stressed on the penultimate. The stress position was also significant for neuter responses (penultimate vs. ultimate: t (81) = 7.88, p < 0.001), whereby responses were higher for nouns stressed on the penultimate than nouns stressed on the ultimate.

Table 9. Response type and stress position for novel words ending in *-i*

Ultimate *-i*	
Masculine	0.00 (0.00)
Feminine	3.24 (1.32)
Neuter	2.76 (1.32)
Penultimate *-i*	
Masculine	0.06 (0.24)
Feminine	2.05 (1.39)
Neuter	3.89 (1.41)

5. Discussion

For categories of novel nouns with a suffix that unambiguously indicates a specific gender, native speakers provided responses that matched this gender value. Thus, for novel nouns with the suffix *-is* as well as for novel nouns with the suffix *-as*, responses were predominantly masculine. For novel nouns with the suffix *-a*, responses were predominantly feminine, whereas for novel nouns with the suffix *-o*, responses were predominantly neuter. Last, novel nouns with the suffix *-ma* triggered significantly more neuter responses, despite the occurrence of feminine responses as well.

For novel nouns with an ambiguous suffix that can be assigned more than one gender value, we observed the following. Novel nouns ending in *-i*, which are ambiguous between feminine and neuter gender, were assigned both gender values, although neuter responses were significantly more than feminine ones. Novel nouns ending in *-os* were predominantly assigned masculine gender, although the suffix *-os* is ambiguous between the three gender values.

These results indicate that native speakers use morphology, specifically the information carried by the noun suffix to predict gender in the absence of semantic information in the noun and in the absence of any phrasal information that would help them to determine gender based on agreement. This confirms both Ralli's (2002; 2003) and Anastasiadi-Symeonidi & Cheila-Markopoulou's (2003) claim that morphology plays an important role in the assignment of gender to Greek nouns. Predictions within each of these analyses regarding the predictive value of individual suffixes are also confirmed to a great extent but with some notable differences. Within Ralli's (2002; 2003) approach, given the systematic co-occurrence between certain inflectional classes and certain gender values, it was expected that the inflectional morpheme will constitute to a great extent a predicting factor of gender, at least in cases where gender and inflectional class seem to have a close relation. Thus, it was predicted that inflectional morphemes such as, *-as*, *-is*, *-a*, *-o* and *-ma* should be sufficient gender

cues for the native speaker, a prediction that was born out by the data even for the suffix *-ma*, which elicited predominantly the target, neuter, responses despite the occurrence of some feminine responses as well. Predictions regarding the predictive value of individual inflectional suffixes were a bit different within Anastasiadi-Symeonidi & Cheila-Markopoulou's (2003) approach. Inflectional morphemes such as, *-as*, *-is* and *-o* were expected to be sufficient gender cues for the native speaker within their analysis as well, given that *-s* is a marker of masculine gender, while *-o* is a marker of neuter gender. However, within Anastasiadi-Symeonidi & Cheila-Markopoulou's (2003) approach, an ambiguity with novel nouns ending in *-a* was expected, given that this inflectional morpheme is considered to be a marker of both feminine and neuter gender. Nonetheless, novel nouns ending in *-a* elicited predominantly feminine responses, whereas neuter responses were elicited predominantly with the inflectional morpheme *-ma*. This indicates in line with Ralli (2002; 2003) but contra Anastasiadi-Symeonidi & Cheila-Markopoulou (2003) that the majority of speakers are aware of the fact that feminine nouns are associated with the suffix *-a*, whereas neuter nouns are associated with the suffix *-ma*, and that gender is determined morphologically on the basis of access to inflection as well as derivation.

Let us now discuss in detail the results obtained for some of these suffixes as well as their implications for the two theoretical analyses of gender assignment in Greek. One interesting observation was that novel nouns with the suffix *-as*, yielded predominantly masculine responses despite the inclusion of two bi-syllabic nouns in this category. Recall that the class of neuter nouns ending in *-as* is a 'close class' of bi-syllabic nouns (see discussion in Section 2 and Section 3, particularly fn. 15 and fn. 20). Therefore, if the suffix *-as* was ambiguous, it should yield some proportion of neuter responses, particularly with the two bi-syllabic nouns. However, for the novel bi-syllabic noun *pléas*, only 4/82 responses were non-masculine (3 of them neuter and 1 feminine) and for the novel noun *yéxas*, only 2/82 responses were non-masculine (both of them feminine). Moreover, an inspection of the responses provided for the other six novel nouns ending in *-as*, revealed that there were more non-masculine, in fact, neuter responses for some tri-syllabic nouns compared to the two bi-syllabic ones. Thus, these results indicate that speakers do not consider the suffix *-as* ambiguous, which is in line with the assumption made in this study (see Section 3) (but contra Mastropavlou, 2006), as well as with the predictions made by the two theoretical analyses of gender assignment in Greek (see Section 2). Within Ralli's (2002; 2003) account, the predominance of masculine responses for novel nouns with the suffix *-as* is expected given the systematic co-occurrence between IC2, the inflectional class of nouns ending in *-as*, and masculine gender, whereas within Anastasiadi-Symeonidi & Cheila-Markopoulou's (2003) account, it is expected given that the suffix *-as* is associated prototypically with masculine gender.

Turning to the ambiguous suffixes, the occurrence of both feminine and neuter responses in our data for the inflectional morpheme *-i* is in accordance with the predictions of both theoretical analyses. The inflectional morpheme *-i* should give rise to ambiguities since, for Ralli (2002; 2003), it characterizes feminine and neuter nouns

that belong to two distinct inflectional classes, and for Anastasiadi-Symeonidi & Cheila-Markopoulou (2003), it characterizes nouns that are prototypically feminine as well as prototypically neuter, i.e., it is a marker of both genders. Nonetheless, despite the occurrence of both types of responses, a preference for neuter responses was noticed. This preference could be due to the fact that the neuter gender is the unmarked gender value in Greek, as pointed out by Anastasiadi-Symeonidi & Cheila-Markopoulou (2003), given that it is the most frequent value in [–animate] nouns, it is the gender value found in most loan words, it is used in impersonal constructions, and it is the gender found in metalinguistic use. Moreover, as observed in Tsimpli (2003) and Varlokosta (2005a), neuter is the interlanguage gender value in Greek as a second language, as it is more frequently overused compared to masculine and feminine. Thus, given the unmarked status of neuter gender in Greek, its prevalence in the native speakers' data does not remain unaccounted.

Results turned out to be quite interesting regarding the inflectional suffix *-os*, which elicited predominantly masculine responses despite the fact it is ambiguous between masculine, feminine and neuter gender.[23] The dominance of masculine responses was expected under Anastasiadi-Symeonidi & Cheila-Markopoulou's (2003) approach, given that *-s* is a marker of masculine gender and characterizes only non-prototypically neuter and feminine nouns. Within Ralli's (2002; 2003) approach, on the other hand, not only masculine but to some extent neuter responses as well were expected with the suffix *-os* given that this suffix characterizes masculine and neuter nouns that belong to two distinct inflectional classes (recall that feminine responses are not expected, given that feminine nouns in *-os* constitute a 'close class'). However, this prediction is not corroborated by the psycholinguistic data. Our results seem to support Anastasiadi-Symeonidi & Cheila-Markopoulou's (2003) claim that nouns ending in *-os* are prototypically masculine and that prototypicality is a determinant factor in the gender assignment of Greek nouns that is part of the native speakers' linguistic competence.

We now turn to the interaction between response (i.e. gender) type and number of syllables as well as response type and stress position for the inflectional suffixes *-os*, *-i* and *-ma*. An interaction between gender type and syllable number was observed for the novel nouns ending in *-os*. Thus, neuter responses were given predominantly for bi-syllabic nouns, whereas masculine and feminine responses were obtained predominantly for tri-syllabic nouns. This is not surprising given that neuter nouns ending in *-os* are predominantly bi-syllabic (Anastasiadi-Symeonidi, 2002) with only a few exceptions of tri-syllabic nouns. This predominance of neuter responses for bi-syllabic

23. There was only one novel noun in *-os* that elicited predominantly neuter responses (16 masculine, 3 feminine, 63 neuter), the noun *psé*θ*os*, which was modelled after the feminine noun *psífos* 'vote'. Given that other bi-syllabic nouns like *ylénos* or *véδos* elicited predominantly masculine responses, it is not clear why *psé*θ*os* elicited predominantly neuter responses. One possibility is that for most participants, *psé*θ*os* was reminiscent of the real noun *psévdos* 'lie', which is neuter, despite the fact this was not evident in the pretest. Nonetheless, native speakers' responses in this novel word did not have an effect on the overall picture regarding novel nouns in *-os*.

nouns is also consistent with the interaction found between gender type and stress position. Specifically, it was observed that there were significantly more neuter responses for nouns stressed on the penultimate (which were all bi-syllabic) compared to nouns stressed on the ultimate (which were tri-syllabic and bi-syllabic) or the antepenultimate. This is again not surprising given that neuter nouns ending in *-os* are not stressed on the ultimate but are mainly stressed on the penultimate (with the exception of tri-syllabic nouns) (Anastasiadi-Symeonidi, 2002). An inspection of the data reveals that for the three bi-syllabic nouns that were stressed on the penultimate, 35% of the speakers' responses (86/246) were neuter, whereas for the three bi-syllabic nouns that were stressed on the ultimate, only 2% of the speakers' responses (5/246) were neuter. These interactions indicate that when morphology gives rise to ambiguities, speakers rely on phonological factors, such as position of stress in words of various syllable size (bi-syllabic, tri-syllabic).

An interaction between gender type and syllable number as well as gender type and stress position was observed for novel nouns ending in *-i* as well. Significantly more feminine responses were obtained for tri-syllabic nouns, whereas significantly more neuter responses were obtained for bi-syllabic nouns. Moreover, there were significantly more neuter responses for nouns stressed on the penultimate and significantly more feminine responses for nouns stressed on the ultimate. The interaction between gender type and stress position, specifically the bias for the penultimate in the case of neuter nouns, is consistent with the fact that a great proportion of neuter nouns ending in *-i* are stressed on the penultimate due to an allophonic rule which operates on the basis of the size of the base to which *-i* is attached. More specifically, it assigns stress on the penultimate when the base is bi-syllabic, e.g. *karíδi* 'nut' (and stress on the ultimate when the base is monosyllabic, e.g. *peδí* 'child') (Anthi Revithiadou, personal communication). In our data, when the base was bi-syllabic, the proportion of neuter responses stressed on the penultimate was greater compared to the proportion of feminine responses stressed on the penultimate (166 neuter vs. 77 feminine). In contrast, the proportion of neuter responses stressed on the ultimate was lower compared to the proportion of feminine responses stressed on the ultimate (46 neuter vs. 200 feminine).

It should be noted that an interaction between gender type and syllable number, and a relationship between syllable number and stress position is expected in a language where the position of stress is not fixed. Thus, we can observe in Greek that certain patterns are associated with specific paradigms, e.g. nouns ending in *-os* that are stressed on the antepenultimate in the nominative are stressed on the penultimate in the genitive (e.g. *ánθropos – anθrópu* 'man'); similarly, neuter nouns in *-i* are associated with the pattern penultimate (for nominative, e.g. *karíδi*) – ultimate (for genitive, e.g. *kariδjú*) or ultimate (for both cases, e.g. *peδí – peδjú*). It turns out that the number of syllables is crucial for identifying a particular stress pattern. For example, in masculine bi-syllabic nouns ending in *-os*, the antepenultimate – penultimate mobile pattern is neutralized, hence bi-syllabic nouns ending in *-os* are more likely to be confused

with neuter nouns in *-os*, which are also bi-syllabic and stressed on the penultimate syllable (Anthi Revithiadou, personal communication).

Rather surprising was the interaction between gender type and syllable number/stress position found in the novel nouns ending in *-ma*. In particular, there were more feminine responses for novel nouns ending in *-ma* that were bi-syllabic and stressed on the penultimate, whereas there were more neuter responses for novel nouns ending in *-ma* that were tri-syllabic and stressed on the antepenultimate. The occurrence of feminine responses in this category indicates that at least some native speakers do not assign gender based on the inflectional suffix *-ma*, but based on the second segment of the inflectional suffix, namely *-a*, particularly in cases of bi-syllabic novel nouns stressed on the penultimate, interpreting, thus, these nouns as feminine, consistently with the predictive value of the suffix *-a*. The fact that some speakers assigned feminine gender on nouns with the inflectional suffix *-ma*, may not be surprising after all if these speakers relied less on morphological criteria and more on phonological criteria (Anthi Revithiadou, personal communication). Bi-syllabic feminine and neuter nouns in *-a* (within our assumptions, neuter nouns in *-ma*) cannot be disambiguated by stress in terms of their gender value, as they are both stressed on the penultimate. The same is true for tri-syllabic feminine and neuter nouns in *-a* (again within our assumptions, neuter nouns in *-ma*) stressed on the antepenultimate. Therefore, if some speakers assigned gender to novel nouns ending in *-ma* based on the second segment of the inflectional suffix, namely *-a*, the existence of feminine responses in the data finds a rather reasonable explanation. Nevertheless, it remains to be seen why this pattern of gender assignment relates to the syllable and/or stress pattern of nouns ending in *-ma*, i.e., why it was that bi-syllabic nouns stressed on the penultimate triggered more feminine responses, whereas tri-syllabic nouns stressed on the antepenultimate triggered more neuter responses.

Last, let us consider the psycholinguistic implications of the present study for gender assignment cross-linguistically. Our results are comparable to the results reported in Mastropavlou (2006), despite the differences in methodology between the two studies as well as the differences regarding the assumptions about suffix ambiguity. Both studies obtained high predictive value for inflectional morphemes that are unambiguous in terms of their gender value (i.e. *-is*, *-a*, *-o*, as well as *-as* and *-ma*, despite the assumptions in Mastropavlou (2006) regarding the last two suffixes). Moreover, both studies reach similar conclusions regarding the ambiguous suffixes, *-os* and *-i*; dominance of masculine responses for novel nouns ending in *-os* and ambiguous gender interpretations for nouns ending in *-i* but with a statistically significant proportion of neuter gender responses. Thus, both studies confirm the claim that morphology plays an important role in the assignment of gender to Greek nouns, particularly in cases where there is no suffix ambiguity. The results of the present study are also compatible with previous psycholinguistic studies in other languages, such as those by Tucker et al. (1977) for French and Mills (1986) for German, indicating that the role of formal assignment rules (phonological in the case of French, morphological in the case of

German and Greek) is a determinant factor in gender assignment and it is part of the speakers' linguistic competence. Although a direct comparison with more recent fMRI studies on gender assignment is not viable given the differences in methodology as well as the differences in the nature of the results obtained (reaction times and brain activation), the main conclusion of our study regarding the role of morphology in the assignment of gender by native speakers is congruent with the conclusion reached by a number of fMR studies that morphological cues facilitate gender decisions.

6. Concluding remarks

To sum up, the present study provided psycholinguistic evidence that confirms Ralli's (2002; 2003) and Anastasiadi-Symeonidi & Cheila-Markopoulou's (2003) claim that morphology plays an important role in the assignment of gender to Greek nouns. It was shown that inflectional morphemes that are unambiguous in terms of their gender value constitute sufficient gender cues for the native speaker. A significant interaction was observed between gender type and syllable number as well as between gender type and stress position for the ambiguous suffixes, suggesting that when morphology gives rise to ambiguities, speakers rely on phonological factors, such as position of stress, in their responses. These findings are compatible with findings of previous psycholinguistic studies in other languages and suggest that formal assignment rules determine gender assignment to a great extent and are part of the speakers' linguistic competence.

The results reported in this study raise a further question. An important difference between Ralli (2002; 2003) and Anastasiadi-Symeonidi & Cheila-Markopoulou (2003), which was not explored in the current study, is that within the former approach, gender assignment is based on the whole inflectional paradigm and not just on the nominative form of nouns. In the current study, though, speakers were asked to provide the nominative form for the novel nouns they heard. Therefore, an important question arising is what would native speakers do if they had to select gender for real nouns that occurred in other cases or if they were instructed to assign gender to novel nouns without the restriction of providing their response in the nominative form. We hope to be able to address these questions in future research (see Nerantzini, Papadopoulou, & Varlokosta, 2009).

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